Unifying the Data Center

Part 2

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Agenda - Cisco Systems Data Center 3.0

History
Camp Fire Stories
- Business Needs
- Change is constant
- 10GE today – 100GE tomorrow
- Standards-based

Unified Fabric
Nexus 5K, 2K-FEX, 7K
- ToR server access
- Wire once infrastructure
- Low-latency lossless
- Virtualization aware
- Standards-based

Server Virtualization
VN-Link, Nexus 1K
- Virtualization aware access layer
- Compatible with switching platforms
- Combine VM and physical network ops
- Standards-based
Addressing The Business Issues with IT

- **Consolidate**
  - Reduced complexity, less to manage
  - Lower OPEX
  - Regain control of IT resources

- **Virtualize**
  - Higher resource utilization
  - Lower CAPEX
  - Decouples logical from physical resources

- **Automate**
  - Dynamically allocate resources
  - Simplified policy-based provisioning
  - Increase IT productivity

The Network is the Platform
Where The **Data** Center Begins

The "**DATA**" Center

12-0-4-9 12-0-1-9 12-11-4-9 12-0-1-9
44:41:54:41
01000100010000010101010001000001

(EBCDIC Card Code)
(ASCII – HEX)
(BINARY)

Density

92%

72DPI

12Mpix – 751KB

8Mpix – 682KB

3Mpix – 392KB

Volume

0

6 months

13200+ tunes = 48+ GB
Change Is Constant!

Ethernet – 10Mbps, Fast Ethernet – 100Mbps, Gigabit Ethernet

Token Ring

Byte Channel Bus & Tag ESCON Ficon

FDDI

HyperChannel HIPPI InfiniBand

OSA

Storage File & Block DASD

FibreChannel

Infamous Gateways

ATM
40/100 GE Targets

IEEE 802.3ba Task Force Timeline

You

Task Force Formation
Baseline
TF Review
WG Ballot
LMSC Ballot

Last Proposal
Last Feature
Last Technical Change

2008
2009
2010

PAR Approved
D1.0
D2.0
D3.0

TF Reviews
WG Ballots
LMSC Ballots


* Adopted by IEEE P802.3ba TF at March 08 Plenary
Evolution of Ethernet

40 / 100 GE Standards Ratification by 2009
Server Consolidation ➔ 10GE

- Multi-Core CPU architectures allowing bigger and multiple workloads on the same machine
- Server virtualization driving the need for more I/O bandwidth per server
- Growing need for network storage driving the demand for higher network bandwidth to the server
- 10GE LAN on server Motherboards (LoM) in Q1CY09
10GE Enables Unified Fabric & FCoE

**Standards**

<table>
<thead>
<tr>
<th>Wire speed 10GE</th>
<th>Data Center Ethernet</th>
<th>FCoE</th>
<th>Virtualization</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /> Ethernet LAN</td>
<td><img src="image2.png" alt="Diagram" /> LAN</td>
<td><img src="image3.png" alt="Diagram" /> SAN A, SAN B</td>
<td><img src="image4.png" alt="Diagram" /> VM-optimized networking</td>
</tr>
</tbody>
</table>

**10GE L2 non-blocking, lossless, low latency switch**

**Standards based Ethernet extensions**

**Unified fabric for LAN, SAN, HPC/IPC**

**Ecosystem Partners**

- QLogic
- Emulex
- Intel
- NetXen
- Panduit
- APC
- VMware
Unified Fabric
Cisco Data Center Ethernet:

- Cisco DCE enhancements are standards-based
- Cisco DCE enhancements are supported by ecosystem partners
- Enables the unified fabric to accommodate LAN, storage, and clustering application
- DCE Features are Modifications to Ethernet
**Priority Flow Control**

IEEE 802.1Qbb

- Enables lossless Fabrics for each class of service
- PAUSE sent per virtual lane when buffers limit exceeded

**Data Center Bridging Capability eXchange Protocol**

Eight Virtual Lanes

- 5020
DCE: BW Management & Delay Drop

**COS based Bandwidth Management**

IEEE 802.1Qaz

<table>
<thead>
<tr>
<th>Offered Traffic</th>
<th>10 GE Link Realized Traffic Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G/s 3G/s 3G/s</td>
<td>3G/s HPC Traffic 3G/s 2G/s</td>
</tr>
<tr>
<td>3G/s 3G/s 3G/s</td>
<td>3G/s Storage Traffic 3G/s 3G/s</td>
</tr>
<tr>
<td>3G/s 4G/s 6G/s</td>
<td>3G/s LAN Traffic 4G/s 5G/s</td>
</tr>
<tr>
<td>t1 t2 t3</td>
<td>t1 t2 t3</td>
</tr>
</tbody>
</table>

- Enables Intelligent sharing of bandwidth between traffic classes control of bandwidth
- 802.1Qaz Enhanced Transmission

**Delayed Drop**

- Use Ethernet PAUSE function to absorb short bursts of traffic
- Nexus differentiator
DCE: Congestion Management

- Moves congestion out of the core to avoid congestion spreading
- Allows End-to-End congestion management
- Nexus 5000 will have capability in ASICs, in future OS release
Why Unified Fabric over Data Center Ethernet

- **Consolidation of Infrastructure**
  - Cabling
  - Switches
  - Adapters
- **TCO Reduction**
  - Equipment costs
  - Operational Costs
- **Enables Virtualization**
  - Unified ports
  - Wire once & Walk away
  - Optimized for virtual machine environments
FC over Ethernet (FCoE)

**FCoE**

- Mapping of FC frames over Ethernet
- Enables FC to run on a lossless Data Center Ethernet network

**Benefits**

- Wire Server Once
- Fewer cables and adapters
- Software Provisioning of I/O
- Inter-operates with existing SANs
- No gateway—stateless
Key Benefits of Unified Fabric

Reduce overall DC power consumption by up to 8%. Extend the lifecycle of current data center.

Wire hosts once to connect to any network - SAN, LAN, HPC. Faster rollout of new apps and services.

Every host will be able to mount any storage target. Drive storage consolidation and improve utilization.

Rack, Row, and X-Data Center VM portability become possible.
Unified Fabric
Nexus Portfolio
Transition to Unified Fabric - Cisco Nexus Family

Preserves Existing LAN Investments

Preserves Existing SAN Investments

Unified Fabric Access Layer

- 1/10GE L2 Access switching
- Classical/DCE Migration Path
- High Performance Cluster
- Unified Fabric Transition
- Virtual Machine Environments

1 GbE
10 GbE
Fibre Channel
10 GbE DCE
10 GbE FCoE/DCE
Nexus Data Center Access Switch Portfolio

- 1/10 GE Line Rate, Low Latency
- Lossless L2 Switches
- Unified Fabric Switching
- Data Center Ethernet
- Fibre Channel Over Ethernet

- Simplified architecture and operations
- Combines benefits of ToR and EoR architectures
- Cost-effective highly-scalable solution for 1/10GE
- Integrated management domain with N5000
Nexus 5000 - Product Portfolio

Industry's First I/O Consolidation Virtualization Fabric for Enterprise Data Center

<table>
<thead>
<tr>
<th>Nexus 5000 Switch Family</th>
<th>28-Port L2 Switch</th>
<th>56-Port L2 Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 20 Ports 10GE/FCoE/DCE, fixed</td>
<td>• 40 Ports 10GE/FCoE/DCE, fixed</td>
</tr>
<tr>
<td></td>
<td>• 1 Expansion Module</td>
<td>• 2 Expansion Modules</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Expansion Modules</th>
<th>Fibre Channel</th>
<th>4-Port FC + Ethernet</th>
<th>6-Port Ethernet</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>• 8 Ports 1/2/4G FC</td>
<td>• 4 Ports 10GbE/FCoE/DCE</td>
<td>• 4 Ports 1/2/4G FC – 8G 2HCY09</td>
</tr>
<tr>
<td></td>
<td>• 8 Ports 10Gbps FC</td>
<td>• 10GbE/FCoE/DCE</td>
<td></td>
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<th>OS</th>
<th>Cisco NX-OS</th>
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<td>Mgmt</td>
<td>Cisco Fabric Manager and Cisco Data Center Network Manager</td>
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Adapter Ecosystem

**10GE Adapters**

- Intel
- Chelsio Communications
- Myricom
- NetXen
- NetEffect

**FCoE**

- Emulex
- QLogic
- Intel

**Adapter Ecosystem Partners Available Today**
Converged Network Adapters (CNA)

Converged Network Adapter
Off-the-shelf NIC and HBA ASICs from QLogic and Emulex, providing Dual Active-Active 10GE and FCoE connection

Support for Native Drivers and Stacks to minimize disruption for existing environments

Replaces multiple adapters per server, consolidating 10GE and Fibre Channel on a single interface

Supports Priority Flow Control and DCBX

AVAILABLE TODAY!!

- SUSE
- Red Hat
- Solaris
- Windows Server 2003
- Windows Server
Enabling Low-Cost 10GE...

**FP+ Direct Attach Copper (CX1)**

..1m, 3m and 5m available today

..7m offering available in future release

..Leverages Twinax Cable Technology

..Cables are pre-terminated (lower cost)

..Low power consumption (~ 0.1W)

..Lowest Latency for 10G Transceivers (~0.25 us)
Nexus 2148T Fabric Extender (FEX)
Bringing together the Best of Both Worlds!

- High density server aggregation switch that:
  - Physically resides on the top of each rack but
  - Logically acts like an end of row access switch
- Combines benefits of both ToR and EoR architectures
  - Introduces a new “remote line-card” design paradigm
- Reduces management devices
- Ensures feature consistency across hundreds of servers
- Reduces cable runs

Nexus 2148T Fabric Extender

48x 1GE ports downlink
4x 10GE ports uplink
N5000 + FEX Single Access Layer

- Nexus 5000 + FEX is a Virtual Chassis
- Nexus 2000 FEX is a Virtual Line Card to the Nexus 5000
- No Spanning Tree between FEX and Nexus 5000
- Nexus 5000 maintain all management and configuration
Nexus 5000 & FEX Network Topology

**FEX Rack -n- Roll Architecture**

- **Architectural Flexibility**
  - ToR or EoR
  - Rack or Blade
  - 1GE to 10GE
  - Unified I/O

- **Investment Protection**
  - Feature inheritance from central switch
  - Evolution from L2 to L3 to L4-7

- **Simplified Operations**
  - Ease of commissioning
  - “Zero touch” auto-configuration
  - Single point of management
  - Policy enforcement

- **VN-Link Capable**
Uniform Architecture 1GE & 10GE Enablement of Virtualization

N5000 in Virtualized Data Center

- VN-Link: optimized environment for VMs
  - Policy based VM connectivity
  - Mobility of security and network policy
  - Leverages existing operational VM infrastructure
  - Automates VM deployments and ongoing operation
Server Virtualization & VN-Link
VN-Link Brings VM Level Granularity

**Problems:**
- VMotion may move VMs across physical ports—policy must follow
- Impossible to view or apply policy to locally switched traffic
- Cannot correlate traffic on physical links—from multiple VMs

**VN-Link:**
- Extends network to the VM
- Consistent services
- Coordinated, coherent management
Cisco Virtual Network Link

Virtualizing the Network Domain

- Policy Based VM Connectivity
- Mobility of Network & Security Properties
- Non-Disruptive Operational Model

Cisco Nexus 1000V
(Software Based)

Nexus 5000 with VN-Link
(Hardware Based)

Two Complimentary Models to Address Evolving Customer Requirements
VN-Link With the Cisco Nexus 1000V

Cisco Nexus 1000V
Software Based

- Industry’s first third-party ESX switch
- Built on Cisco NX-OS
- Compatible with switching platforms
- Maintain VirtualCenter provisioning model unmodified for server administration but also allow network administration of Nexus 1000V via familiar Cisco NX-OS CLI

Policy-Based VM Connectivity
Mobility of Network and Security Properties
Non-Disruptive Operational Model
VN-Link with Network Interface Virtualization

Nexus Switch with VN-Link
Hardware Based

- Allows scalable hardware-based implementations through hardware switches
- Standards-based initiative: Cisco & VMware proposal in IEEE 802 to specify “Network Interface Virtualization”
- Combines VM and physical network operations into one managed node
- Future availability

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Policy-Based VM Connectivity

Mobility of Network and Security Properties

Non-Disruptive Operational Model
Cisco Nexus 1000 Family
The Business Benefits for Data Center

Consistent operation model for virtual & physical servers
VM level security & policy for regulatory compliance
Network policy to scale with VM sprawl
Simply VM network debugging
Enable flexible collaboration w/ individual team autonomy
# Cisco Nexus Family

## The Business Benefits of Unified Fabric

<table>
<thead>
<tr>
<th>Benefit</th>
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<tr>
<td>Reduction of Total Cost of Ownership</td>
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<tr>
<td>Consolidation with Investment Protection</td>
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<tr>
<td>Increased Business Agility</td>
</tr>
<tr>
<td>Enhanced Business Resilience</td>
</tr>
<tr>
<td>Ease of Deployment and Operational Alignment</td>
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</tbody>
</table>

![Diagram of Nexus Family devices](image-url)
Virtual Desktop Infrastructure

First enterprise application of cloud computing
WAN Acceleration for Desktop Virtualization

- WAN performance issues may inhibit deployment of VDI
- Cisco Wide Area Application Services accelerate RDP traffic to ensure end user experience and broaden deployment scenarios
- Building block for the “anywhere” aspect of cloud computing
How Does WAAS Work?

Branch Users

Cisco WAAS

WAN

Applications

End User Throughput Goes Up

Throughput

60Mbps
50 Mbps
40 Mbps
30 Mbps
20 Mbps
10 Mbps

01:20 01:21 01:22 01:23 01:24 01:25 01:26

WAN Consumption Goes Down

Throughput

3 Mbps
2.5 Mbps
2 Mbps
1.5 Mbps
1 Mbps
.5 Mbps

01:20 01:21 01:22 01:23 01:24 01:25 01:26

Automatic video stream splitting

Data Redundancy Elimination

TCP Flow Optimization

Application Specific Acceleration
VDI Acceleration with WAAS

Without WAAS

- User experience varies by location

With WAAS

- LAN-like desktop performance over the WAN

60-70% Reduction in Bandwidth
Business Decisions
Consolidation and Virtualization lowers total cost of ownership

- Business requirements are increasing
- Current projections can’t keep up
- New technology initially cost more but,
- Investment lowers future OPEX and offers a Richer infrastructure
Cisco Data Centers

Total of 215,000 square feet of raised Data Center space at Cisco

51 Data Centers
13 Business, 38 Engineering
Cisco Data Center Storage Growth

Over 13 petabytes of raw storage
~ 2000% Growth over the last 8 years
Improved TCO, Operations, Responsiveness

**Storage Consolidation**

- 13+PB of storage, growing at ~50% per year
- TCO reduced from $0.21/MB to $0.01/MB over 6 years
- Managed storage per FTE increased from 25 TB to 600 TB
- Overall utilization increased from 20% to 68%
- **$71 Million in cost avoidance over last 4 years**
Improved TCO, Operations, Responsiveness

Server Consolidation

- 14,250 servers, 3,780 applications
- 50% of existing, 75% of all new server environments virtualized
- 2,720 VM’s installed
- $19+ Million in cost avoidance and reductions to date
- Deployment time reduced from 8-12 weeks to 3 days
Nexus - Foundation for the Virtualized DC

Network Virtualization

Compute Virtualization

Storage Virtualization
Data Centre Virtualization
The Foundation Building Blocks

Nexus 7000
Nexus 5000
Nexus 2000
Nexus 1000V
MDS 9000 WAAS

Centralized Management

10Gbe
Unified I/O
High Availability
VDCs, VRFs
VLAN/VSAN
VN-Link
Segmentation,
Security,
Isolation

Consolidation
Virtualization
Thank You