Cisco Data Center 3.0
Aligning IT with the 21st Century Business

Mark Berly
Product Management – Data Center Business Unit
Data Centers are Under Increasing Pressure

Business Pressures

Operational Limitations
The Issue is Complexity of IT Infrastructure

- Silo'd applications, departments, information, devices don't collaborate
- Complex, heterogeneous infrastructure driving cost, efficiency, agility
- New developments driving additional demands on infrastructure
Today’s Business Processes Are Complex

BRANCH / WAN
- Customer Hits “Buy”
- Confirm Shipment
- Billing Notification
- Order Complete
- Notify Sales Rep
- Update Contracts
- Credit Approved
- Update Call Center
- Update Call Center

Trading Partners
- Logistics
- Deliver Order
- Warehouse
- Pack & Ship Order
- Credit
- Check Credit History

DATA CENTER
- CRM
  - Premium Customer?
  - Update Records
- ERP
  - Enter Order
  - Check Inventory
  - Update Inventory
- SCM
  - Check Availability
  - Initiate Billing
- Accts
  - Check Account Balance
  - Check Credit
  - Credit Override Required
- Cust Master
  - Check Customer DB
- Purchasing
  - Procure Material

Process Order
Check Credit
Ship Order
Bill Customer
Update Cust Svce

EXTENDED ENTERPRISE

Intranet
Extranet
WAN
Data Center Evolution

Data Center 1.0
- Mainframe
- Centralized

Data Center 2.0
- Client-Server and Distributed Computing
- Decentralized

Data Center 3.0
- Service Oriented and Web 2.0 Based
- Virtualized

- Consolidate
- Virtualize
- Automate
21st Century Data Center… 3.0

From

- Basic connectivity
- Box-based provisioning
- Organizational silos
- IT as a cost center

To

- End-to-end virtualization
- Adaptive orchestration
- Integrated teams
- IT as a service
The Vision is a Virtual Data Center

**Current: ‘Accidental Architecture’**
- Silo’d IT resources
- Low utilization, power inefficiency
- Branch offices ➔ ‘mini data centers’

**Emerging: Web 2.0 Model**
- Cloud of virtualized services
- Significant new resource demands
- Challenges with visibility, control, security
The Network Facilitates Alignment between IT and the Business
Incremental Approach to Data Center 3.0

**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
Server Virtualization is Changing the Game

- Virtual networks growing larger and faster than physical
  - Network admins are getting involved in virtual interface deployments
  - Network access layer needs to evolve to support consolidation and mobility

- Multi-core Computing driving Virtualization & new networking needs
  - Driving higher SAN attach rates higher (10% ➔ 40% ➔ Growing)
  - Driving users to plan now for 10GE to servers

- Virtualization enables the promise of blades
  - 10GE and FC are highest growth technologies within blades
  - Virtualization and Consolidated I/O removes blade limitation

- Network Virtualization enables CPU & I/O Intensive Workloads to be Virtualized
  - Enable broader adoption of x86 class servers
10GbE Market Dynamics

- Data Center Convergence and Virtualization drive 10GbE
  - Servers moving to dense rack chassis
  - Rapid Adoption of multicore
  - Growth of virtualization exceeds growth of physical servers

- NetXen, Broadcom, Intel and others driving 10G NIC and LOM into servers

- De facto uplinks from access switches are going to 10GbE
Server Virtualization – Qualcomm’s Success Story

- 2003 - 2007
  - Started with less than 10% Virtualized
  - Currently more than 85% Virtualized in Production
  - Flexible, Virtualized Infrastructure

- Realized the cost savings and IT flexibility
  - Charge back method – Incentive for Apps to Choose VM
  - Two choices – Virtualized was cheaper, more, sooner

- Five Elements for Success
  - Top Down Sponsorship
  - Treat Virtualization as an Architectural decision within Org
  - Big Picture Design with Incremental Deployment
  - Form a core Virtualization team, center of excellence, Virtualization in Title
  - Collaboration/High Quality Design/IT Stakeholder Buy-In including Storage, Security, Network, Server
Degrees of Virtualization

**Server Virtualization**
Consolidation of *physical* servers to reduce management, power and cooling, etc

**Storage Virtualization**
Consolidation of physical storage assets to logical storage assets

**Network Virtualization**
Creating pools of network ports that are isolated, but which reside on the same physical infrastructure

Virtual Data Center Infrastructure
Cisco’s Switching Portfolio Loaded with 10GE Uplinks

Get Core and Aggregation Ready for 10GE

Catalyst 3750-E
Catalyst 3560-E
Catalyst 4900M
Catalyst 4500
Catalyst 6500
Nexus 5000
Nexus 7000

10 GbE Uplinks focused on Data Center and Campus products
Cisco’s Data Center Technology Strategy

Next Generation Data Center

- Multi-Protocol
- Modular Design
- Continuity

Data Center
- Class OS

System Scalability
- 10G Density
- 40/100 Gbps
- Brocade
- Flow Layer
- Active Directors (S
- Eliminate
- Multipairing

Unified Mgmt
- Architecture

Modular Switching
- Cisco Data
- Center

ToR Switching
- Open WX API
- for all CLI
- parameters
- Connect Policy
- (Virtual or Ethernet)

Blade Switching
- DC wide
- server
- prov.
- Improved VM
- Scalability
Catalyst and Nexus: Complementary Focus

**Cisco® Nexus 7000**
- 15 Terabit Scalability
- Unified Fabric
- 100GbE
- 40GbE
- 10GbE
- 1GbE
- 3.7T
- 720G

**Transport Flexibility**

**Operational Continuity**

**Cisco Catalyst® 6500**
- 2 Terabit Scalability
- Integrated Services
- 10GbE
# Cisco Nexus 7000

**Enabling the Virtualized Data Center**

## Server Virtualization

### Networking Requirements
- **1/10 GbE Scalability**
  - 10GbE interfaces to consolidate multiple GbE interfaces, drives 10GbE in Agg & Core

### Layer 2 Scalability
- Provide large layer two networks for VM Mobility

### Enabling Layer 2 Clustering
- Requirement for DR and Business Continuance

### Unified Fabric
- Consolidation of FC, LAN, IPC Interfaces

## Nexus 7000

### Architected to Deliver
- **High-density 10/40/100 GbE**
  - Support for dense 10GE Interfaces
  - 15+ Tbps of scalability

### Virtual Port-Channel (vPC)
- Multi-pathing without Spanning Tree Limitations

### Overlay Transport Virtualization
- Extend Layer 2 Networks anywhere

### Transport Flexibility
- Unified Fabric and Data Center Ethernet Ready
Device & Network Consolidation with Nexus 7000

- Lower Capital Expenditure
- Consolidate multiple devices
- Remove interconnect links
- Reduce Operational Costs
- Fewer number of devices to manage
- Lowers overall data center power draw
Device Consolidation with Nexus 7000

Consolidation into a single large chassis

Device Partitioning into Multiple Contexts

<table>
<thead>
<tr>
<th>Lower Capital Expenditure</th>
<th>Consolidate devices in larger chassis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Collapse Security Zones with Virtual</td>
</tr>
<tr>
<td></td>
<td>Device Context’s</td>
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</tbody>
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Actual Savings through Switch Consolidation

Option 1

Option 2

<table>
<thead>
<tr>
<th></th>
<th>Typical Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x Option 1</td>
<td>12,096 Watts</td>
</tr>
<tr>
<td>1 x Nexus 7010</td>
<td>5,543 Watts</td>
</tr>
<tr>
<td>Savings</td>
<td>54%</td>
</tr>
</tbody>
</table>

Requirement: 64 Line Rate 10GE Ports with full bandwidth

Solution: 1 Nexus 7010
Nexus 7000 Virtualization
One to Many with VDCs

Virtualization

Virtual Device Context
✓ Flexible separation of hardware resources and software components
✓ Complete software fault isolation
✓ Securely delineated administrative contexts
Data Center Class Availability
Redundancy at Every Component Level

**NX-OS Modular Architecture**

**Zero Service Disruption Operating system**

- Granular Modularity – every service exists in protected memory
- Process restart provides fault containment
- Conditional Services – process and CLI are not allocated until a service is enabled
Data Center Class Availability
Redundancy at Every Component Level

Fault Tolerant Hardware

- No Single Point of Failure
  - Dual supervisors offer active/standby Control Plane
  - Fabric redundancy
  - Dual control channels to ensure control packet delivery
  - Power supply designed for grid redundancy

24 x 7 x 365

Every Link + Communication Channel is redundant!
Avoid Network Reconvergences

- Processes can restart in milliseconds and maintain state from state database (PSS)
- Net effect is zero impact to neighbor relationships
- Supported for all L2 protocols as well as OSPFv2
Data Center Class Availability

*In Service Software Upgrade (ISSU)*

**In Service Software Upgrades**

**Minimize Planned Downtime**
- Upgrades are possible between minor and major software releases
- Critical components for LAN + SAN vision

Upgrade and reboot
Initiate stateful failover
Upgrade and reboot I/O CPU

Release 4.1

I/O Module Images
**Cisco Nexus 7000**  
**Designed for Continuous Operations**

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**Zero-Service Disruption Design**  
**Hitless software upgrade**  
**Zero Packet Loss**

**High-Availability Tests**

<table>
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<tr>
<th>Frame Size</th>
<th>Traffic Loss ISSU-Upgrade</th>
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<tr>
<td>64 Bytes</td>
<td>0 packets / msec</td>
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<table>
<thead>
<tr>
<th>Frame Size</th>
<th>Traffic Loss ISSU- Downgrade</th>
</tr>
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<tbody>
<tr>
<td>64 Bytes</td>
<td>0 packets / msec</td>
</tr>
</tbody>
</table>

ISSU = Zero Packet Loss
**NETWORK WORLD Monster Switch:**
Top Marks for Uptime, Features and Modular Design

- Zero Service Loss when Upgrading and Downgrading the software image - ISSU
- Zero Service Loss when removing Fabric Cards
- Zero Service Loss when killing and restarting OSPF

**Quotes:**
- “.there was no packet loss with just two out of five fabric cards left.”
- “In many ways, the Nexus CLI is a better IOS than IOS.”
- “This is a different mechanism than graceful restart, ..... Process restart occurs much faster (Typically in less than a second).”

**Network World Test Report**
Nexus 7000 Virtualization

**VDC Use Cases**

**Virtualization**

- **Network Consolidation:**
  - Clearly delineated logical networks
  - Independent Topologies

- **Service Velocity:**
  - In-line tests, Rapid deployment/rollback

- **Device Consolidation:**
  - Logical Multi-layer topologies
  - Pwr, Cooling & Real-Estate efficiencies

- **System Resource Scaling**

Different network islands virtualized onto common data center networking infrastructure
Data Center 3.0 Delivers ...
Cisco Nexus Series Built with a
Network Platforms for Data Center

Data Center Vision

Over 1513 Patents Pending/Issued on Data Center Technologies

Cisco Nexus Series Delivers a Unified Fabric and I/O for the DC

Transport Flexibility

Over $1B in Overall Data Center Research and Development

Cisco Nexus Series Consists of Multiple Products with a Data Center Class OS

Operational Continuity

Infrastructure Scalability
NX-OS: Built on SAN-OS for the Data Center
Comprehensive Data Center Feature Set

Layer 3
- Distributed IPv4 and IPv6 unicast hardware forwarding
- 128K FIB TCAM entries
- OSPF, EIGRP, IS-IS, BGP, RIP, PBR
- PIM-DM, SSM, Bidir, MSDP, MP-BGP
- IGMP/MLD
- 16-way per-flow and per-packet ECMP
- HSRP, GLBP, VRRP with object tracking

Virtualization
- VRF-lite
- Virtual Device Contexts (VDCs)

High Availability
- In-Service Software Upgrade (ISSU)
- Stateful supervisor switchover
- Stateful process restarts
- Graceful restart for routing protocols
- Smart Call Home
- GOLD

Operational Manageability
- 512K NetFlow table
- NDE v5 and v9 with FNF CLI
- SPAN
- SNMP/XML
- Configuration rollback
- EEM

Layer 2
- Distributed Layer 2 hardware switching
- Hardware MAC learning
- 128K MAC table entries
- 16K unique VLANs (4K per VDC)
- Virtual Port Channels (VPC)
- PVRST, MST
- BPDU Guard, Root Guard, BPDU Filter, Bridge Assurance
- Link Aggregation Control Protocol (LACP/802.1AD)
- Private VLANs

Security
- 64K classification TCAM entries
- RACLs, VACLs, PACLs
- Cisco TrustSec: SGACLs, LinkSec (802.1AE)
- CoPP and rate limiters
- DHCP snooping, DAI, IP source guard
- Port security and 802.1x
- Storm control
- Unicast RPF check
- Roles-based management

Quality of Service
- Ingress queuing with tail drop
- Egress queuing (with PQ or shaping) with WRED and tail drop
- Marking policies and mutation
- Ingress and egress 1-rate 2-color and 2-rate 3-color policing
- Color-aware policing
- MQC CLI model
Cisco Nexus 7000
World-Wide Data Center Transformation

- Over 275 Customers
- Over 1000 Chassis Shipped
- 18,000 Customer Ports – First 9 Months
Nexus 7000 Platform

Industry’s First Data Center Class Platform

Nexus 7000 and NX-OS
- 10 & 18 Slot versions
- 15+ Terabit System
- Unified Fabric Ready
- Modern, Modular OS
- Device Virtualization
- Cisco TrustSec
- Continuous Operations

Nexus 7010  Shipping Today
8 I/O Slots + 2 Supervisor Slots
Front to Back Airflow
256 10GbE (4:1) / 64 Ports line rate
384 10/100/1000 Ports

Nexus 7018  Shipping Today
16 I/O Slots + 2 Supervisor Slots
Side to Side Airflow
512 10GbE (4:1) / 128 Ports line rate
768 10/100/1000 Ports

Cisco NX-OS Multi-protocol Operating System
Data Center Network Manager (DCNM)
Nexus 7000 I/O Module Roadmap
Services Rich Platform

Shipping Today

32-Port 10GbE Module
- SFP+ SR, LR, CX-1 and USR (Future)
- 80 Gbps per slot
- Performance or Density Mode
- 60 Mpps
- Virtual output queuing (VOQ)
- Integrated L2 / L3 Forwarding Engine
- 128K FIB TCAM
- 64K ACL TCAM
- 802.1AE LinkSec
- 512K Netflow Entries

48-port 10/100/1000
- RJ-45 Copper
- 48 Gbps per slot
- 60 Mpps
- Virtual output queuing (VOQ)
- Integrated L2 / L3 Forwarding Engine
- 128K FIB TCAM
- 64K ACL TCAM
- 802.1AE LinkSec
- 512K Netflow Entries
48 Port 1GbE Fiber Module (SFP)

Integrated M1 Forwarding Engine
- 46G Fabric / 48G Local Switching
- 60Mpps performance
- 48 ports wire-rate L3 multicast replication
- SX, LX and ZX at FCS
  - Further optics supported at FCS+3
  - DOM Optics are supported
- 802.1AE LinkSec
- List Price $27K

Places in the Network
- Enterprise, Commercial and SP – Gig Fiber ToR and Blade
- Content Providers – Aggregation for low cost uplinks
High Density and Transport Flexibility
Bandwidth Scales with Each Fabric Module

 Scalable Architecture to
 40G/100G

Future Proofed System
✓ Architectured to deliver scalability for the next 10+ years
✓ Each Fabric module provides 46Gbps to each slot
✓ **Day one** Fabric Architecture provides **230Gbps per slot**
✓ Platform scalable to 500+Gbps per slot
✓ Allows dense 40G/100G solutions for future growth
New Nexus 7018 – Ultra-High Density

Targeted Solutions:
- Core, Aggregation and Access Layer
- Top of Rack and Blade Aggregation
- Up to 1504 ports with vPC Support

System Characteristics:
- **Ultra-high density compact system**
  - 512 10G interfaces per system
  - 768 1G interfaces per system
  - 128 non-blocking 10G ports
  - Common Supervisor and Power Supplies
- **High performance**
  - Fab-1 230Gbps per slot on all slots
- **Future proof**
  - Initial fabric provides up to 7.8Tbps
  - Chassis scaleable to 17.6Tbps
  - 40/100G and Unified Fabric ready
**Panduit Switch Cabinet For the Nexus 7018**

- Co-Developed by Cisco and Panduit for the Nexus 7018
- Common cabinet with Catalyst, MDS and Nexus
  -- optional kits for extensions and ducting
- Ensures sufficient clearance for copper and fiber cabling and airflow
- Creates a ‘front to rear’ airflow system – using add-on ducting on each side
- Ducting directs cold air to the inlets and warm exhaust air to the hot aisle
- Allows for Deployment in EoR and MoR models with server racks
- Available direct from Panduit

- Dimensions: 40W”x48”Dx84”
- Based on extension pieces added onto a Panduit CN3
virtual Port-Channel
Feature Overview

- Allow a single device to use a port channel across two upstream switches
- Eliminate STP as principle loop management technology
- Uses all available uplink bandwidth
- Provide fast convergence upon link/device failure
- Provide port channel multi-path capability to the host
- Reduce CAPEX and OPEX
- Supported on all shipping hardware
- All existing features are compatible
Summary

Cisco® Nexus is the network foundation for Data Center 3.0

Cisco Nexus is the platform for High Availability Networks and designed to Optimize Virtualization efforts in the data center network

Cisco Nexus provides customers with consolidation, infrastructure scalability, and operational continuity