Virtual Machine Deployment

Cisco IT’s Story
Agenda

- Cisco
- Business
- Compute
- Storage
- Network
- Application
- Case Study
Cisco at A Glance
WW Headcount
66,000 employees*
35% Engineering
27% Sales
38% all others

128+ Acquisitions

51 data centers & server rooms
1500+ labs (500+ in San Jose)

Over 180,000 people around the world in the extended Cisco family

WW Portfolio:
18.9 million sf (60% owned, 40% leased)
283 metros
90 countries
444 buildings

20,000 Channel Partners
110+ ASPs
210+ Business & Support Development Partners

End of Q2 FY08
* Persons Housed (excluding SA, Webex, & Ironport)
Cisco Runs Its Business on a Cisco Infrastructure

- >352 x Content Engines
- 3537 x Switches
- 125 x MDS 9000 Multilayer Directors
- 50,000 x Cisco Security Agents
- 2500 x Voice and Remote Gateways
- 2552 x Routers
- 2754 x Access Points
- 70,000 x IP Telephones
- 30,000 x IP Communicator/Softphones
We face the same challenges as our customers!

New Business Pressures

- Collaboration
- Empowered User
- SLA Metrics
- Global Availability
- Reg. Compliance

Operational Limitations

- Power & Cooling
- Asset Utilization
- Provisioning
- Threat Prevention
- Bus. Continuance
Virtual Machine Deployment

Services Oriented Data Center (SODC)
Cisco Data Centers Today

Total of 230,000 square feet of raised Data Center space at Cisco
Cisco’s Data Center Journey –

*Wake Up Call!*

- 51 Data Centers
- 230,000 sq ft of Raised DC floor globally
- 150 Megawatts of Power
- 45%+ of Cisco Data Centers Require Action

**Current Constraints**

- Services responsible for Cisco revenue
- Business Continuance
- Green technologies not built into older DC designs

**Time Factors**

- DC Construction requires 2 - 3 years
- Application provisioning and data migration may add 1 - 2 years, or 3 – 5 years total
Business Climate

"The Perfect Storm"

Capacity
Acquisitions
Inconsistent Policies
Architecture
Growth
Mature Technology Solutions
Geographic Risk
Costs
Business Resiliency

A confluence of events impacting data centers
New Data Center Business Model Impact

*Software as a Service (SaaS)*

Additional Considerations

- Highly **resilient** service delivery imperative to **both** traditional and new business model success
- Data center **proximity** drives performance, experience and revenue
Global Data Center Strategy

**Strategic Alignment**

**Technology Leadership**
- New Opportunities
  - Acceleration
  - Automation
  - Virtualization
  - Next-Gen DC Networking
  - Management
- Adoption Curve
- Accelerated Adoption

**Business Strategy**
- Drive for growth
  - Enable market transitions
  - New business models
  - Globalization
  - Technology and business architecture
  - Enable every move we make with IT

**Cisco Green Initiative**
- Minimize energy consumption
- Consider power from renewable sources
- Technical innovation
- Environmental compliance
- Enable new Green business models
- Demonstrate corporate citizenship

- Early Adoption
- Flexibility through modularity
- Product quality improvement
- BU/IT/AS Joint discovery
- Early value realization
- Acquisition opportunities
Global Data Center Strategy

**Growth Enablement**

- New Markets and Business Models
- Global Expansion
- Service-Oriented Architecture

- Run IT as a Business
- Transform to Service Provider Model

- Increase Data Center Tiers
- Multi-Site Architecture
- Move out of High Risk Geographies

- Build and Occupy Data Centers
- Optimize Demand

Decision Points enable Incremental Execution
Global Data Center Strategy –

**Service Oriented Data Center (SODC)**

**SODC Target State:**
Pooled Virtual Resources, Automated, Standard Services Based, Secure, Intelligent Unified Data Center Network
Service Oriented Data Center –SODC

Opportunity to Drive “The Business”

IT Architecture

IT Operations

Data Center Architecture
WAN Optimization
Data Center Provisioning

Critical Systems Resiliency Tracks
Application Enterprise Architecture
Application Dependency Mapping
Common Management Database

Agility and Resiliency
SODC Design Phases

- **Consolidate**
  - Optimize Data Center Resources
  - Increase Resource Utilization

- **Virtualize**
  - Virtual Resource Pools
  - Increase Availability and Agility

- **Automate**
  - Adaptive Orchestration
  - Rapid Delivery of Services
## Cisco’s Data Center Evolution –
*Roadmap for “virtual machine deployment”*

<table>
<thead>
<tr>
<th>Legacy Data Center</th>
<th>Consolidated Data Center</th>
<th>Virtual Data Center</th>
<th>Service Oriented Data Center</th>
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<tbody>
<tr>
<td>Compute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 4 Tier Silos</td>
<td>• Standardization</td>
<td>• Server Orchestration</td>
<td>• Infrastructure</td>
</tr>
<tr>
<td>• Heterogeneous OS</td>
<td>• Virtual Machines</td>
<td>• VM Mobility</td>
<td>Aligned to Application</td>
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<tr>
<td>Storage</td>
<td>• SANs, VSANs</td>
<td>• Storage Virtualization</td>
<td>• Policy Based Management</td>
</tr>
<tr>
<td>• Storage Silos</td>
<td>• Tiered Storage</td>
<td>• Unified Network</td>
<td>• Unified I/O</td>
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<tr>
<td>• Low Utilization</td>
<td></td>
<td>Services FCoE</td>
<td>• Tiered Recovery</td>
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<tr>
<td>Network</td>
<td>• IP Connectivity</td>
<td></td>
<td>• Usage and SLA-based</td>
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<tr>
<td>Security</td>
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<td></td>
<td>Funding Model</td>
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<tr>
<td>• Perimeter Security</td>
<td></td>
<td></td>
<td>• Cloud Based Apps &amp; Services</td>
</tr>
<tr>
<td>Application</td>
<td>• Application Silos</td>
<td>• Secure Each</td>
<td></td>
</tr>
<tr>
<td>• Distributed</td>
<td>• Consolidate, Centralize</td>
<td>Application Tier</td>
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<table>
<thead>
<tr>
<th>2004</th>
<th>2005</th>
<th>2006 - 2009</th>
<th>2010 - 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidation Phase</td>
<td>Virtualization Phase</td>
<td>Automation Phase</td>
<td></td>
</tr>
</tbody>
</table>
Global DC Presence –
**Target End State FY13**

### Global Disaster Recovery Strategy
- **Short to Mid-Term:** Leverage Current Assets
- **Long-Term:** Part of Decision Process (Make/Buy)

### Netherlands – Metro-based DC Pair (Tier-III)
- Single-Instance Order Management (OM/AR)

### AsiaPAC TBD – Single DC (Tier-III) + land
- Continental hub for SaaS, Unified Communications and software development

### Mountain View (CA) –
- Early Adopter DC

### Richardson (TX) – Metro-based DC Pair (Tier-III)
- Global hub for business applications
- Continental hub for SaaS and communications

### Distributed standalone DCs (Tier-II)
- Latency-sensitive software development at lower availability

- **BC/DR Plan**
- **1A** Type-A (Tier-III)
- **2A** Type-B (Tier-II)
- **1A** Early Adopter DC
- **2A** at Synchronous Capable Distance

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## Data Center Tiers

*As defined by the Uptime Institute*

<table>
<thead>
<tr>
<th>Tier</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Components</strong></td>
<td>Need only (N)</td>
<td>N+1</td>
<td>N+1</td>
<td>2 (N+1)</td>
</tr>
<tr>
<td><strong>Delivery Paths</strong></td>
<td>One only</td>
<td>One only</td>
<td>One active One passive</td>
<td>Two active</td>
</tr>
<tr>
<td><strong>Single Points of Failure</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Concurrently Maintainable</strong></td>
<td>No</td>
<td>Components only</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Site Availability/Annual Downtime</strong>*</td>
<td>99.671% 28.8 hours</td>
<td>99.749% 22.0 hours</td>
<td>99.982% 1.6 hours</td>
<td>99.995% 0.4 hours</td>
</tr>
</tbody>
</table>

Existing DCs

New Cisco DCs
Data Center Operational Choices

- **Active-Standby**
  - Same as today
  - Doesn’t work well today
  - Only critical apps
  - Idle hardware
  - Different configuration in both DCs
  - Min infra complexity
  - Med apps complexity

- **Active-Active-Hybrid**
  - Similar to other customers solutions
  - Majority of apps
  - Identical configuration in both DCs
  - Not specific to vendor
  - Best Cisco on Cisco
  - Med infra complexity
  - Min apps complexity

- **Active-Active**
  - Used by financial institutions (E.g. metro clusters, multi-master data)
  - Majority of apps
  - Vendor specific
  - High infra complexity
  - High apps complexity
Services Oriented Data Center Technologies

Virtualized Computing
Data Center Server Landscape

- 14,230 virtual/physical servers
- 3,775 Applications
- 317 Production Databases

Source: Cisco IT, July 2008
SODC Server Virtualization

- **Data Center Server Consolidation**
  - Improve Operational Agility
  - Lower Data Center Operating Expense

- **Increase Utilization of Physical Servers**
  - Optimize TCO
  - Improve Data Center Capacity Management

- **Reduce Service Provisioning Times**
  - Rapid deployment of Operational Services

- **Increase Operational Efficiencies**
  - Support of Environments
  - Zero down time Operations
Server Virtualization Considerations

- **Support Model**
  Support Model must drive operational objectives
  Managed by core SODC Team

- **Risk vs. Virtualization Targets**
  ISV’s Support?
  Reduced Risk = Reduced Potential Savings

- **Keep Clients In Mind**
  Minimize Impact of Migrating to Virtual Servers
  Platespin, VM Converter Software is Crucial

- **Communicate VMware Strategy and Direction**
  Success Depends on Leadership Support
SODC Server Virtualization Architecture

Legacy

Data Center Aggregation Block

Network Services Block

Catalyst 4948

Catalyst 6509

SAN A

SAN B

Ethernet

Fiber Channel
Consolidation of Network Fabrics

Phase 1

Consolidated transports

Ethernet
Fiber Channel

SAN A
SAN Aggregation

SAN B

Data Center Aggregation Block
Network Services Block

Nexus 7000
Catalyst 6509
Nexus 5000

10 GbE Server Access

Ethernet
Fiber Channel
Consolidation of Network Fabrics

Phase 2

SAN A
Data Center Aggregation Block
Network Services Block

Nexus 7000
Catalyst 6509

SAN B

Nexus 5000
10 GbE Server Access

10 GbE Server Access
Service Oriented Data Center –
*VMware Landscape & Growth*

- 204 VMware Servers Across 25 Clusters in 8 Data Centers
- ~300 New VMs/Qtr (Greenfield)
  - Target 80% of All New Servers deployed as a Virtual Machine (currently at 60%)
- ~3,160 VMs Deployed to Date
  - ~2700 Active VMs
  - ~20% of Server Environment
  - ~Nearly 200 TB of Storage

Improved Availability

Improved Agility and Integrated Business Continuance

Services Delivered in under 3 days
Over $20M in Total Cost Avoidance To Date!

Improved Server utilization from 8% to 65%
Virtualization Benefits

- Improved Agility and Integrated Business Continuance
- Services Delivered Under 3 Days
- Improved Availability
- 3,160 Total Virtual Machines Today
- Over $20.4 M in Savings And Cost Reduction To Date
Services Oriented Data Center Technologies

Virtualized Storage
Over 13 PB of "raw" storage

Overall Growth Rate: FY’02=69%, FY’03=32%, FY’04=50%, FY’05=58%, FY’06=29%, FY’07=52%, FY’08=48%
SODC Storage Architecture consolidation

Timeline

2001
Phase 1: Originally scheduled for 1 year (2001)

2002
Phase 2: Predicted to take 18–24 months Planned to begin in 2002 Start delayed for 12 months

2003

2004
Phase 3: Predicted to take 12–18 months Originally planned to begin in 2004

“Physical” Cisco Business Functions

“Logical” Cisco Business Functions

*Multiple Datacenters (campus/metro)
SODC Storage Architecture consolidation

Timeline

2004

Phase 4: Originally scheduled to begin in 2005

2007

Phase 5: Predicted to take 12—18 months (2005-2007).
Cisco IT SODC Storage Architecture
SODC Storage Results

- Overall utilization increased from 20% to 68% over past 6 years

- Managed storage per FTE increased from 25 TB to 750 Terabytes over past 6 years

- Total Cost of Ownership reduced from .21/MB to .01/MB over past 6 years

- $71 Million in cost avoidance over past 4 fiscal years ($9M in FY04, $14M in FY05, $27M in FY06, $21M in FY07)
Services Oriented Data Center Technologies

Data Center HA Network
Data Center Operational Choices

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Cisco IT Active/Active-Hybrid Data Center

Network
- Using DNS, users are directed to GSS
- GSS load balances users across both DC #1 & #2
- ACE selects the optimal server to forward request between DC servers

Note:
Production infrastructure (network, hosts, infrastructure) configuration is identical in both DCs

Normal operations
- Web and app server are processing requests in both DCs
- Transaction logs are applied to remote DB

Failure Scenario
- Last transaction logs applied
- Apps DB connection timeout and reconnect
- No runtime apps changes required

Note:
In the physical implementation active DBs will be distributed across both DCs
Continuous Availability with Disaster Recovery

Non Cisco DNS Service

External User

DC 2

GSS

ACE

Web Server
(Load Balanced)
Active

App Server
(Load Balanced)
Active

Database Server
(Local Cluster)
Standby

Storage

Replication
Async

DC 1

GSS

ACE

Web Server
(Load Balanced)
Active

App Server
(Load Balanced)
Active

Database Server
(Local Cluster)
Active

Storage

Replication
Async

Remote DC

GSS

ACE

Web Server
(Load Balanced)
Active

App Server
(Load Balanced)
Active

Database Server
(Local Cluster)
Active

Storage

Replication
Async

ACE

GSS

Web Server
(Load Balanced)
Standby or Quick Ship

App Server
(Load Balanced)
Standby or Quick Ship

Database Server
(Local Cluster)
Warm Standby
Services Oriented
Data Center
Technologies

Wide Area Application Services
Symmetric Acceleration (Now)

- Based on the Wide Area Application Services (WAAS) technology
- Enabler for NAS Consolidation
- WAN savings
  Experienced 40-60% savings (volume) in lab PoC
  Capacity plan impact: from 68kbps (20 kbps for apps) to 60 kbps (12 kbps for apps)
- Acceleration for Emerging Markets
- Architecture
  Core (or “Server Edge”) and Edge (or “Client Edge”)
  Transparent at Layer3-4 (WCCP)
  Inter-DC traffic not in initial wave
WAAS Acceleration Metrics

- Potential productivity increase of est. $21M (3 year horizon)

Note: ANS Test Environment: 256Kbps BW and 150ms latency
3MB PowerPoint file used in document downloads

* Note: Benefit is variable depending on transaction characteristics
** Note: Validated at Moscow and Sao Paulo POC sites
Site Selection
PDC Site Selection Strategy

*From 420 Metro Areas Down to 8, Then 1*

**Must-haves:**
- U.S. or Canada
- Negligible environmental risk (e.g. earthquake, hurricane, tornadoes, etc.)
- Fiber service
- At least 2 long distance providers

**Additional Criteria:**
- Electrical power cost; long-term price stability
- Other costs: real estate, labor, taxes, govt incentives
- Proximity to existing Cisco IT operations
- Close to customers
- Availability of technical labor
- Regulatory environment
Winner - Richardson Data Center

**Purpose:** Meet Cisco current and future plans within scope of GDCS for Production Data Centers

**Power and space:** Cisco’s largest Production data center; ~29,000 sq ft raised floor area; power capacity of dual redundant 10 MW utility feeds.

**Devices:** Space for ~750 server racks

**Use:** Hosting Cisco’s primary production applications in a Tier III / IV data center

**Current state:** Production Ready, service migration in process with first client operational 08/2008.
Case Study
EAP – cabling transformation
Cisco Nexus 5020 Delivering Unified I/O

Operational for Early Adopter Clients

* Total PCI adapter reduction dependent on the use of single or dual port HBAs and / or network adapters as well as the level of redundancy required

Simplifies Cable Management

Cable Connectivity to Each Server Reduced by 60%

Adapters required in Each Server Reduced by 66%

Without Unified I/O
- Four 1Gb Copper Connections
  - Two Trunked for VM data
  - Two Trunked for vMotion
- Two Fiber Connections for San Storage
- Out-of-Band Management
- Three Additional PCI Adapters*

With Unified I/O
- Two 10gb fibre Connections
- Out-of-Band Management
- One Additional PCI Adapter*

---

* HKU link to Cisco Nexus 7K at distribution layer.
* Servers using physical N5K interface with 1/3 and with 1/4.
* Virtual Ethernet ports are interface 1/3 and with 1/4.
* Virtual Port Channel ports are interface 1/3 and with 1/4.
* Port-group load balancing configured as published uses one path and Service Console, VMkernel use other path.
* Load balancing done through ACE Appliance using One-Num Mote so VM’s needing Load Balancing can be placed on public network.
Case Study – DRT

Overview
- 1MW
- 12 kW/rack
- TO3R
- 21 Pods

To3R
- Nexus 5020
- Console
- FEX

Core
- Nexus7010
- Cat6
- MDS
Case Study – DRT power/ cabling

<table>
<thead>
<tr>
<th>Current design</th>
<th>Nexus design V1</th>
<th>V2</th>
<th>Nexus compared to Current V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Storage</td>
<td>9</td>
<td>63</td>
<td>96</td>
<td>96</td>
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<tr>
<td>Network</td>
<td>08</td>
<td></td>
<td>23%</td>
<td>21%</td>
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<tr>
<td>Servers</td>
<td>33</td>
<td>12</td>
<td>16</td>
<td>8%</td>
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<tr>
<td>FEX</td>
<td>79</td>
<td>8%</td>
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<td></td>
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<tr>
<td>Blades (4kW)</td>
<td>122</td>
<td></td>
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<tr>
<td>Standard config</td>
<td>90</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

![Graph showing power allocation comparison](chart.png)
Virtualization: Where we are

- Phase 1: Server Networking
- Phase 2: Storage Networking
- Phase 3: Unified Fabric via the Nexus platform
- Phase 4: Virtual Machine Optimized
- Phase 5: Transparent Virtualization

By implementing virtualization, Cisco can achieve:

- Increased resource utilization
- Decreased power and cooling consumption
- Faster provisioning
- Higher availability
- Business continuity
A few things we learned!
Virtualization Ready Network –
Approach for Success

Build Foundation with Business Vision

Evolve to Service Aligned Organization
Reengineer Operational Practices

Buy in from Critical Stakeholders

IT “Cost Model”
Executive Support

Organization and Process
Additional IT Resources

- Part of Cisco IT mission is to help make you, our customers, successful

- We enable this through a series of Case Studies and White Papers available on Cisco.com

- URL: [www.cisco.com/go/ciscoit](http://www.cisco.com/go/ciscoit)
Thank You!

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