Data Center Networking

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Cisco IT Infrastructure, Intelligent Network Solutions
Outline for Today’s Discussion

- Cisco IT Data Center Background
- Current Data Center Network Architecture
- Data Center Network Evolution
Cisco IT Data Center Background
Cisco Data Center Landscape

- Overall population of 7,000 servers
- Cisco currently has one SA for every 80 servers
- Server environment and ratio will continue to grow
- Heterogeneous environment with multiple hardware vendors
- Multiple OS environments

Source: Cisco IT, October 2005
Cisco Data Center Goals

- **Optimize TCO**
  - Consolidate data centers
  - Life cycle management
  - Data center standards

- **Business agility**
  - On-demand utility
  - Rapid delivery of services
  - Enabler of business goals

- **Business continuance**
  - Security
  - Active-active architecture
  - Virtual OS and application layers
Utility Data Center: Foundation for ISM

Three Major Integrated Service Management Components

Client Services
- Centralized MACS
- CC
- Cell
- Pagers
- Home Access
- VPN
- Softoken/DES
- ORYX
- OnRamp
- Billing and Financial Reporting

Management Services
- Enterprise Monitoring
- Executive Metrics
- Historical Trending
- Chg Mgt/SLA/DR/Dependencies

Infrastructure Services
- AM/DNS/DHCP
- Epage
- ACS (LEAP)
- Active Directory
- Cisco Unity™
- Microsoft Exchange 2000
Cisco IT Data Center
Network Architecture
Today’s Data Center Network in Cisco IT

• Production data center network is a standard L2-based, core-distribution-access architecture on Cisco Catalyst® 6500 platforms

• IP network services (load balancing, SSL off-load, firewall) supported using service switch model

• OOB access provided by serial consoles via Cisco 2600/3600 or Ethernet lights-out management via Cisco Catalyst® 3750 switches in separate infrastructure

• Most servers are connected at 100 Mbps; new deployments are deploying copper Gigabit Ethernet ports

• Distributed Director providing global load balancing services
Cisco IT Data Center Network Layout

- Layer 2 domain
- Enables L4–L7 deployments with full redundancy
Operating System Architecture

Existing Server Environment

- Host 1
- Host 2
- Host 3
- Host 4

Connections:
- GigE/100Mb Ethernet
- 2Gb Fiber Channel
- Out-of-Band Mgmt.

Network Components:
- IPC/Heartbeat Switch
- Ethernet Switch
- FC Switch
- Mgmt. Switch

SAN Fabric
- Mgmt. Network

IP Network
IT Content Switching Services

- 600+ virtual servers on CSM infrastructure
- Applications on CSM
  - CCO, a.k.a. [www.cisco.com](http://www.cisco.com): 50M+ L7 decisions per day
  - Sametime: 20k+ simultaneous connections
  - Oracle 11i
  - CCX/CCI (external and internal Java 2 Platform, Enterprise Edition)
  - Exchange front-end (SMTP, POP3, IMAP4, HTTP)
Content Networking Product Evolution

**LocalDirector 430**
- Large-scale distributed deployment
- LD pair per server (VLAN)
- Still used for DNS, DHCP, ACS, etc.
- LD430 EOS’ed in 2002

**Content Switching Module (CSM)**
- Preferred Platform
- L2-3 Network integration
- L4-7 capabilities
- Integrated Cisco IOS®

**Content Service Switch (CSS 11503)**
- Limited adoption of CSS
- L4-7 capabilities
Content Switching: Bridged Mode

- CSM deployed in bridged mode
- Multiple routable/non-routable VLAN pairs
- Active/standby with stateful failover ("replicate")

<table>
<thead>
<tr>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>No L3 Changes</td>
<td>All Server Traffic Through CSM</td>
</tr>
<tr>
<td>VLAN Segregation</td>
<td>Spanning Tree Loop Risk</td>
</tr>
<tr>
<td>No Changes to Server</td>
<td>Complex Troubleshooting</td>
</tr>
<tr>
<td>Source IP Preserved</td>
<td></td>
</tr>
</tbody>
</table>

Layer 3 View:
- Virtual IP
- Real IP 1
- Real IP 2
- Subnet 10.10.10.x/24

Layer 2 View:
- VLAN 301
- VLAN 601

Layer 1 View:
- SSW
- DC-GW
- CSM
Cisco IT
Future Data Center
Network Evolution
Cisco Data Center Trends

**Today**
- Heterogeneous Environment
- Rigid User Environment
- Application Specific Security
- Multi-Services Network
- SAN and NAS Storage
- Dedicated Compute Resources
- Application Specific Management

**Future**
- Standards-based Environment
- Flexible User Environment
- Self-Defending Data Center
- Intelligent Network Services
- Network Virtualized Storage
- Dynamic Compute Resources
- Policy Based Management
Data Center Consolidation

**Data Center Consolidation**
Collapsing many data centers to few
- Higher number of servers
- Larger network infrastructure

**Server/App Consolidation**
Concentrating servers and apps
- Standard high performance servers
- Fewer application architectures

**Storage and SAN Consolidation**
Centralizing storage/SAN resources
- Improve effective storage utilization
- Fewer isolated SANs

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**What the Network Needs**

**Flexibility**
Seamless deployment of new application environments

**Scalability**
Higher density, better aggregate performance, service scaling ability

**High Availability**
More predictability, higher redundancy
Service-Oriented Data Center Model

Business Goals

Demand

SODC

Supply

SODC Utility Pool

SODC Vision
- Highly Automated Virtual Environment

Main Objectives
- Drive Productivity
- Enable Cisco Business
- Optimize TCO
- Show case Cisco

Main Requirements
- Availability
- Scalability
- Flexibility
- Business Continuance
- Security

SODC Intelligent Management Fabric (IME/VFrame 4.0)
### Service-Oriented Data Center Roadmap

<table>
<thead>
<tr>
<th>Legacy Data Center</th>
<th>Current Data Center</th>
<th>Virtual Data Center</th>
<th>Service-Oriented Data Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Infrastructure aligned to BU</td>
<td>- Infrastructure consolidation</td>
<td>- Infrastructure aligned to application</td>
<td>- Infrastructure aligned to Service</td>
</tr>
<tr>
<td>- Storage silos</td>
<td>- SAN virtualization</td>
<td>- Active SAN/NAS virtualization</td>
<td>- Automated application</td>
</tr>
<tr>
<td>- Manual patches</td>
<td>- Centralized resources</td>
<td>- Virtual</td>
<td>- Policy-based</td>
</tr>
<tr>
<td>- Heterogeneous OS</td>
<td>- OS</td>
<td>- Common OS</td>
<td>- Utility model</td>
</tr>
<tr>
<td>- Low utilization</td>
<td>- Improve utilization</td>
<td>- Automated purposing</td>
<td>- Policy-based management</td>
</tr>
<tr>
<td>- Element management</td>
<td>- Centralize DC</td>
<td>- Fabric management</td>
<td>- Self purposing</td>
</tr>
<tr>
<td>- Distributed DC</td>
<td></td>
<td></td>
<td>- Optimized TCO</td>
</tr>
</tbody>
</table>

#### Timeline:
- **2004**: Consolidation Phase
- **2005**: Virtualization Phase
- **2006**: Automation Phase
- **2008**: Service-Oriented Data Center
Data Center Network Drivers

Integrate Storage Transport into DC IP Network
Consolidates Infrastructure
Reduces TCO via Utility Computing

Integrate Roles-Based Access to Critical Areas of the Network
Authenticate All Access
Protect Critical Cisco Assets

Automate Infrastructure Service Provisioning and Delivery
Reduce Defects
Increase Availability

Deploy Intelligent Capabilities to Optimize Applications (e.g., WAFS, AONS)
Improves User Experience and Satisfaction
# Network Segmentation

## Three Primary Functions for Network Segmentation

<table>
<thead>
<tr>
<th>Separation of Access (Path Isolation)</th>
<th>Protection of Critical Data Center Assets (Access Control)</th>
<th>Quarantine Unhealthy and Untrusted Systems (Policy Enforcement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapt to a Changing Acquisition Model</td>
<td>Protect Corporate Financial Data, HR data, and Source Code</td>
<td>Limit Damage Potential From Untrusted and/or Unhealthy Systems</td>
</tr>
<tr>
<td>Limit Access (Coarse-grained) for Vendors and Contractors</td>
<td>Assists in Sarbanes-Oxley Compliance</td>
<td>Provide a Self-service Platform for Remediation</td>
</tr>
<tr>
<td>Extend “Specialty Networks” Such as Guest Access/DMZ in the Infrastructure</td>
<td></td>
<td>Support Network Edge Authentication and NAC</td>
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Data Center Network Architecture Impacts

- Continuing Bandwidth Growth with Convergence of Storage onto IP Network
- Scaling Switching Architecture to Support High Density Utility Computing Environment
- Enhancement of QoS Architecture to Support Storage Traffic Over IP Network
- Required Alignment of Architecture Resiliency Characteristics Among the Network, Computing Resources, and Applications
- Enhancing Service Delivery Automation for Application Deployment or Movement Among Compute Resources
- Continued Focus on Security
Data Center Network Design Considerations

- Jumbo Frames
- Spanning Tree Scalability
- High Availability
- Data Center Space Considerations
- Number of Network Devices to Manage
- Cabling: Rack-to-Rack and SDF-to-Rack
- Network Component Lifetime vs. Server Components
- Granular Incremental Deployment
Physical SODC Architecture

Site Backbone Router

Data Center Distribution GW

Shared Network Services (CSM, SSL, FWSM, AONS)

Access Switches

1RU Servers

Blade Server with Cisco SFS Module or Ethernet Switch

6500 Series

6500 Series

6500 Series

6500 Series

6500 Series

Fibre Channel

65xx

iSCSI

MDS 9509

MDS 9509

SAN Storage

SAN SAN Extension

Intelligent SAN with Virtualization, Replication, Serverless Backup

NAS Filer(s)

NAS Gateways

Backup Master Server(s)

Backup Media Server(s)

Fibre Channel

Tape Library
Cisco SFS for I/O Consolidation and Clustering

Single InfiniBand link for:
- Storage
- Network

Cisco MDS 9000 Series

Cisco SFS 3012

Cisco Catalyst® 6500 Series

Fibre channel to InfiniBand gateway for storage access
- Create 10-Gbps virtual storage pipe to each server

Ethernet to InfiniBand gateway for LAN access
- Create virtual GigE pipe to each server
High-Density Attachment to the DC Network

Each Server Has GE Uplink to Each 4948-10GE in Rack (Not Pictured)

10 Gig Ethernet
Blade Server High Availability Using Integrated Switches

- Systematic approach
- Redundant devices and links in the network create no single point of failure
- L2/L3 features such as HSRP, VRRP, RPVST+
  - Fast convergence
  - Predictable behavior
- Load balancers to support applications
- Blade server HA enhanced via NIC teaming
Q and A
More Data Center Resources

Case Studies (Coming Soon); Please Check:

Operational Practices and Design Guides


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