The Cisco IT Storage Story

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Manager, IT
Cisco IT Storage

Summary

• Disk is cheap, but storage and storage management is expensive

• Growth is rampant; datacenter space is at a premium

• At Cisco, poor storage utilization creates an enormous ROI potential

• Cisco IT is creating a consolidated storage utility using Cisco’s own end-to-end storage networking solutions

• The storage utility model reduces overall TCO, providing storage when needed, as needed and at appropriate service and cost levels
Background
Cisco IT Storage Landscape

- Cisco: storage > 50% of datacenter budget
- Currently, Cisco IT supports nearly 3.9 PB of “raw” storage
- TCO/MB: FY02=.12, FY03=.10, FY04=.075, FY05=.03
- Growth Rates: FY02=69%, FY03=32%, FY04=50%, FY05=58%
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Early 2001—Challenges

Issues and Concerns:

• Direct Attach model was not scaling
  Management burden—too many points of management

• Immaturity of storage management tools lead to inefficient business processes
  Provisioning
  Capacity planning
  Cost visibility back to client base

• Led to inefficient storage utilization and significant TCO
# Cisco IT Storage

## Utilization and the Storage Lifecycle

<table>
<thead>
<tr>
<th></th>
<th>Physical Storage</th>
<th>Configured Storage</th>
<th>Addressable Storage</th>
<th>Logical Volume</th>
<th>Application Allocation Unit</th>
<th>Used Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FY’03</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilization*</td>
<td>100%</td>
<td>67%</td>
<td>70%</td>
<td>82%</td>
<td>86%</td>
<td>60%</td>
</tr>
<tr>
<td>Cumulative</td>
<td>100%</td>
<td>67%</td>
<td>47%</td>
<td>39%</td>
<td>33%</td>
<td>20%</td>
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<tr>
<td><strong>FY’04</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Utilization*</td>
<td>100%</td>
<td>85%</td>
<td>80%</td>
<td>87%</td>
<td>86%</td>
<td>60%</td>
</tr>
<tr>
<td>Cumulative</td>
<td>100%</td>
<td>85%</td>
<td>68%</td>
<td>59%</td>
<td>51%</td>
<td>30%</td>
</tr>
</tbody>
</table>

*These are Cisco’s Utilization Numbers Within Each Component or Point Along the Storage Lifecycle for SAN and DAS (Does Not Include NAS)*
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Vision Driver—ROI Potential (Utilization)

Assumptions

- 1.1 PB of DAS/SAN storage with current growth rate of 24%, decreasing to 20% for years two and three
- Storage TCO of .10 per Mb drops by 20% per year
- Once utilization improved, it is held there

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Industry Average</th>
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<tbody>
<tr>
<td>DAS</td>
<td>40%</td>
</tr>
<tr>
<td>SAN</td>
<td>60%</td>
</tr>
<tr>
<td>SAN (with Storage Management SW)</td>
<td>85%</td>
</tr>
</tbody>
</table>

Storage Vision
Goal: Consolidate to Reduce Points of Management and Implement Storage As a Utility-like Service and Ultimately Reduce Cisco’s Storage TCO
Vision Enabler: People
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Storage Vision Enabler: People

• **Dedicated storage team formed in early 2002**
  
  Define the processes, architecture, technology, deployment and support of the storage and backup infrastructures required to meet the needs of the business

  Responsible for working on the projects required to achieve the storage vision

  Currently consists of one Sr. Manager, one Storage Ops Manager, four Project Managers and nine Storage Managers/Administrators

• **Global, virtual storage team formed in mid 2002**

  High level vision, strategies, migration plans

  Global communication and coordination

• **Cisco IT Infrastructure Architecture Team**

  Storage identified as a separate technology domain
Vision Enablers: Processes + Software = Storage and Data Management
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Storage Supply Management

- **Device Management**
  
  Current practice is to utilize management tools from the device vendor

  Future plans are to consolidate and leverage a common tool for device management where possible

- **SAN Management**
  
  Cisco MDS Fabric Manager Server

- **NAS Management**
  
  Vendor storage management tools
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Storage Supply Management

Storage Resource Management (SRM)

• Storage metrics classified as one of the top architectural priorities for FY’05

• Considered “cornerstone” for offering storage as a utility like service (custom reports, SLA measurement, cost accountability, etc.)

• Vendor management tools currently deployed

• SRM still relatively immature
  
  Other metrics tools (SRP, SARS, FLR, EMAN, DFM, custom scripts)
Storage Virtualization

• Definition
  Not a new concept—analogous to RAID, volume management on much larger scale

• Important enabling technology for:
  Storage pooling and management consolidation
  Optimized utilization
  Replication (especially heterogeneous storage) and support for DLM/ILM related initiatives
  Automation (especially provisioning)
  Transparent data migration
  Over subscribed LUNs and File Systems

• Storage Virtualization Project
  Participating with three storage vendors and for SAN virtualization (Cisco on Cisco)
  Cisco IT researching NAS virtualization technologies and roadmaps with multiple vendors
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Storage Demand Management

Service Level Management (SLM)

• Seven storage services defined
  Planning, Design, Consulting, Reporting
  Capacity and Performance Management
  Provisioning
  Data Integrity and Resiliency
  Data Replication and Migration
  Financial Management
  Problem Resolution and Support

• Now working on associated SLAs, hardware tiers

Storage Recovery Project (SRP)

• Utilization Management
• Storage Metrics
• Portal/Dashboard
Vision Enabler: Hardware
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Vision Enabler: Hardware Strategy

- Local DAS and NAS
- Consolidated DAS and NAS
- Consolidated DAS, Small, FC SAN “Islands” and NAS
- Consolidated FC SANs (BUs per Datacenter) and NAS
- Consolidated FC SANs (Datacenter, Campus) and NAS
- Consolidated FC SANs (FCIP on WAN) and NAS
- Consolidated FC and IP Storage (NAS, iSCSI SANs)
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SAN Consolidation/Migration Timeline

```
<table>
<thead>
<tr>
<th>Year</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
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<tbody>
<tr>
<td>2001</td>
<td>Originally scheduled for 1 year (2001)</td>
<td>Predicted to take 18–24 months Planned to begin in 2002 Start delayed for 12 months</td>
<td>Predicted to take 12–18 months Originally planned to begin in 2004</td>
</tr>
</tbody>
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“Physical” Cisco Business Functions

“Logical” Cisco Business Functions
*Multiple Datacenters (campus/metro)
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SAN Consolidation/Migration Timeline

Timeline

<table>
<thead>
<tr>
<th>2004</th>
<th>2005</th>
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<tbody>
<tr>
<td>Phase 4: Originally scheduled to begin in 2005</td>
<td>Phase 5: Predicted to take 12—18 months (2005-2006).</td>
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Vision Catalyst: Storage Consolidation I, II, and III

- Defining a storage vision and justifying products to support that vision are sometimes difficult to justify due to the fact that there are more intangible than tangible benefits
- Consolidation of DAS storage and SAN Islands into larger SAN islands is relatively easy to justify using very tangible metrics
- While consolidating, consolidate with a purpose – make sure the consolidation efforts fit in with your overall vision
- Cisco specific examples
  - Storage Frame Consolidation
    - +58% ROI in FY03
    - +51% ROI in FY04
    - +50% ROI in FY05
  - DAS to SAN, SAN island to MDS consolidations
    - +52% ROI in FY03
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Why Cisco IT Chose the MDS 9509 SAN Switch

• Improve Availability
  More ports to support multiple paths between servers and storage
  Non-disruptive upgrades
  Advanced troubleshooting and diagnostics
  VSANs to segregate traffic and management

• Reduce Data Center Crowding
  Multi-protocol support allows primary storage to be located in remote data centers

• Reduce Costs
  SAN consolidation using VSANs to increase storage utilization by sharing each storage frame among many servers and business units
  Large, consolidated SANs mean less points of management

• Provide Intelligent SAN fabric services
  Virtualization, Continuous Data Protection, Replication

• Improve performance
  A fully non-blocking architecture
  Intelligent traffic management (QoS, FC congestion control)
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Pre-MDS (Consolidation Phase 1) ERP LOB (Jan, 2003)

- 14 SAN Islands
- 33 Sun, HP Hosts
- 38 Storage Frames
- Over 350 Terabytes

Cisco ERP/DW Business Function
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ERP MDS Initial Deployment

ERP Oracle 11i Development SAN Islands

Cisco IP Network

7 HPUX Hosts

4 HPUX Hosts

Dual Fabric SAN

4 port ISL

4 port ISL

2 McData 32 Port SAN switches

2 McData 32 Port SAN switches

Dual Fabric SAN

1 McData 32 Port SAN switch

1 McData 32 Port SAN switch

11 Storage Frames (~ 90 Terabytes)

1 Storage Frame (~ 10 Terabytes)
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ERP MDS Initial Deployment (Step 1)

Cisco IP Network

7 HPUX Hosts

4 HPUX Hosts

4 port ISL

2 McData 32 Port SAN switches

2 Cisco MDS-9509 SAN switches

1 McData 32 Port SAN switch

11 Storage Frames (~ 90 Terabytes)

1 Storage Frame (~ 10 Terabytes)
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ERP MDS Initial Deployment (Step 2)

- Cisco IP Network
- 7 HPUX Hosts
- 4 HPUX Hosts
- 2 Cisco MDS-9509 SAN switches
- 12 Storage Frames (~100 Terabytes)
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ERP MDS Initial Deployment—Consolidation Phase 2

Two Fabrics:
2 Cisco MDS 9509 SAN
Switches on Each

- 640 port SAN
- 33 Sun, HP Hosts
- 5 VSANs
- 38 Storage Frames
- Over 350 Terabytes

DR HP VSAN
DR SUN VSAN
Backup VSAN
Development HP VSAN
Development SUN VSAN
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Cisco SAN Switch Deployment – Best Practice Award

Systems Implementation
Spring 2004

Graph showing McData Ports, Brocade Ports, and Cisco MDS Ports from December 2002 to July 2005.
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SAN Consolidation Phase 3 (January, 2004)

RTP BLDG 5

MDS 9509
RTP5-ERP-SW1
4 port (8Gb/s)
Port-Channel

MDS 9509
RTP5-ERP-SW2
2 Port (4Gb/s)
Port-Channel

MDS 9509
RTP5-ERP-SW3
4 port (8Gb/s)
Port-Channel

MDS 9509
RTP5-ERP-SW4
2 Port (4Gb/s)
Port-Channel

2 Port (4Gb/s)
Port-Channel

MDS 9509
RTP5-SANGW-SW1
2 Port (4Gb/s)
Port-Channel

Fabric “A”

16 Port (32 Gb/s)
Port-Channel

Single Mode Fiber

RTP BLDG 7

MDS 9509
RTP5-CORPSYSCA-SW1
MDS 9509
RTP5-IOPS-SW1

Approximately 1.5K

MDS 9509
RTP7-ITSAN-SW1

4 Port (8Gb/s)
Port-Channel

4 Port (8Gb/s)
Port-Channel

4 Port (8Gb/s)
Port-Channel

1600 Ports (160 Ports Per Switch)
Growing to ~2500 Ports by Mid-2004
Campus Wide SAN (Multiple BU’s)
~125 Hosts (Solaris, HPUX, NT)
~700 TB
Single Point of Mgmt
Interface Feature Highlights

- 8 Gigabit Ethernet ports
- Concurrent iSCSI and FCIP on all ports
- Full wire-rate performance for FCIP and iSCSI
- Managed as Fibre Channel hosts

Cisco IT has implemented FCIP and iSCSI and is expanding on both:

- **FCIP**
  - Wide area SAN interconnect for consolidated management
  - Business Continuance, Backup/Restore, High Availability, Disaster Recovery
  - Wide area data migration (another building block to support ILM)

- **iSCSI**
  - Offers a “value” connectivity option for mid-range platforms (Win2K/Linux)
  - In production for over a year in Win2K environment (SN5428)
  - Moving to iSCSI SAN connection through the MDS
  - Further consolidation without the additional cost of fiber HBA, etc.
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SAN Consolidation Phase 4 (October, 2004)
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NAS Consolidation

• Management consolidation solution/strategy
  Multiple filers create management scaling issues analogous to DAS and small SAN island problems
  Researching potential for NAS gateways
  Researching potential for NAS virtualization

• Remote filer consolidation
  Cisco File Engine and Wide Area File Services (WAFS)
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Cisco Remote Field Sales Office (FSO): Current Architecture

Example Remote Site 1:
- Primary NAS storage located in remote DC and accessed over WAN
- 50-80% performance reduction vs. local
- Cisco has 51 sites architected in this way

Data Center 1:
- Primary NAS Storage
- Secondary NAS Storage

Data Center 2:
- Primary NAS Storage
- Secondary NAS Storage

Example Remote Site 2:
- Primary NAS storage local and accessed over the LAN
- Data “snapped” back to closest data center for backup & D/R
- Cisco has 39 sites architected in this way
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Cisco File Engine: Wide-Area File Services (WAFS)

Kiev, Ukraine:
- Primary NAS storage still in remote DC
- Clients get improved WAN performance (~80% increase)

PoC Environment

Amsterdam Data Center

Berlin, Germany
- Primary NAS storage consolidated to remote DC
- Clients get slightly reduced performance (~10 – 15% less than LAN)

File Engine
Primary NAS Storage
Bunker NAS Storage
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File Engine: Preliminary Performance

Office Applications Performance

- File Engine vs. WAN (40-200ms)
  T1: 7 to 10x improvement
  T1/80: 7.5 vs. 58 sec/op

- File Engine vs. LAN
  Open: 2 to 5 sec difference vs. LAN
  Save: <10 second difference vs. LAN
Cost Savings Analysis
• **Improved Availability**
  - More ports to support multiple paths between servers and storage
  - Non-disruptive upgrades
  - Advanced troubleshooting and diagnostics
  - VSANs to segregate traffic and management
  - Virtualization

• **Multi-protocol Support Provides Architecture Flexibility**
  - Multi-protocol support allows primary storage to be located in multiple data centers and accessed by remote clients
  - Tiered storage (iSCSI)

• **Improved Utilization Reduces Hardware Costs**
  - SAN consolidation using VSANs to increase storage utilization by sharing each storage frame among many servers and business units

• **Consolidated Management Reduces Staff Costs**
  - Large, consolidated SANs mean less points of management, more managed storage per FTE
  - Faster provisioning (closer to on-demand storage)

• **Intelligent SAN Fabric Services Provide New Capabilities**
  - Virtualization, Continuous Data Protection, Replication
  - Avoid vendor lock-in, support heterogeneous tiered storage
Q and A
Further Resources
Further Storage Resources

Case Studies

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