The Cost of Poor Quality

- Most companies waste more than half their storage.
- Between 1999 and 2002, estimated $35 Billion of storage assets have gone unutilized.*
- Approximately one quarter of all annual computer-related U.S. revenues.

*Worldwide OEM Revenues 1999-2002
Summary

• Falling disk prices = Increased TCO
• Create value with STORAGE STRATEGIES
• In order to take advantage we must:
  - Understand the problem
  - Visualize the impact
  - Use metrics and know TCO components
• Cisco has implemented a STORAGE VISION to direct strategies for storage management with significant impact

Agenda

• Part 1—Storage Strategies for Lowering TCO
  - Definitions
  - Strategies
  - Measurement
  - Metrics
  - QA
• Part 2—Cisco IT Storage Story
  - Environment Overview
  - Cisco IT Storage Vision
  - Strategies (Migration, Consolidation, Recovery)
  - ERP SAN Migration
PART 1: STORAGE STRATEGIES FOR LOWERING TCO

DEFINING TCO TERMINOLOGY
Definition—Total Cost of Ownership (TCO)

• The sum total of all costs associated with implementing a storage solution including acquisition and depreciation of raw storage, labor, support, maintenance, etc. over the lifetime of the solution
• Provides for “apples-to-apples” comparisons of different solutions
• Measures impact on environment and on bottom line—real world costs
• Cash basis or depreciation?
  Cash basis—present value of all acquisition costs**
  Depex—matches budget structures

Cash vs. Depreciation

<table>
<thead>
<tr>
<th>Cash Basis</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW</td>
<td>$ 1.00</td>
<td></td>
<td></td>
<td>$ 1.00</td>
</tr>
<tr>
<td>Maint</td>
<td>$ 0.20</td>
<td></td>
<td></td>
<td>$ 0.20</td>
</tr>
<tr>
<td>Labor</td>
<td>$ 0.10</td>
<td>$ 0.09</td>
<td>$ 0.08</td>
<td>$ 1.30</td>
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<tr>
<td>Total</td>
<td>$ 1.30</td>
<td>$ 0.09</td>
<td>$ 0.08</td>
<td>$ 1.47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depex</th>
<th>Year 0</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HW</td>
<td>$ 0.33</td>
<td>$ 0.33</td>
<td>$ 0.33</td>
<td>$ 0.69</td>
</tr>
<tr>
<td>Maint</td>
<td>$ 0.20</td>
<td></td>
<td></td>
<td>$ 0.20</td>
</tr>
<tr>
<td>Labor</td>
<td>$ 0.10</td>
<td>$ 0.10</td>
<td>$ 0.10</td>
<td>$ 0.30</td>
</tr>
<tr>
<td>Total</td>
<td>$ 0.63</td>
<td>$ 0.43</td>
<td>$ 0.43</td>
<td>$ 1.50</td>
</tr>
</tbody>
</table>

• Year 1 labor costs = $0.1*(0.9^1)
• Year 2 labor costs = $0.1*(0.9^2)

**Cash Basis—Present Value of Future Costs at 10% Discount Rate
Storage Strategies

- Storage Management
  - Storage Demand
  - Storage Supply

- Storage Resource Management
  - Virtualization
  - Framework
  - Information Lifecycle Management
  - Data Integrity and Resiliency
  - Management and Consolidation

- Utility-Like Storage Service
  - Service-Level Management
  - Appropriate Hardware Tiers

- Storage Recovery Program
  - Best Practices and Processes
  - Special Tools and Metrics
Strategies

• **Migration to storage networks**
  - Increases allocation efficiency
  - Decreases management costs

• **Storage consolidation**
  - Fewer hosts and fewer frames
  - Reduce points of management
  - Reduce maintenance costs

• **Storage recovery**
  - Increases utilization efficiency
  - Reclaim unused storage
Measurement

- Data collection
  - Asset reports
  - Accounts payable
  - Storage inventory
  - SRM
  - Spreadsheets
- Need measurement of “before” picture
- Key values
  - Allocation efficiency
  - Utilization efficiency

Utilization

Allocation Efficiency

Utilization Efficiency

60%  40%
## Allocation Efficiency

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Industry Average Allocation Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAS</td>
<td>30%–40%</td>
</tr>
<tr>
<td>SAN</td>
<td>50%–60%</td>
</tr>
</tbody>
</table>

## Measurement Example: (DAS)

- **Sample DAS TCO**
  - Seven storage frames
  - 7 x external RAID arrays (total 24,192 GB)
  - $350K purchase price
  - $2.45M total
  - One storage manager
  - $150K per year
  - Seven datacenter tiles
  - $10K per tile
  - $5K for cabling
  - $75K total
Measurement DAS (Cont.)

- Backups
  - Per GB $0.086
  - Plus tape costs per GB $0.868
  - Total per GB $0.954
  - Total $63,698

- Maintenance
  - $6K per frame per month
  - $42K per month
  - $504K total

- Utilization
  - Allocation efficiency factor (60%)
  - Utilization efficiency (40%)

Sample DAS TCO

<table>
<thead>
<tr>
<th>Sample TCO</th>
<th>Cash Basis</th>
<th>Depex—Year 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seven Storage Frames</td>
<td>7 x External RAID Arrays (Total 24,192 GB)</td>
<td>$350K Purchase Price $1.75M Total</td>
</tr>
<tr>
<td>One Storage Manager</td>
<td>$150K per Year $388,160.00</td>
<td></td>
</tr>
<tr>
<td>Seven Datacenter Tiles</td>
<td>$10K per Tile $199,080.00</td>
<td></td>
</tr>
</tbody>
</table>

- Backups
  - Per GB $0.086
  - Plus Tape Costs per GB $0.868
  - Total per GB $0.954
  - Total $63,698

- Maintenance
  - $6K per frame per month $388,160.00
  - $42K per month $75,000.00
  - $504K total $504,000.00

- Utilization Rates
  - Allocation Efficiency Factor (60%) 0.6
  - Utilization Efficiency (40%) 0.4

- Total Storage 24,192,000
- Total Cost $4,448,756.11
- TCO Per MB $0.77

*Expenses Not Depreciated, but Totaled over 3 Years
**Discount Rate Needed for Present Value—Years 2 and 3 Discounted at 12%
Measurement Example: SAN Migration Strategy

- **Sample SAN TCO**
  - Seven storage frames
    - 7 external RAID Arrays
      - (36 GB drives)
      - (total 24,192 GB)
    - $350K purchase price
    - $2.45M total
  - One storage manager
    - $150K per year
    - $15K for training
    - $165K total
  - Seven datacenter tiles
    - $10K per tile
    - $5K for cabling
    - $75K total
  - One storage manager
    - $150K per year
    - $15K for training
    - $165K total
  - Maintenance
    - $6K per frame
    - $42K per month
    - $504K total
  - Backups*
    - Total $63,698.51

*Significant Savings in Backups Possible—Not Analyzed Here

- **FC switches**
  - $500K total including maintenance
- **Utilization**
  - Allocation efficiency factor (75%*)
  - Utilization efficiency (40%)

*Assumes 15% Increase
## Sample SAN TCO

<table>
<thead>
<tr>
<th></th>
<th>Cash Basis</th>
<th>Depex—Year 0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seven Storage Frames</strong></td>
<td>7 x External RAID Arrays (Total 24,192 GB)</td>
<td>$330K Purchase Price $2.45M Total</td>
</tr>
<tr>
<td><strong>One Storage Manager</strong></td>
<td>$150K per Year</td>
<td>$15K for SAN Training $165K Total</td>
</tr>
<tr>
<td><strong>Facilities - Seven Tiles</strong></td>
<td>$10K per Tile</td>
<td>$3K for Cabling $75K Total</td>
</tr>
<tr>
<td><strong>Backups</strong></td>
<td>$0.086 Per GB</td>
<td>$0.868 Tape Costs per GB $0.954 Total per GB</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>$6K per Frame per Month</td>
<td>$504K Total</td>
</tr>
<tr>
<td><strong>Switches</strong></td>
<td>4 Director Class Switches (Inc. Maint.)</td>
<td>$500,000 $166,667</td>
</tr>
<tr>
<td><strong>Utilization Rates</strong></td>
<td>Allocation Efficiency Factor (75%) Utilization Efficiency (40%)</td>
<td></td>
</tr>
<tr>
<td><strong>Total Storage</strong></td>
<td>24,192,000</td>
<td>35,040,000</td>
</tr>
<tr>
<td><strong>Utilization Efficiencies</strong></td>
<td>7,257,600</td>
<td>10,512,000</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$4,986,134</td>
<td>$1,750,412</td>
</tr>
<tr>
<td><strong>TCO per MB</strong></td>
<td>$0.69</td>
<td>$0.17</td>
</tr>
</tbody>
</table>

## Consolidation Impact

<table>
<thead>
<tr>
<th></th>
<th>Cash Basis</th>
<th>Depex—Year 0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two Storage Frames</strong></td>
<td>2 x External RAID Arrays (42,048 GB)</td>
<td>$750K Purchase Price $1.5M Total</td>
</tr>
<tr>
<td><strong>One Storage Manager</strong></td>
<td>$150K per Year</td>
<td>$15K for Training $165K Total</td>
</tr>
<tr>
<td><strong>Facilities</strong></td>
<td>$10K per Tile</td>
<td>$3K for Cabling $35K Total</td>
</tr>
<tr>
<td><strong>Backups</strong></td>
<td>$0.086 Per GB</td>
<td>$0.868 Tape Costs per GB $0.954 Total per GB</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>No Maintenance for 3 Years</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Switches</strong></td>
<td>4 x 32 Port Switches</td>
<td>$500,000 $166,667</td>
</tr>
<tr>
<td><strong>Utilization Rates</strong></td>
<td>Allocation Efficiency Factor (80%) Utilization Efficiency (40%)</td>
<td></td>
</tr>
<tr>
<td><strong>Total Storage</strong></td>
<td>42,048,000</td>
<td>42,048,000</td>
</tr>
<tr>
<td><strong>Utilization Efficiencies</strong></td>
<td>13,455,360</td>
<td>13,455,360</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$2,592,141</td>
<td>$889,746</td>
</tr>
<tr>
<td><strong>TCO per MB</strong></td>
<td>$0.19</td>
<td>$0.07</td>
</tr>
</tbody>
</table>
Recovery Impact

Sample TCO

Two Storage Frames
2 x External RAID Arrays (42,048 GB)
$750K Purchase Price
$1.5M Total

One Storage Manager
$150K per Year
$15K for Training
$165K Total

Facilities
Three Tiles
$10K per Tile
$5K for Cabling
$35K Total

Backup
Per GB
$0.086
Plus Tape Costs per GB
$0.868
Total per GB
$0.954
Total
$61,261
$23,079

Maintenance
No Maintenance for 3 Years
$0
$0

Switches
4 Direct Class Switches
$500,000
$166,667

Utilization Rates
Allocation Efficiency Factor (80%) 0.8
Utilization Efficiency (60%) 0.6

Total Storage
42,048,000
42,048,000

Utilization Efficiencies
20,183,040
20,183,040

Total Cost
$2,592,141
$889,746

TCO per MB
$0.04
$0.13

Solution/Cost Comparison

Effect of Storage Program on TCO

<table>
<thead>
<tr>
<th>TCO/MB DAS</th>
<th>TCO per MB SAN</th>
<th>TCO per MB Consolidation</th>
<th>TCO per MB Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Basis</td>
<td>$0.77</td>
<td>$0.27</td>
<td>$0.69</td>
</tr>
<tr>
<td>Depex</td>
<td>$0.27</td>
<td>$0.17</td>
<td>$0.07</td>
</tr>
<tr>
<td>TCO per MB DAS</td>
<td>$0.19</td>
<td>$0.07</td>
<td>$0.13</td>
</tr>
<tr>
<td>TCO per MB Consolidation</td>
<td>$0.07</td>
<td>$0.04</td>
<td>$0.13</td>
</tr>
</tbody>
</table>
Metrics

- Project metrics
  - Payback method
  - ROI
  - NPV
Metrics Examples: Payback

• Pros
  “Napkin math”
  Suitable for small capital investments
  Measures time to recoup investment
  Payback period = initial investment/annual income

• Cons
  Doesn’t work well for large investments
  Doesn’t work well for long time horizons (>1 year)

Example: $5000 for New Disk Infrastructure to Increase Performance for Online Transactional System which Increases Revenue by $2500 over Two Quarters

Payback Period Is One Year
$5000/$2500 = 4 Quarters = One Year
Reasonable Payback—Do the Upgrade

Metrics Examples: ROI

• Pros
  “Napkin math”
  Suitable for large capital investments
  Well known

• Cons
  Easy to manipulate
  Maligned as a marketing tool
  Does not account for cost of capital
  Does not account for time value of money

Example: $5000 for New Disk Infrastructure to Increase Performance for Online Transactional System which Increases Revenue by $2500 over Two Quarters

ROI = $2500/$5000 = 50%
Metrics Examples: NPV

• **Pros**
  - Accurate measurement
  - Suitable for large capital investments
  - Accounts for cost of capital and time value of money

• **Cons**
  - Definitely not “napkin math”

Example: $5000 for New Disk Infrastructure to Increase Performance for Online Transactional System which Increases Revenue by $2500 over Three Years; Cost of Capital is 12%

\[
\text{NPV} = -5000 + (833.33 \times (1.12^1)) + (833.33 \times (1.12^2)) + (833.33 \times (1.12^3))
\]

\[
\text{NPV} = -$2998.47 \text{ (i.e. DON'T DO THE PROJECT)}
\]

Summary

• DAS to SAN migrations significant cost savers
• Coupled with consolidation and storage recovery Programs greater reductions in TCO possible
• Use FC and IP networks as enabling technologies for lower TCO
• Use strategies to adjust storage TCO **FUNCTION**
• Uptime and availability are part of TCO
• Use FC and IP storage networks to increase business continuance, uptime, and availability in turn further decreasing TCO
• Play WHAT-IF scenarios with uptime, availability, backups, retention
Summary

- Cost of raw storage has fallen while data has grown at nearly exponential rates at Cisco
- Data center space is at a premium
- Poor utilization has created potential for significant ROI
- Cisco IT is focusing on creating a consolidated storage utility to raise utilization and lower TCO
- Cisco is well underway towards consolidating storage into large SANs and providing storage as utility-like service
Agenda

- Environment Overview
- Cisco IT Storage Vision
- Strategies (Migration, Consolidation, Recovery)*
- ERP SAN Migration
- Q&A

*Application of Concepts from Part 1
**Cisco IT Storage Landscape**

- Cisco IT storage large portion of data center budget
- 2001 and 2002 storage growth > 120%
- Currently, Cisco IT supports 2.1 PB of “raw” storage
- Along with management and facility costs, our storage TCO is ~.10 per MB*  

* Based on January 2004 TCO Study Conducted by the Cisco IT Storage Team (Bill Williams)

---

**Cisco IT Storage Environment: 2001**

- Predominantly DAS (estimated 600–700TB) with SAN-islands interspersed
- Between 1999–2002—estimated 30+ SAN islands created using 148 Brocade and McData switches—2340 ports combined (mix of 16, 32, and 64-port switches)
- Virtual storage team of 10 individuals spending 10%–90% of their time on storage-related activities
- Absolutely no standards across verticals or support groups
- Estimated TCO for storage $0.30–$0.40 per MB
Early 2001: Challenges

- Direct-attached model was not scaling
  - Management burden—too many points of management
  - Poor utilization due to port constrictions
  - FC switches used as “dumb hubs” to create SAN islands
  - Rapid consumption of data center resources
- Immaturity of storage management tools led to inefficient business processes
  - Provisioning
  - Capacity planning
  - No cost visibility back to client base
- Poor storage utilization led to increased TCO
Implement a Network-Centric Storage Model and Offer Storage as a Utility-Like Service

Vision Enablers

People
Business Processes
Software
Hardware

Goal: Reduce Points of Management and Implement Storage as a Utility-Like Service to Improve Overall Storage Utilization and Reduce TCO
**Still Lacking Job Description for “Storage Administrator”**

- Dedicated team formed in early 2002—Enterprise Storage Systems (ESS)
  - 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
  - Eight full-time storage managers and three full-time project managers
- Global, virtual storage team formed in mid 2002
  - High-level vision, strategies, migration plans
  - Global communication and coordination
- Executive sponsorship in 2001 nonexistent; 2002 director-level sponsorship obtained

**Processes and Software**

- Storage Demand
- Utility-Like Storage Service
  - Service-Level Management
  - Appropriate Hardware Tiers
- Storage Recovery Program
  - Best Practices and Processes
  - Special Tools and Metrics
- Storage Management
- Storage Resource Management
  - Virtualization
  - Framework
  - Information Lifecycle Management
  - Data Integrity and Resiliency
  - Management and Consolidation
- Storage Supply
Storage Vision Enabler: Processes

- Harden processes for client storage requests
  - Update web-based storage request tool
  - Create tiered storage based on client SLAs
- Consolidate budgets across business verticals
  - Single budget for all enterprise storage
- Create SLA framework based on services provided by team:
  - Planning, design, consulting, and reporting
  - Data integrity and resiliency
  - Capacity and performance management
  - Information lifecycle management
  - Provisioning
  - Financial planning
  - Problem and incident management

Storage Vision Enabler: Software

- Storage Resource Management software (SRM) key enabler
- SRM software critical to establish baseline and metrics for application and hardware availability
- SRM required for inventory and capacity-planning purposes
- SRM and SAN management software critical for designing and measuring client SLAs
- Scalable software for provisioning, striping, mirroring, multipathing, replication
Storage Vision Enabler: Hardware

- Robust platform, enterprise-level scalability to one PB and beyond
- Multiple platforms needed to address tiered storage requirements (i.e. optical solutions for metro clustering, NAS, and ATA for lower tiers)
- Interoperability, standards aware
- Manageability key to success

Vision Inhibitors (2001)

- Financial
  SAN costs (economy and the initial investments)
- New technology
  SANs were in the “learning phase” for Cisco IT and the industry
- Company philosophy
  Concept of network-centric storage and organization required time to gain acceptance
- Immature storage management software
  SRM, SAN management, virtualization, capacity planning, etc.
- Immature SAN hardware
  Lack of SAN technology to support large, heterogeneous SANs (lack of scalability = complexity = higher costs)
Migration of DAS to SAN

- Most critical piece of storage management vision
- All other strategies depend on moving storage to storage networks
- Moving DAS storage and SAN islands into consolidated datacenter SANs is relatively easy to justify using very tangible metrics
- Cisco specific examples
  - DAS to SAN, SAN island to MDS consolidations
  - +52% ROI in FY '03
Consolidation as a Catalyst

• Enhance storage vision built on storage consolidation and storage recovery
• While consolidating, consolidate with a purpose—make sure the consolidation efforts fit in with your overall vision
• Cisco specific examples:
  Enterprise Frame Consolidation Phase 1
  +58% ROI in FY ’03
  +51% ROI in FY ’04
  Enterprise Frame Consolidation Phase 2
  Estimated > 50% ROI in FY ’05

Consolidate to Point of Diminishing Returns

Diminishing Returns of Consolidation

*Investment at Each Phase—$1,500,000
**Increase in Utilization and Other Efficiencies Decrease as Disk Density Increases
**Vision: 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 (currently $0.10 per Mb) drops by 20% per year
  - Goal: once utilization improved, it is held there

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Industry Average Allocation Efficiency</th>
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</thead>
<tbody>
<tr>
<td>DAS</td>
<td>30%–40%</td>
</tr>
<tr>
<td>SAN</td>
<td>50%–60%</td>
</tr>
</tbody>
</table>
Storage Recovery Program: Addressing Storage Demand

• SRP started as strategy to address demand-side issues of poor UTILIZATION EFFICIENCY
• SRP began in tandem with SAN migrations and relied upon MDS rollout as enabling technology (and ostensibly EMC storage scope)
• SRP application staff targeted application owners, users, and abusers of storage and worked closely with Enterprise storage staff to determine policies and procedures for reclaiming storage
• SRP and ESS together outlined the “chevron” system
• SRP reclaimed roughly $2.9 million in the first year

Storage Recovery Program: Chevrons

• Physical storage is the raw TB as shown on invoice
• Configured storage is configured LUNs
• Addressable storage—storage shown down multiple paths
• Logical volumes—(what the host sees)*
• Application allocation unit—raw volumes or file systems
• Used—consumed (what the application sees)**

*Allocation Efficiency
**Utilization Efficiency
Utilization and the Storage Lifecycle (2001)

Utilization Rate

- Physical Storage: 40%
- Configured Storage: ??%
- Addressable Storage: ??%
- Logical Volume: ??%
- Application Allocation Unit: 30%
- Used Storage: ??%

Cumulative Utilization

- Physical Storage: ??%
- Configured Storage: ??%
- Addressable Storage: ??%
- Logical Volume: ??%
- Application Allocation Unit: ??%
- Used Storage: 10%

Utilization and the Storage Lifecycle

Utilization Rate

- Physical Storage: *100%
- Configured Storage: 67%
- Addressable Storage: 72%
- Logical Volume: 88%
- Application Allocation Unit: 83%
- Used Storage: 59%

Cumulative Utilization

- Physical Storage: *100%
- Configured Storage: 67%
- Addressable Storage: 48%
- Logical Volume: 42%
- Application Allocation Unit: 35%
- Used Storage: 21%

*Current (as of May 12, 2004)
Storage Management Timeline

- Framework
- Virtualization
- Information Lifecycle Mgmt
- Service Level Management
- Storage Recovery Program
- Storage Resource Management
- Device Management
- Data Integrity and Resiliency

Years:
- 2001
- 2002
- 2003
- 2004
- 2005
Hardware Strategy: Consolidation

- Local DAS (Baydel, Sun T3, local disk) and NAS
  Phase 0 (pre 2001)
- Consolidated DAS (EMC Symmetrix, HP XP) and NAS
  *Some iSCSI
  Phase 1 (2001–2002)
- Consolidated DAS, small, FC SAN “islands” and NAS
  Phase 2 (2003–2004)
- Consolidated FC SANs (BUs per datacenter) and NAS
- Consolidated FC SANs (datacenter, campus) and NAS
- Consolidated FC SANs (FCIP on WAN) and NAS
  Phase 5 (2005+)
- All IP storage (NAS, FCIP, iSCSI SANs)

Consolidated SAN Migration Timeline

Cisco IP Network

Timeline

Phase 1: Originally Scheduled for One Year (2001)
Phase 2: Predicted to Take 12–18 Months; Start Delayed for 12 Months (2003–2004)
SAN Lessons Learned

• PROS
  Storage pools increase utilization potential
  Provisioning simpler and faster
  Consolidation = fewer management points
  Reliability equal to or greater than direct and network attached
  Added flexibility of fiber (distance)
  SAN TCO at least 12% less than DAS

• CONS
  Consolidation has been difficult, time consuming
  Initially higher TCO, especially during transition
  Increased workload and CAPEX—need to draw function out over time

• Analysis
  We proved to ourselves that our strategy and vision were sound

ERP SAN MIGRATION
Initial SAN Deployments: ERP LOB

- 14 SAN islands
- 33 Unix hosts
- 38 storage frames
- Over 350 terabytes

Cisco ERP/DW

Business Function

ERP 11i: Initial SAN Deployment

ERP Oracle 11i Development SAN Islands

- 11 External RAID Arrays (~ 90 Terabytes)
- 1 External RAID Array (~ 10 Terabytes)

**Separated Due to Different Host and Disk Platforms**
ERP 11i: Initial SAN Deployment (Stage 1): January 2003

ERP 11i Initial SAN Deployment (Stage 2): March 2003
ERP 11i: Initial SAN Deployment

- 640 port SAN
- 33 Unix hosts
- 5 VSANs
- 38 Storage frames
- Over 350 terabytes

Two Fabrics:
- 2 Cisco MDS 9509 SAN Switches on Each

DR Unix VSAN
DR Unix VSAN*
Backup VSAN
Development Unix VSAN
Development Unix VSAN*

*Separate VSANs per OS

Phase 3 SAN Consolidation

RTP Production DC

RTP Development DC

MDS 9509 RTP5-CORPSYSCA-SW1
MDS 9509 RTP5-IOPS-SW1
MDS 9509 RTP5-ERP-SW1
MDS 9509 RTP5-ERP-SW2
MDS 9509 RTP5-ERP-SW3
MDS 9509 RTP5-ERP-SW4

Fabric “A”

Fabric “B”

4 Port (8 Gb/s) Port Channel

4 Port (8 Gb/s) Port Channel

4 Port (8 Gb/s) Port Channel

MDS 9509 RTP7-ITSAN-SW1
MDS 9509 RTP7-ITSAN-SW2
MDS 9509 RTP7-ERP-SW3
MDS 9509 RTP7-ERP-SW4

Approximately 1.5K
16 Port (32 Gb/s) Port Channel

Single-Mode Fiber
### Phase 3: Fabric Manager Screenshot

![Fabric Manager Screenshot](image)

### Total MDS Ports Deployed

<table>
<thead>
<tr>
<th></th>
<th>RTP</th>
<th>San Jose</th>
<th>London</th>
<th>Hong Kong</th>
<th>Sydney</th>
<th>EMEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS 9509</td>
<td>1440</td>
<td>2880</td>
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<td>160</td>
<td>160</td>
<td>320</td>
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<tr>
<td>MDS 9216</td>
<td>16</td>
<td>16</td>
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<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MDS 9506</td>
<td>48</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>MDS 9120</td>
<td>–</td>
<td>440</td>
<td>80</td>
<td>–</td>
<td>–</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1456</td>
<td>3336</td>
<td>80</td>
<td>160</td>
<td>160</td>
<td>400</td>
</tr>
</tbody>
</table>

Total Number of Ports Deployed—5,640
Upcoming Initiatives

• Rollout of IPS (iSCSI and FCIP)—SAN Migration
• Further consolidation until break-even point is reached—SAN Consolidation
• Further migration of DAS to SAN (either FC or IP)—SAN Migration
• Metro HA clustering project to utilize CWDM or DWDM (Q1 FY ’05)—Replication and Tiered Services
• Pilot programs for virtualization (Veritas and IBM SVC)—Replication and Tiered Services

Recommended Reading

• Cisco Storage Networking Architectures Poster [158720102X]

Available on-site at the Cisco Company Store
Online References

- Business Ready Data Center
  http://www.cisco.com/go/datacenter
- Cisco Storage Networking Solutions
  http://business.cisco.com (click “Storage”)
- Search Storage http://www.searchstorage.com
- Byte and Switch http://www.byteandswitch.com
- Storage Networking World Online
  http://www.snwonline.com
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**WHAT:** Complete an online session evaluation and your name will be entered into a daily drawing

**WHY:** Win fabulous prizes! Give us your feedback!

**WHERE:** Go to the Internet stations located throughout the Convention Center

**HOW:** Winners will be posted on the onsite Networkers Website; four winners per day