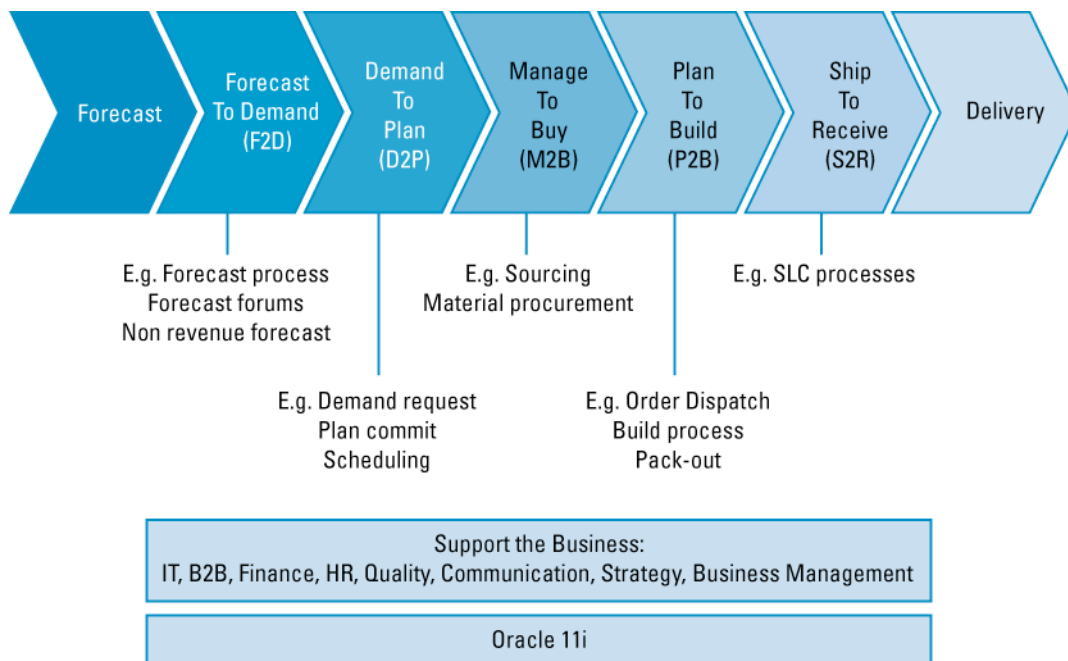


BUSINESS-PROCESS VELOCITY WITH ORACLE 11i IMPLEMENTATION POWERED BY CISCO MDS 9000 FAMILY-BASED INFRASTRUCTURE

Cisco Systems® IT has been shifting to an end-to-end business-process focus to increase visibility to critical information, enhance customer satisfaction, increase employee productivity, and lower costs. This has led to the deployment of a Cisco® Services Oriented Architecture (SOA) where cross-functional collaboration is critical to achieving this goal. In addition, a business-process reengineering effort has been required to attain a cross-functional visibility, with a focus on the following individual processes:

- **Issue to Resolve (I2R)**—this business flow consists of the service processes that involve capturing and resolving cases, developing solutions for customer issues, including managing and distributing replacements as well as spares. It focuses on reducing the time between issue detection and problem resolution, leading to higher customer satisfaction and greater insight into future requirements.
- **Market to Sell (M2S)**—this process flow tracks all activities that occur between identifying a market and closing the deal, including lead generation, identification of sales opportunity, and account relationship.
- **Idea to Offer (I2O)**—this process consists of all activities that occur from identifying and committing an idea to end of life of the offered product. Some activities include designing, validating, monitoring to improve, and determining the end of life of the product.
- **Quote to Cash (Q2C)**—this business flow deals with processes and systems involved from initiation of a quote to collecting cash for orders for the Cisco implementation with the Oracle 11i. The Q2C program is organized by four “tracks,” which cover all processes between opportunity and quote creation to cash collection. The tracks include accounts receivables, order management, pricing and discounting, and quoting and ordering.
- **Forecast to Delivery (F2D)**—this process deals with all activities in sourcing raw materials to delivery of finished products, including inventory and product change management.

Figure 1. F2D Business Process






Figure 1 illustrates the F2D business process and all its subprocesses. Thus, an end-to-end business-process flow requires a transparent flow of information from start to finish. Because various subprocesses are interconnected, there must be complete transparency of data within each business process. This demands a single data model where information is easier to disseminate, track, and maintain. The global nature of each business process further mandates high availability and continuous access that can be delivered through technologies such as clustering and data mirroring. Business processes thus require an underlying application and network architecture that addresses the following:

- Lower total cost of ownership
- Scalability
- Faster access to geographically distributed information
- Reduced administration costs with a simple infrastructure
- Continuous availability
- Open architecture—standards compliance
- Service levels based on applications
- Ability to deploy new applications quickly while interoperating with existing applications

Because of its ability to address these primary business concerns and help create a global application and IT infrastructure, Oracle 11i was used as the application architecture powered by the Cisco MDS 9000 Family-based storage-area-network (SAN) infrastructure. During the implementation phases of Oracle 11i and the supporting infrastructure, Cisco IT faced numerous challenges. The following sections discuss some essential activities as well as the major challenges involved in this migration.

MAJOR ACTIVITIES

To meet the business objectives of process reengineering, Cisco IT had to make application as well as infrastructure changes. Some major activities included:

- Upgrade of Oracle10.7 to Oracle 11i applications
- Database consolidation and migration to create a single global source of information
- Implementation of new Oracle 11i modules to deliver new business functions
- Consolidation and replacement of custom tools with Oracle 11i modules

TECHNICAL CHALLENGES AND SOLUTIONS

During the upgrade and implementation process, Cisco IT faced significant challenges, which are discussed in the following sections.

Storage Scalability

During migration, Cisco IT had to deploy multiple releases of Oracle 11i concurrently. This put significant strain on the infrastructure as the storage demand grew from 50 to 300 TB to support the test and development requirements of these releases. The underlying SAN infrastructure also had to be scalable in order to sustain this growth in storage. During the upgrade process, the size of Oracle 11i databases for enterprise-resource-planning (ERP) applications grew substantially, primarily because multiple copies of production databases had to be maintained for practice upgrades.

Because these databases as well as development and test cycles of complex Oracle 11i projects required a continuous and fast access to storage, it became increasingly important for both storage and network infrastructures to accommodate growth easily and quickly.

Various tasks such as database consolidation, data migration, and implementation of additional modules for new business functions significantly increased workload and capacity requirements of Oracle 11i applications. This led to an increase in network traffic for access to storage from these applications.

Storage Management and Provisioning

Growth in storage also reflected directly on the storage administration requirements as the operational workload continued to rise. During concurrent testing cycles, the Oracle 11i staging environment required frequent reconfigurations at short notice. Thus, the storage network infrastructure needed to be less complex and easier to manage, and it needed to deliver highly available access. A large complex cross-functional project such as the Cisco Oracle 11i program can always create some unplanned immediate storage demand. Hence, the SAN architecture needed to have the flexibility to deliver dynamic provisioning and scalability to address unexpected growth in storage and network traffic.

Features such as virtual SAN (VSAN) provide the capability for on-demand provisioning of infrastructure and storage resources. Cost of ownership is reduced by sharing a pool of ports that can be allocated to any VSAN as needed, thereby allowing any application to grow without a need for rewiring. This increases application uptime because human errors are minimized while changes are made dynamically.

High Availability and Business Continuity

Consolidation of databases and increased business functions provided by a single database and Oracle 11i upgrade increased the need for a highly available storage architecture. Redundancy was required at multiple levels to achieve the desired levels of availability. Servers were dually homed into a redundant switch infrastructure, PortChannels were used between switches to eliminate a single point of failure, and Oracle 9iRAC was used for database tiers to enhance end-to-end application uptime.

The requirement to access major Oracle 11i applications 24 hours a day around the globe resulted in reduced or zero planned or unplanned maintenance windows—offline backup is not a viable option for critical data. In addition, continuous availability of Oracle 11i applications is mandatory—regardless of the type of outages—including servers, network, storage, and even entire data centers. Thus a reliable campus and WAN business-continuity solution was implemented to overcome the threat of downtime.

Cisco IT implemented synchronous replication between two buildings on the main campus using the Cisco MDS 9000 Family-based coarse wavelength-division multiplexing (CWDM) solution. The two data centers were load sharing for different applications, with built-in capacity for failover. The Fibre Channel-over-IP (FCIP) feature integrated in the Cisco MDS 9000 Family was used for asynchronous replication between San Jose, California, and RTP in Raleigh, North Carolina. This eliminated the impact on live data for the purposes of backup and business continuity. Cisco IT plans to use the Cisco MDS 9000 Family-based features such as hardware-based encryption and compression to optimize the use of WAN bandwidth and reduce total cost of ownership (TCO). In addition, integrated inter-VSAN routing feature can be utilized to enable separate fabrics across a wide area link thereby limiting fault domains for a faster recovery from failures.

Security

A large physically connected SAN for the entire Cisco IT department has simplified management and increased utilization of their storage pool. The Cisco Oracle 11i environment required isolation to be maintained among various applications for security purposes.

VSANs are used to create multiple segregated domains for Oracle 11i and other applications. Tiered security implementation, including role-based access control (RBAC) per VSAN, device fabric login access control, and long-distance data-transportation security, achieves multilevel protection.

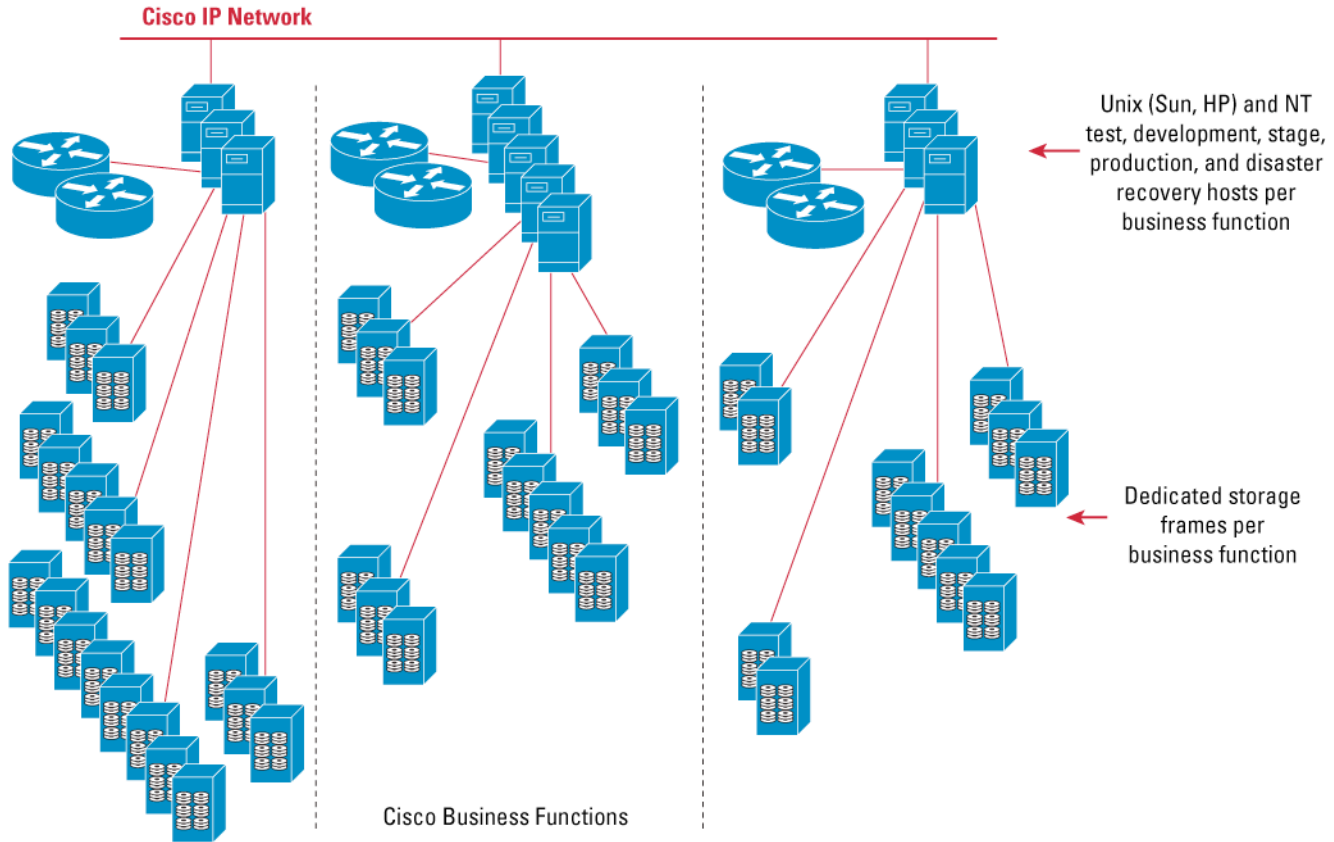
CISCO IT: SAN EVOLUTION USING CISCO MDS 9000 FAMILY PRODUCTS

Cisco IT solved the major challenges, including storage management and scalability, in multiple phases in order to maintain control over its application environment. In phase 1 of the deployment of this business-process architecture, direct attached storage (DAS) was migrated to individual SANs per business function, where the end goal was to consolidate them in a single Global SAN. The Oracle 11i portion of the ERP deployment was the first component to be migrated to the new Cisco MDS 9000 Family-based architecture.

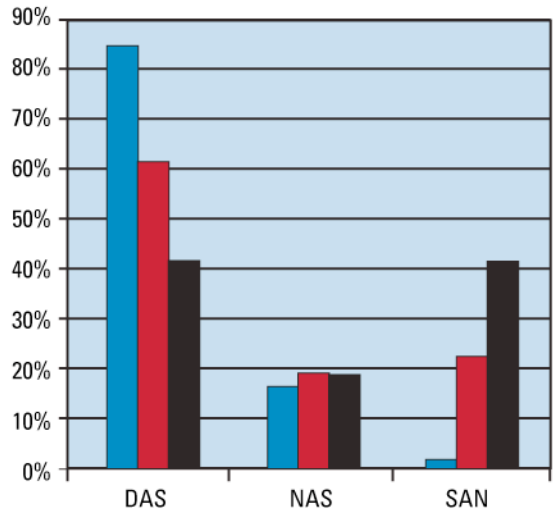
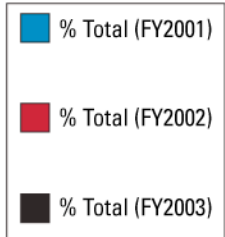
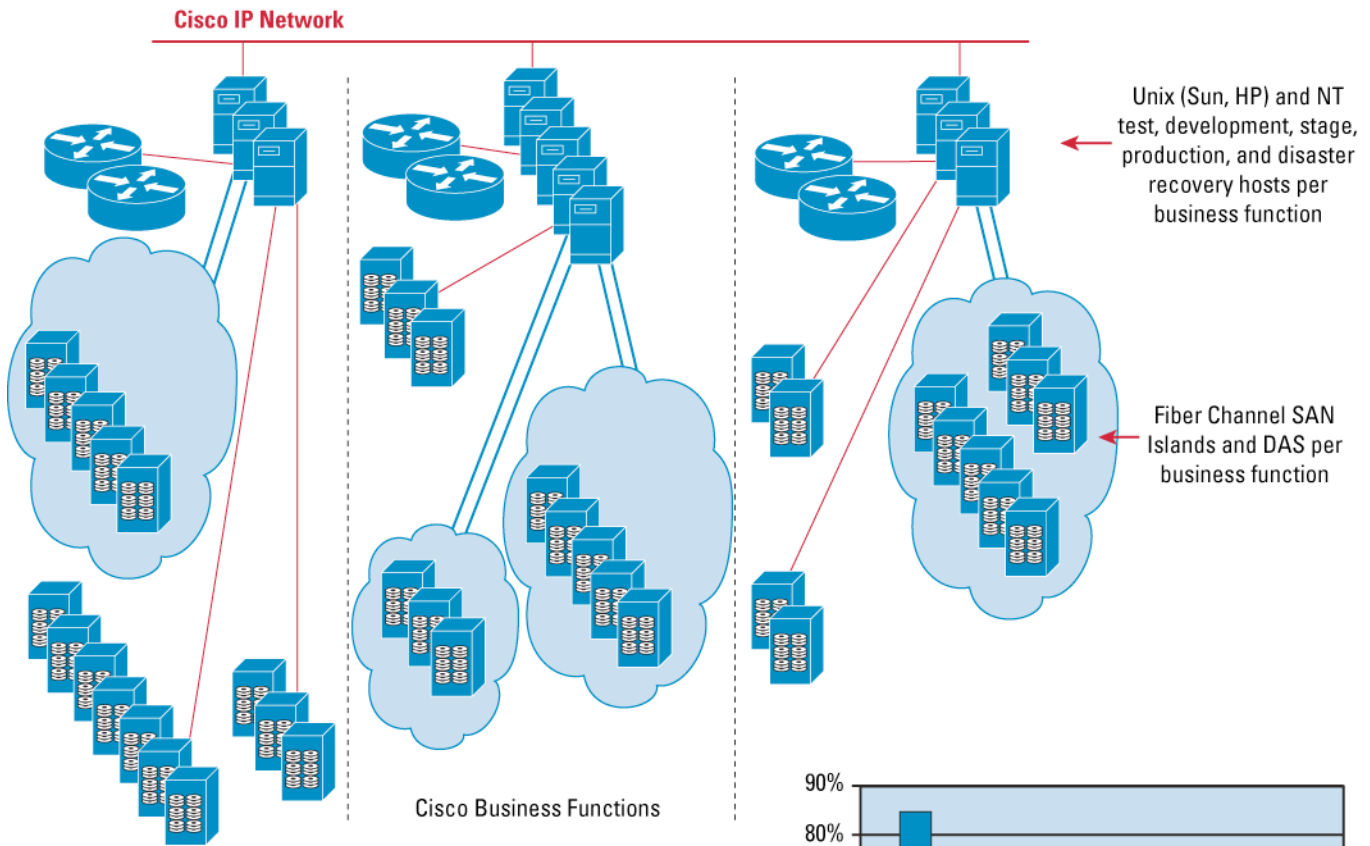
The next step of the migration was to create a single SAN per data center, requiring as many as 400 ports to support the ERP business function. Original deployment of applications used individual SAN islands, as depicted in Figure 2.

Figure 2. SAN Evolution at Cisco IT

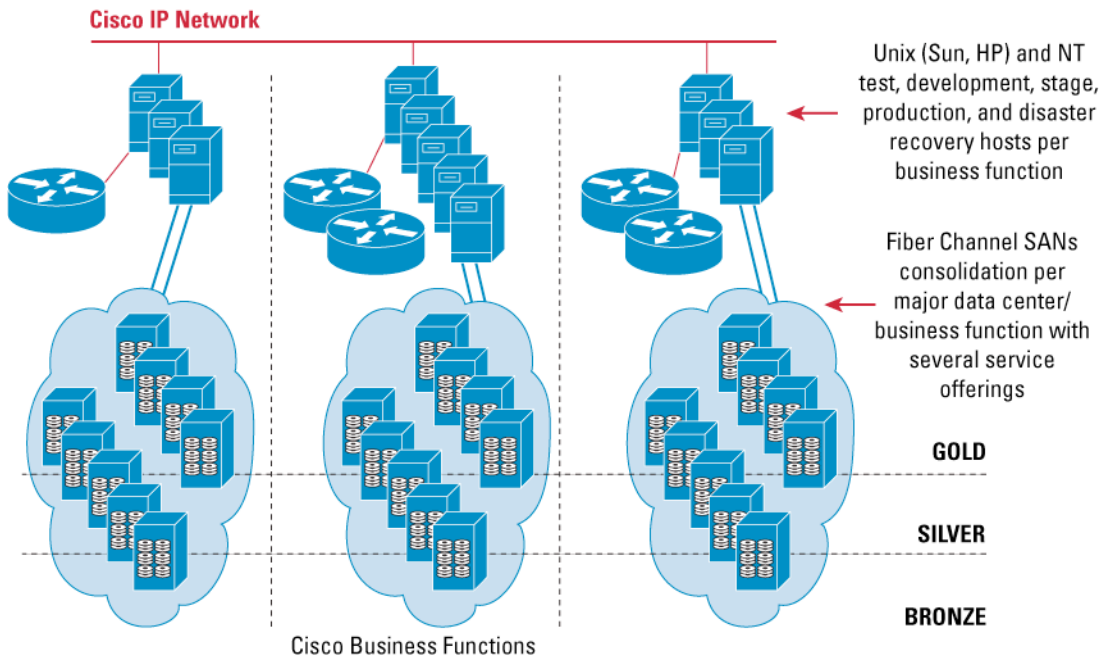
Phase 1: Cisco Storage Architecture in mid- to late-1990s



Phase 2: Cisco Storage Architecture after migration to individual SANs per business function

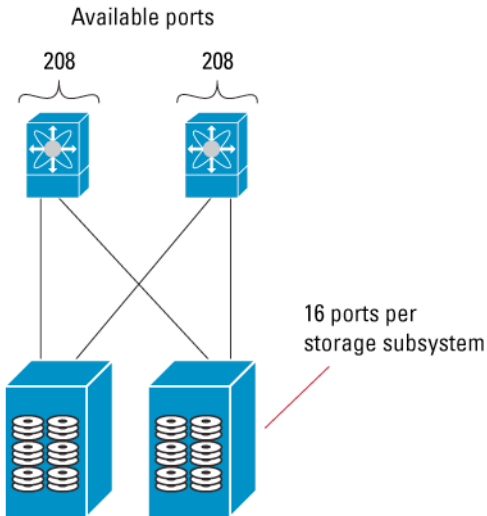


Phase 3: Service-enabled infrastructure



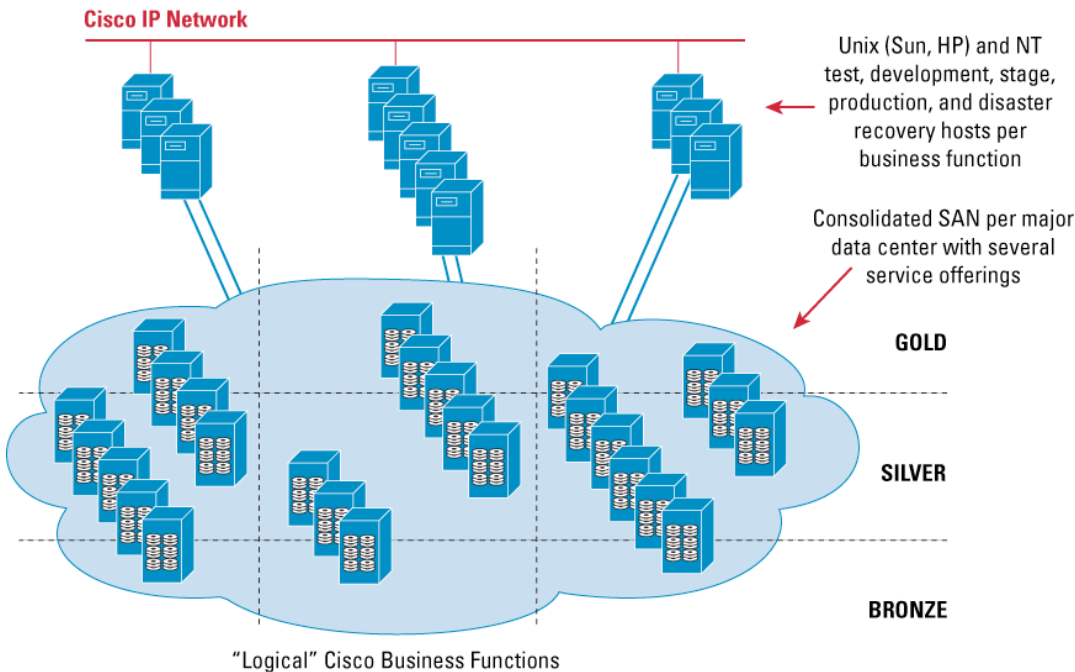
This environment was difficult to manage and scale because it was quite complex, consisting of traditional 16- or 32-port switches interconnected with a large number of Inter-Switch Links (ISLs) as shown in Figure 3. ISLs are used to create a high-speed interconnection between switches. Migrating to an architecture where a global database would be created necessitated a new, consolidated SAN infrastructure with a path toward a single SAN per region, and eventually a global SAN (see Figure 4). This infrastructure would enable Cisco IT to service applications in multiple time zones, eliminate multiple copies of data as well as backup policies, and allow for a global business-continuity strategy to be put in place. A global database makes it even more important to ensure that effective management and disaster-recovery plans are implemented. A single SAN per data center (regional or Global SAN) delivers central access to information and provides the capability to deliver multiple service levels to customers around the globe. With a consolidated data-center infrastructure, resources can be much more easily shared and effective policies can be implemented to differentiate among various services (see Figure 5). This can be achieved only with an enabling intelligent network infrastructure.

Figure 3. New SAN Deployment utilizing two Cisco MDS 9509 Multilayer Director Switches



Cisco IT was able to meet these objectives with Cisco MDS 9000 Family-based switches that support high port density, PortChannel protocol, high availability, as well as innovation in terms of VSAN technology. High port density makes deployment and management of SANs simpler because it delivers scalability and density while eliminating the need for ISLs. When needed, an ISL could use a PortChannel that provides a mechanism to aggregate up to 16 links to form one ISL. Although it provides a load-balancing, scalable network interconnection, it also increases the availability of the ISL because outage in one or more links within the PortChannel group is transparent to the environment. New technology pioneered by Cisco, VSANs deliver the ability to create multiple, segregated VSAN environments over a single physical infrastructure. This reduces the number of switches that are deployed and managed in a live network and significantly lowers the cost of management. VSANs coupled with features such as quality of service (QoS) and RBAC help enable the delivery of multiple service levels based on application requirements of different departments.

Figure 4. Infrastructure Enabled with Cisco SOA



A shared SAN infrastructure maximized the use of storage because it allowed access to storage capacity across multiple applications on an as-needed basis—a capability that could not be delivered with DAS or SAN islands. One of the challenges Cisco IT faced was reducing the time to deploy and provision new applications as well as adding capacity on an as-needed basis, especially during the migration phase. Another important consideration included maintaining uptime and ensuring no interruption to application traffic while these applications were being tested and migrated. Features such as VSANs enabled this because new ports and SANs could be provisioned for existing or new applications while maintaining the same security levels. Changes could be implemented dynamically and segregation could be maintained among multiple applications while reducing the total cost of infrastructure using economies of scale.

The new architecture for the infrastructure enabling ERP applications is depicted in Figures 7, where multiple switches (Figure 6) have been consolidated into fewer switches for a simpler, manageable design using the high-port-density switches from the Cisco MDS 9000 Family.

Figure 5. Original SAN Configuration Utilizing Multiple SAN Switches

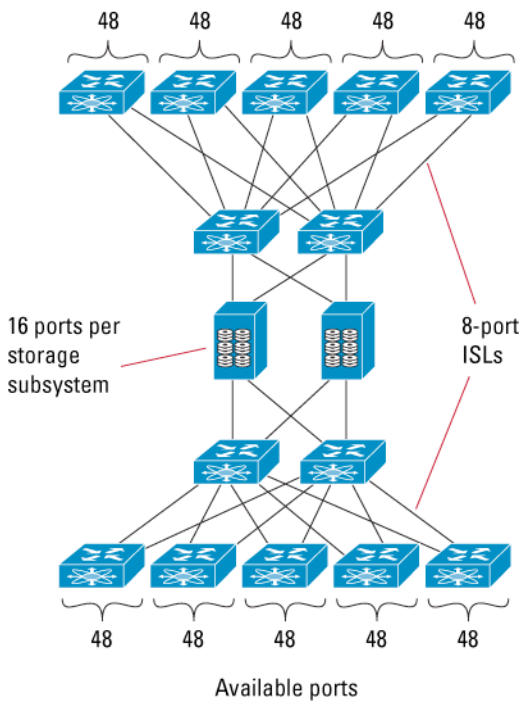


Figure 6. Oracle 11i with 16- and 32-port Traditional Switches

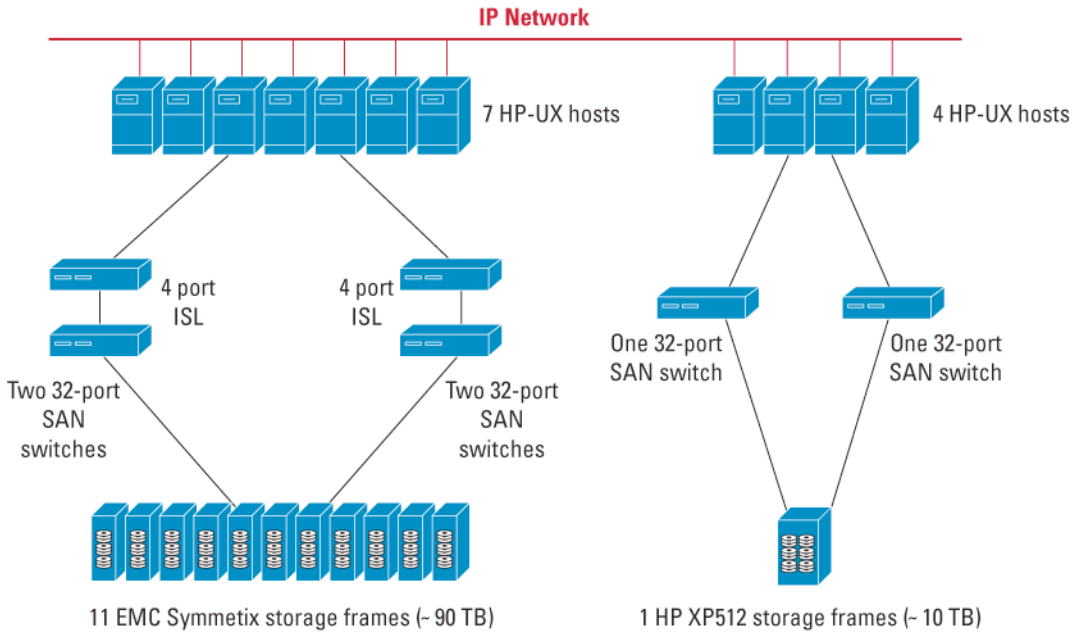
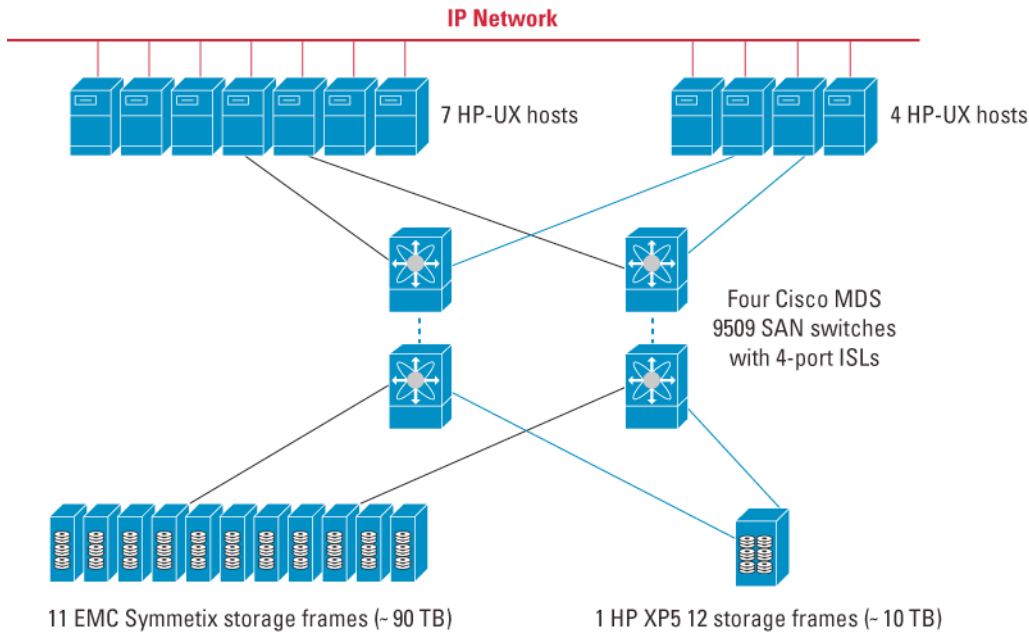


Figure 7. Oracle 11i Deployment with Cisco MDS 9000 Family



With this migration, the Cisco Oracle 11i environment is better positioned for growth, scalability, and availability. Enabled by Cisco MDS 9000 Family switches, the storage-pool concept offers multiple levels of service for various applications.

INFRASTRUCTURE SOLUTIONS DELIVER HIGH AVAILABILITY, SCALABILITY, AND HIGH PERFORMANCE FOR ORACLE 11i DEPLOYMENTS

In a typical Oracle 11i deployment, a 3-tier front end-to-middleware-to-back end computing model is used to support applications such as ERP, customer relationship management (CRM), and data warehousing. Oracle applications consisting of a thin client or Java applet, Oracle application server, and Oracle database server are the three main software platforms in this advanced client-server environment. In the back end, the Oracle database server, Oracle 9iRAC, is the primary component, helping enable a high-performance end-to-end solution. Because of its importance and criticality, a typical Oracle 11i deployment for ERP, CRM applications requires a highly scalable, highly available, and flexible SAN infrastructure in order to read, write, copy, back up, and recover application data from a storage device.

Large-scale computing environments, such as online transaction processing (OLTP), batch processing, online analytical processing (OLAP), and data mining, demand consistent data I/O latency, optimal bandwidth, large storage capacity and growth, as well as dynamic and flexible I/O connectivity. All OLTP applications require a quick and consistent I/O response at both normal and peak times, whereas batch-processing and data-warehousing applications require sustainable high throughput.

For Cisco IT today, the total size of all ERP and CRM databases, including Development, Stage, Test cycles, and performance databases, is about 300 TB—and it continues to grow at an exponential rate. In addition, applications such as data warehousing, OLAP, upgrade, migration, and data protection all demand high storage capacity and dynamic I/O connectivity between database servers and storage. Before the Oracle 11i project, high availability, application segregation, and security purposes had led Cisco IT to build many completely physically isolated SANs or groups of switches for a connection among hosts and storage devices.

With these requirements in mind, Cisco IT chose the Cisco MDS 9000 as the infrastructure of choice because it helps enable intelligent features that help Cisco IT meet these goals as discussed in previous sections.

Data protection is always important in any Oracle 11i application environment. Local and remote data mirroring, data replication combined with Oracle cluster architecture, as well as the Oracle database data replication are generally deployed to ensure no data loss and business continuity. Cisco IT designed a campus wide Cisco Metro Cluster architecture, in which cluster servers and storage subsystems are located at different locations across the Cisco campus connected with CWDM. Databases are replicated synchronously between storage devices while all Oracle 11i modules are running. Two live data centers run in a load-sharing manner between two buildings using two Cisco MDS 9000 Family switches for the integrated CWDM connection. This ensures the availability of applications even during a complete data-center outage.

For remote data replication, fast database backup and recovery on a consistent basis are a routine operation. Asynchronous replication over a Cisco MDS 9000 Family-based FCIP connection across a WAN link copies data asynchronously to protect committed transactions and data integrity at the remote site (RTP). The FCIP write acceleration (WA) feature further shortens I/O latency and increases the fast data recoverability. Hardware and software compression use the standard algorithm and most efficient implementation to potentially provide 1.5 to 2 times the throughput of the actual WAN bandwidth.

Cisco IT currently uses FCIP for asynchronous data replication between San Jose and Raleigh. Future plans include using features such as FCIP write and tape acceleration (TA) to further enhance remote backup and recovery performance.

SUMMARY: CISCO MDS ADVANTAGE

The Cisco MDS 9500 Series is equipped with 1.4 Tbps of raw switching performance implemented in a high-availability configuration using two 720-Gbps redundant fabrics functioning in an active-active load-sharing arrangement. Each switching module in the Cisco MDS 9500 Series directors uses virtual output queuing (VOQ) to maintain low latency, consistent performance, and throughput. Furthermore, the Cisco MDS 9500 Series switch supports up to 255 business-to-business (B2B) credits per port, thereby providing extension capabilities at full line rate up to 500 km on a point-to-point 1-Gb Fibre Channel connection and up to 250 km for 2-Gb Fibre Channel.

The Cisco MDS 9000 Family platform architecture delivers multiple standard protocols such as VSAN, Fibre Channel Protocol (FCP), Fibre Channel over IP (FCIP), and Small Computer System Interface over IP (iSCSI), including myriad leading-edge hardware and software features such as, compression and IP Security (IPSec) on FCIP and iSCSI for performance and security, as well as tape acceleration on FCIP to reduce the latency effect of remote backup and write acceleration (WA) on both FC and FCIP for high performance data replication.

Intelligent features enabled by Cisco MDS 9000 Family switches make the Cisco IT Oracle 11i environment easy to deploy, upgrade, manage, and scale.

Table 1. Benefits to Feature Mapping

Benefit	Contributing Cisco MDS 9000 Family Features
Reduced Time to Provisioning	VSANs and fabric and device manager
Capacity Utilization	VSAN, VOQ
Lower Time to Implement	VSAN, fabric manager, and fabric manager server (FMS)
High Availability	VSAN, redundancy, PortChannel, and Fabric Shortest Path First (FSPF)
Resilience	PortChannel and FSPF
Security	Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP), IPSec, RBAC, port security, VSAN, and access control lists (ACLs)
Scalability	VSAN
Investment Protection	VSAN, iSCSI, and FCIP
Business Continuance	FCIP
Standards Compliance	FC, Management, Security, Logical Fabrics (VSAN), Zoning, TCP/IP
Ease of Manageability	Fabric manager or device manager and RBAC

Table 1 lists all the features currently used by Cisco IT; it does not list all the intelligent features enabled by the Cisco MDS 9000 Family. Cisco IT plans to continue to use additional features as more and more applications can use the embedded intelligence of the platform. Thus, this product line offers maximum investment protection and future proofing as Cisco IT prepares for growth. Additional intelligent features that are already integrated in Cisco MDS 9000 Family and available for further enhancement in the Oracle 11i environment are shown in Table 2.

Table 2. Additional Benefits to Feature Mapping

Benefit	Additional Contributing Cisco MDS 9000 Family Features
Reduced Time to Provisioning	Cisco Fabric Services (CFS)
Capacity Utilization	Qos, FC Write Acceleration
High Availability	PortChannel Protocol (PCP)
Resilience	Inter-VSAN Routing (IVR)
Security	Hardware-assisted Compression and Encryption (IPsec)
FC Over Optical DR Capability	Up to 3500 B_B Credits per port
Business Continuance	WA, TA, compression, FC-WA and inter-VSAN routing (IVR)

Benefit	Additional Contributing Cisco MDS 9000 Family Features
Ease of Manageability	Command Scheduler, Device Aliases, Performance Monitor, Port Track, SAN Extension Tuner, iSNS
Third-Party Application Integration	SAN-Tap, X-Copy

More information on Cisco 9000 Family intelligent features can be obtained at www.cisco.com.

Business-process reengineering and migration of ERP with Oracle 11i to a Cisco MDS-based SAN infrastructure led to numerous important benefits for Cisco IT. With backup windows disappearing, Cisco IT was able to attain a highly available architecture where the backup traffic could coexist on the SAN without causing an impact to existing applications. The new architecture provided the intelligent infrastructure that was instrumental in achieving a services-oriented architecture for Cisco ERP applications.



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