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Compaq Computer Corporation

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The Power of Compaq ENSA: Enabling *NonStop™* eBusiness

Abstract:

The Internet-enabled enterprise encompasses mission-critical environments that demand the highest levels of availability, reliability, performance, and scalability. Applications that run in these environments — *NonStop™* eBusiness applications — must be continuously available to the enterprise without interruption.

The Compaq Enterprise Network Storage Architecture (*Compaq ENSA*) satisfies these requirements with distributed pools of highly available, flexible, and centrally managed storage. Compaq's Storage Area Network (SAN) and other technologies provide a powerful, flexible framework for deploying and managing enterprise-wide storage resources. The customer can manage and access storage, modify storage configurations easily, and allocate storage dynamically and automatically to distributed, heterogeneous application servers as needed. Compaq ENSA offers a broad range of data protection methods that drastically reduce the time it takes to protect data from loss. These methods also simplify and speed up backup and restore of critical data.

Compaq ENSA offers unprecedented levels of investment protection by providing clearly defined, evolutionary upgrade paths to future technologies, across a number of popular operating system platforms. This white paper describes the ENSA-based storage solutions that Compaq is delivering for *NonStop™* eBusiness.

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Executive Summary

By 2000, organizations will have more than 2,600 petabytes of primary storage capacity, an increase of more than 60% over 1999. Besides absorbing this massive amount of storage capacity, businesses must ensure that the stored information is readily available whenever it is needed. The Internet and Web-based eCommerce—both consumer and business-to-business—have ushered in an era of continuous, non-stop business, in which systems must run, and data must be available 24 hours a day, 365 days a year.

Compaq *NonStop*TM eBusiness is a strategy that delivers the levels of service, availability, and responsiveness required by applications. It features solutions, services, products and technologies that enable customers to compete effectively in a global marketplace. Compaq's eBusiness strategy addresses IDC's observation that "mission-critical needs do not apply solely to e-commerce, but to the larger e-business phenomenon that emerged this year [1999]."

Compaq ENSA plays a significant role in supporting Compaq's *NonStop*TM eBusiness strategy by providing the storage solutions needed for highly availability business applications. Key *NonStop*TM eBusiness requirements met by Compaq ENSA include business continuance, manageability, flexibility, scalability, and disaster tolerance.

Compaq ENSA supports business continuance with capabilities that provide prompt, reliable, and uninterrupted access to data, even at distances that can span sites. For example, the StorageWorks Virtual Replicator can create instant copies of production data. These copies eliminate costly application downtime by reducing the time it takes to protect and recover valuable data. Backup and application testing occur with minimal or no impact on users and applications.

If a component fails, storage systems must continue to deliver required data to applications without disruption or data loss. Today, Compaq StorageWorks provides complete fault tolerance across a broad line of storage systems.

Storage systems must enable business-critical applications to keep operating, even when an entire site fails. To solve this problem, Compaq ENSA now delivers host-less data replication across Fibre Channel SANs. The StorageWorks Data Replication Manager enables remote mirroring over long distances, which provides protection from site disasters. This capability can be integrated within a corporate Disaster Recovery plan.

Compaq StorageWorks has long been involved in mission-critical enterprise environments. Compaq ENSA extends this tradition by building on a foundation of hardware, software, and other technologies that can be connected to application platforms directly or through storage area networks (Figure 1).

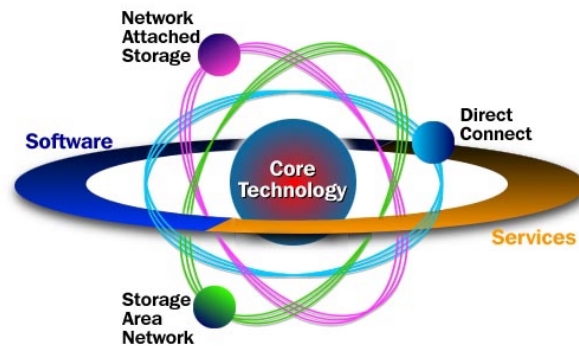


Figure 1. The Compaq Enterprise Network Storage Architecture provides a highly flexible environment for data storage capacity and management.

Through ENSA, Compaq leverages industry standards to allow deployment of storage where applications need it, and provides the strength of centralized storage management to reduce overall management costs. Today, Compaq provides an extremely flexible, open architecture and supporting products that satisfy the most demanding applications on UNIX, OpenVMS, Windows NT, and other platforms.

Compaq StorageWorks has already delivered many *NonStop*[™] eBusiness-enabling solutions, and is now delivering the next round of capabilities in the areas of Business Continuance, Data Protection, Flexibility, and Simplified Management. By extending its breadth of technology and the functionality of its solutions, Compaq maintains its lead with the best solutions for *NonStop*[™] eBusiness, thereby demonstrating that Compaq ENSA is the present and future storage approach of choice.

Introduction

Some of today's business-critical applications, such as electronic mail, started out as non-critical. But since usage has grown by leaps and bounds, these applications now demand more robust, data-center-like capabilities. Deployment of such applications drives the need for continuous availability on the platform. Today's nonstop computing requires high availability, high reliability, high performance, scalability, and simplified storage management. Compaq StorageWorks carries out Compaq's commitment to deliver solutions that meet these needs today. The power of these solutions is ever increasing, with more, richer capabilities over a broader range of supported platforms.

Storage Requirements for Nonstop Computing

Nonstop computing platforms make a number of demands on the storage systems that service them. These requirements include:

- Highest reliability and availability to ensure business continuance under all conditions. Storage systems need to protect against all failures, including storage system components (disks, subsystem controllers, cache, and host bus adapters).
- Quick, easy recovery of data when required, and reduced disruption from data protection activities like backup.
- Scalability of performance and capacity to satisfy application demands. Storage environments must accommodate the insatiable demands of applications and users—quickly and easily.
- Flexibility to add capacity, connectivity, and performance to enable easy, low-cost growth as business needs dictate. Storage capacity and performance must facilitate quick, non-disruptive growth that protects the organization's previous systems and storage investments. Storage systems must also accommodate changes in application deployment across multiple platforms.
- Simplified management to minimize staffing and other challenges as business growth occurs. Storage systems need tools that allow the Information Systems staff to manage an ever-expanding environment without corresponding increases in staff size and expertise.
- Secure access to storage, for all data from any location, balanced with the need to access data readily.
- Cross-platform capability to service *NonStop*TM eBusiness deployments across the enterprise, on platforms that include multi-vendor UNIX, Windows NT, and OpenVMS. The ability to deploy common storage systems across heterogeneous server platforms can simplify management challenges significantly, while lowering the overall cost of storage.

Compaq ENSA meets these needs, while allowing businesses to leverage today's rapid technology changes. Compaq StorageWorks provides a low cost of entry to these emerging technologies, and offers very high investment protection as more complex SAN storage solutions evolve.

The Compaq Enterprise Network Storage Architecture and Nonstop Computing

The Compaq Enterprise Network Storage Architecture provides a framework for delivering highly available, scalable, flexible storage through the use of simplified management, virtualization, dynamic scalability, and data replication. A detailed description of the Enterprise Network Storage Architecture can be found in the white paper entitled "" which is available on the Internet at http://www.compaq.com/products/storageworks/menu_vision.html.

During the past 15 months, Compaq ENSA has evolved through the delivery of a long list of StorageWorks capabilities. Today, these capabilities form the basis of a family of products that contributes to the success of *NonStop*TM eBusiness applications. The products that implement them are described in the next section. The following features and technologies are shipping today for a number of operating system platforms.

- Securely allocates and provides storage to different hosts through Selective Storage Presentation.
- Host-less Data Replication to remote sites for protection from disasters.

- Highest availability through extensions of redundant hardware that result in no single point-of-failure.
- Higher backup performance through SAN-based backup and restore, host-less replication, and host-based enablers.
- Quick recovery from data outages using snapshot and other data replication technologies.
- Solutions that scale easily from gigabytes to petabytes within a single, unified architecture.
- High performance and capacity for direct-connected storage through homogeneous SANs that use cost-effective Fibre Channel loops.
- Highly scalable, flexible storage deployment using switched Fibre Channel SANs that can span sites.
- Extended use of fast, highly available Ultra SCSI technology for dedicated server applications.
- Centralized management from a single command console that allows storage management to reside wherever it is convenient for the business.

Figure 2 illustrates the overall ENSA vision that provides the context for the technologies and products offered by Compaq StorageWorks. The next section provides more detail on how today's Compaq StorageWorks products are now delivering the vision.

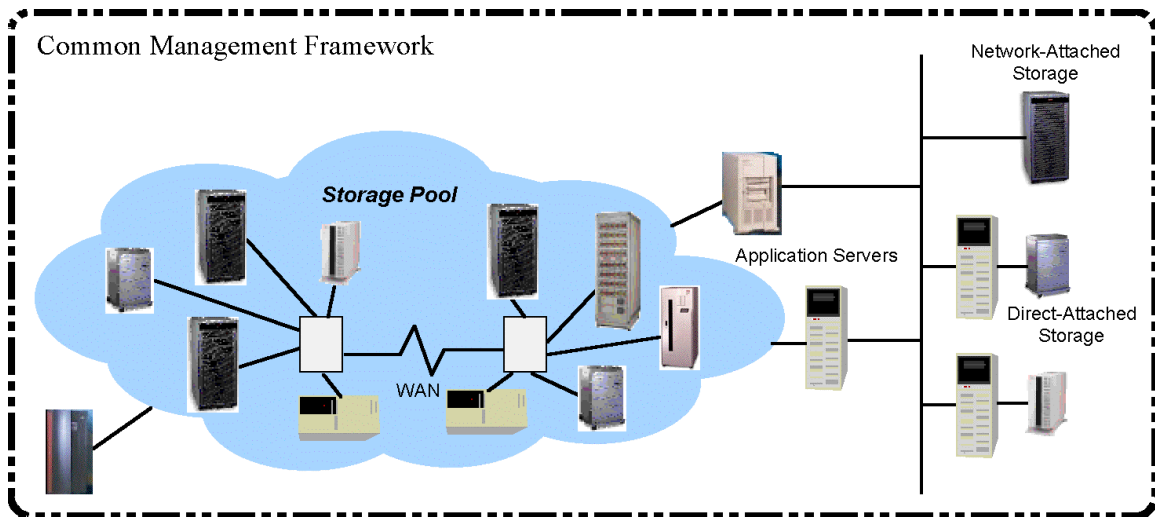


Figure 2. Compaq ENSA vision: a highly flexible environment

NonStop™ eBusiness Solutions from Compaq StorageWorks

StorageWorks Solutions for NonStop™ eBusiness Today

The capabilities described in the previous section are the basis for solutions to nonstop eBusiness requirements. Figure 3 summarizes key Compaq ENSA capabilities and the NonStop™ eBusiness requirements they address. The rest of this section discusses these capabilities in more detail.

NonStop eBusiness Requirement	Today's ENSA Solution
24 x 7 Availability	StorageWorks Data Replication Manager StorageWorks SecurePath StorageWorks Virtual Replicator
Disaster Tolerance and Recovery	StorageWorks Data Replication Manager Storage Area Networks (SANs)
Rapid Backup and Restore	StorageWorks Virtual Replicator StorageWorks Data Replication Manager
Centralized and Simple Administration	StorageWorks Command Console StorageWorks Virtual Replicator
Performance	RA 8000 ESA 12000 SANs
Scalability	SANs
Flexibility	ENSA

Figure 3. Today's StorageWorks capabilities for NonStop™ eBusiness computing needs

Solutions: Integrating ENSA Capabilities

Compaq ENSA synthesizes many technologies from Compaq and its partners to provide total solutions for data storage and management. Figure 4 is a conceptual overall view of how today's ENSA capabilities can be deployed to solve data storage and management problems *today*—and form a foundation for evolution into the future.

Compaq ENSA enhances overall storage system functionality by developing and refining storage topologies through Fibre Channel-connected storage, using Storage Area Networks and direct storage-to-host connections. Compaq StorageWorks creates a storage environment that requires fewer overall management resources than traditional environments and addresses availability, reliability and performance issues.

Today, Compaq ENSA is delivering solutions that provide broad support across a number of operating systems and can encompass large numbers of application servers.

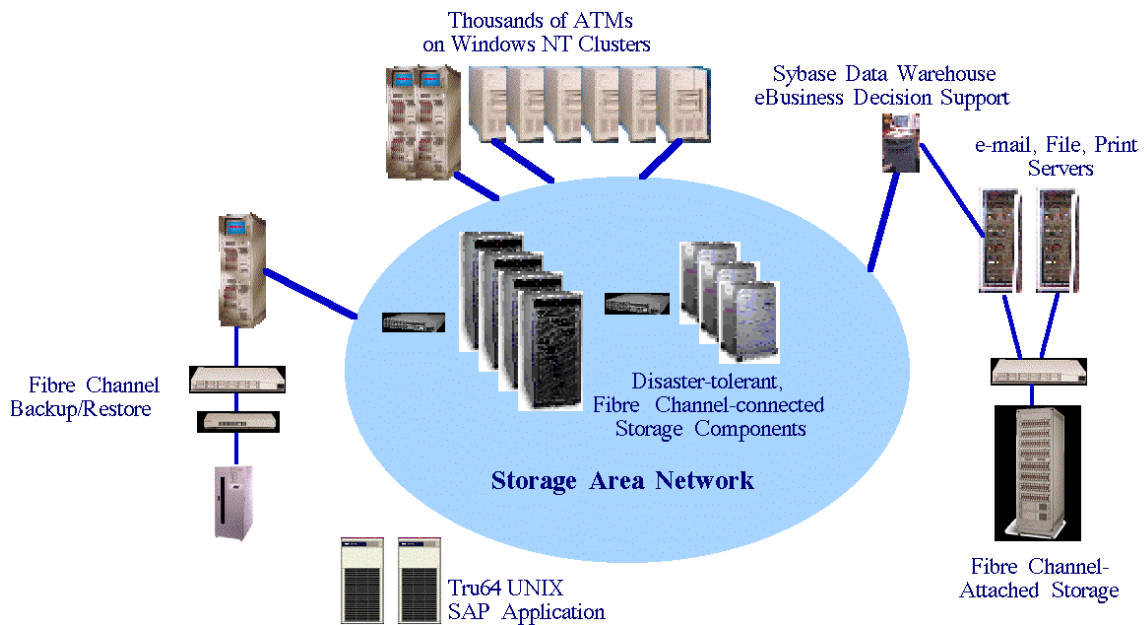


Figure 4. Overview of today's Compaq ENSA

Satisfying Business Continuity Needs

These solutions provide business continuity with disaster tolerant storage. With fully redundant components in the storage systems, redundancy within the SAN infrastructure, and storage system-based data replication, these solutions provide excellent protection against most possible losses of data access. Figure 4 illustrates the comprehensive protection and flexible connectivity possible within a Compaq ENSA Storage Area Network.

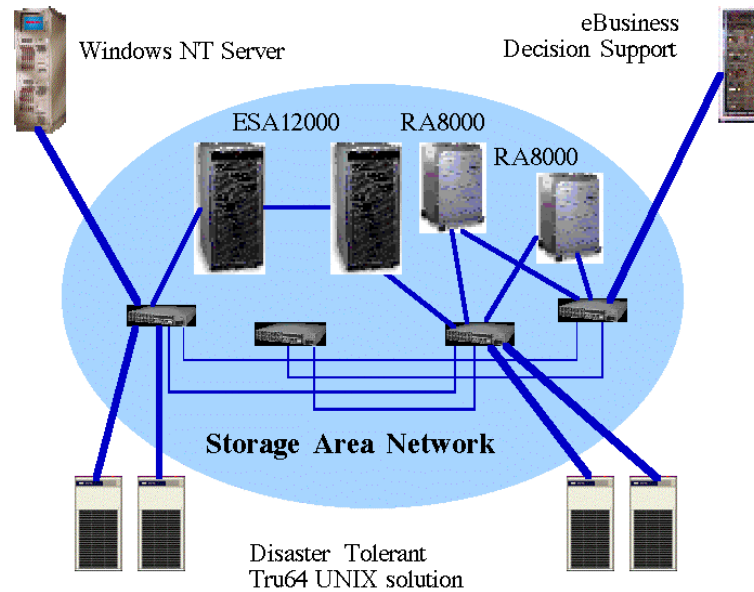


Figure 5. Fibre Channel SANs serve heterogeneous hosts and provide Disaster Tolerance.

The storage solution shown satisfies several application needs simultaneously. At the bottom, a critical SAP application running on a Tru-64 UNIX cluster is accessing highly available storage within the SAN. This application requires high performance and connectivity, so a Fibre Channel Storage Area Network configuration was created. Because of its importance to the business, the SAN has been configured to provide disaster tolerance via the StorageWorks Data Replication Manager running inside each ESA 12000 storage system.

The Fibre Channel switch and other connections shown in the detail view (Figure 5) result in no single points of failure. This topology is always functional and indifferent to the loss of any component. If one of the AlphaServer or storage system fails, its alternate will provide application service. In the unlikely event of a cluster or site failure, the cluster at the secondary site will assume the load. Note that the SAN infrastructure gives servers direct access to all storage.

Delivering Storage In Multiple-Server Environments

The SAN in Figure 4 is also providing storage to an eBusiness decision support server. This system may be running a Sybase data warehousing or similar application. Like the SAP application, its data can be accessed reliably through the SAN. Also, thanks to the Selective Storage Presentation feature of the ESA 12000 and RA 8000 storage systems, the data for this Windows NT system can reside on the same storage systems as the data for the Tru-64 UNIX application. This is shown in Figure 6. Each server owns its storage, and the storage systems' built-in security ensures that each server sees only the data it is authorized to see. This is the same feature that allows the Windows NT server in the upper left to access its own disks (LUNs) in the SAN.

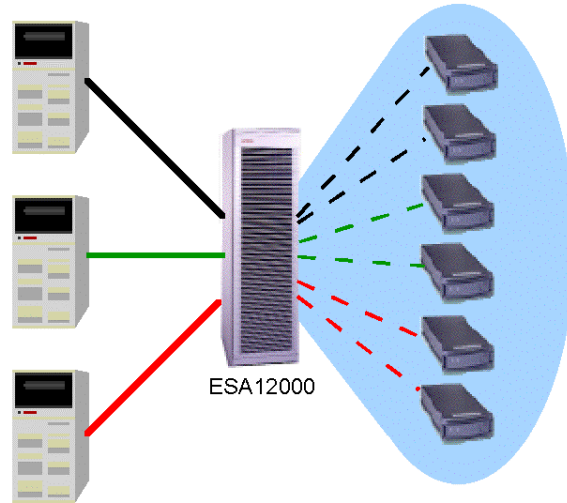


Figure 6. Selective Storage Presentation

Easing Data Protection Problems: Quick Backup and Recovery

The applications in Figure 4 require protection for critical data while minimizing disruptions to running applications, along with a way to recover data quickly in case of a failure. Compaq offers the solution on Windows NT today. Figure 7 illustrates how the Enterprise Backup Solution and the StorageWorks Virtual Replicator address this challenge.

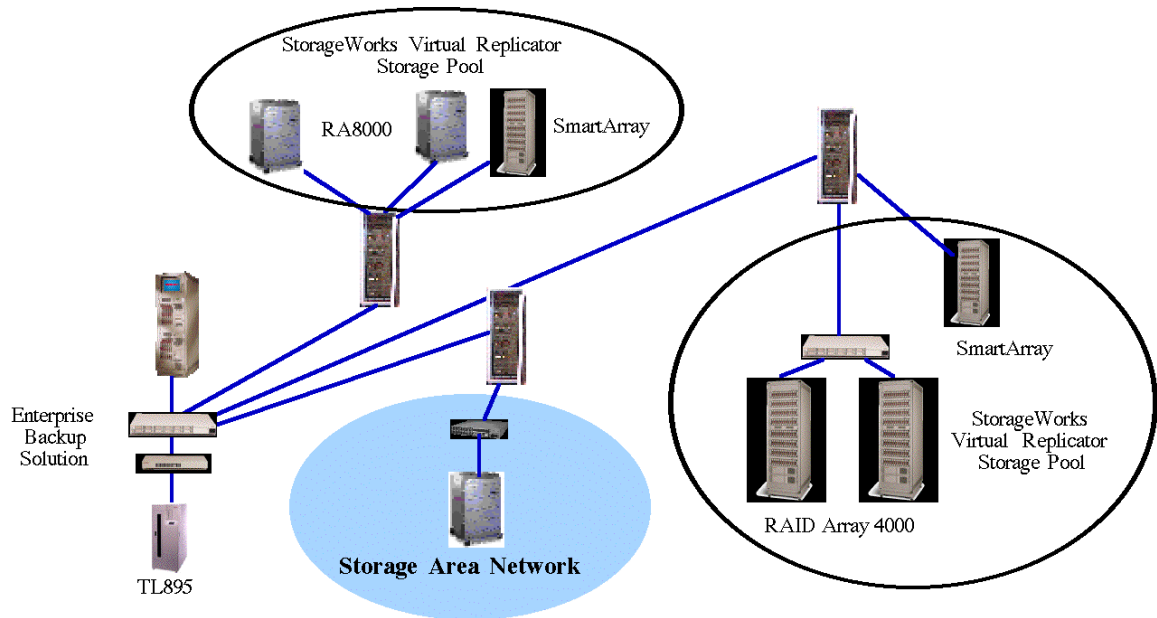


Figure 7. Quick Backup and Restore with snapshot copies and Fibre Channel-based backup

The solution uses both SmartArrays and RAID Array 4000 Storage Systems to satisfy the storage needs of a File and Print Server (right). This server started with SmartArray 4200-attached storage, and the RAID Array 4000 systems were added as the application grew. At the top, an e-mail server is accessing data from two RAID Array 8000 systems. Both of these servers are also

running StorageWorks Virtual Replicator. This simplifies storage management by combining all storage behind each server into a single pool of storage that the server accesses.

StorageWorks Virtual Replicator allows all storage attached to its host server to be combined into a storage pool that can be managed with the Microsoft Management Console. Disks, or Logical Units (LUNs), are created from this pool and securely provided to the application server. Applications store data on these disks exactly as they store it on any other disk. In addition, data can be distributed among the subsystems to optimize performance across host bus adapters. In this example, StorageWorks Virtual Replicator is installed on a server that is running a Microsoft Exchange mail server application that services a large number of clients across a LAN.

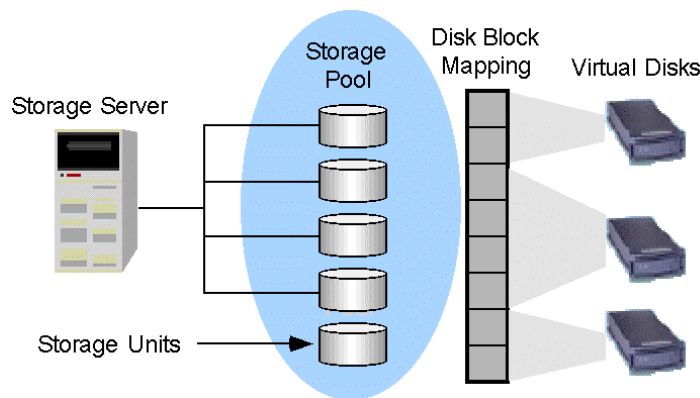


Figure 8. StorageWorks Virtual Replicator virtualizes storage into pools

The StorageWorks Virtual Replicator makes instantaneous snapshot copies of disks. These copies can then be used as sources for backup and restore of entire volumes or files. When used for backup, critical data can be protected with virtually no application disruption. In addition, recovering data from a snapshot is much faster than from tape media. In addition, snapshots can be used to create additional copies of data for report generation, application testing, and similar purposes.

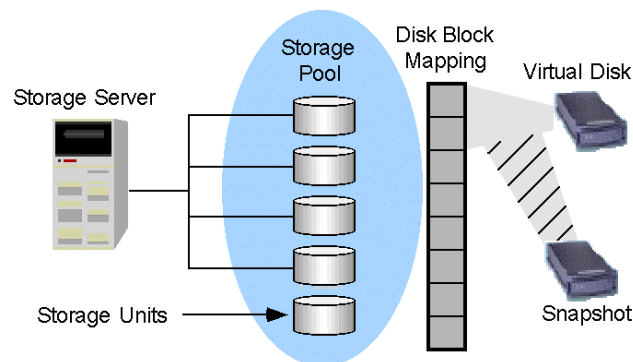


Figure 9. Snapshot copies

While StorageWorks Virtual Replicator is able to greatly reduce application disruption, complete data protection usually requires backup to tape. The StorageWorks Enterprise Backup Solution provides the means to move data from storage systems to tape libraries over Fibre Channel

connections. Moving backup streams over Fibre Channel instead of over a general purpose LAN means backup is much faster, and backup and normal network applications do not interfere with each other.

On the left is an Enterprise Backup Solution that contains a TL895 tape library. The library is shared by all of the servers, each of which is running Seagate Backup Exec, Computer Associates ARCserve, or another backup application. True to the Compaq ENSA vision, this solution shows the deployment of both SAN-based and direct-connect storage for a collection of application servers.

The Enterprise Backup Solution can turn a collection of tape libraries into a shared by a number of backup servers. This shared pool ensures that all tape libraries are maximally utilized, thereby lowering the total cost of backup.

Unified Management of Storage: StorageWorks Command Console

All storage for all application servers in Figure 4 are managed centrally using the StorageWorks Command Console. Figure 10 shows the StorageWorks Command Console, which can consolidate the management of up to 4096 array controllers in storage systems across a Wide Area Network.

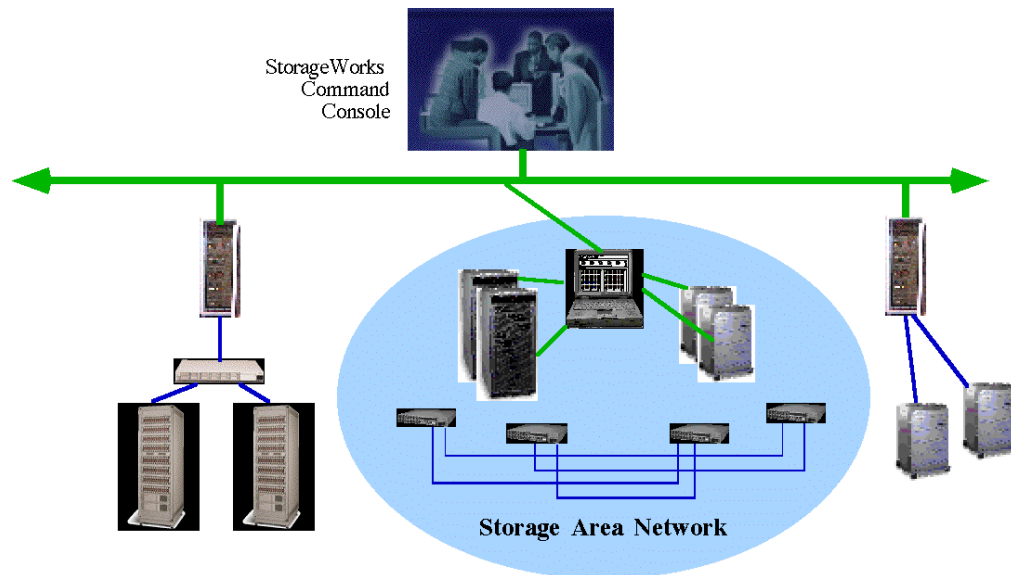


Figure 10. Unified manageability with StorageWorks Command Console

The figure shows an enterprise environment that includes all the storage described throughout this white paper. StorageWorks Command Console provides single-point configuration and monitoring of all this storage. The user accesses the console through a graphical user interface (GUI) that runs on any Windows 95 or Windows NT workstation. The StorageWorks Command Console offers a familiar Windows Explorer look and feel. It can monitor and configure StorageWorks systems connected to Tru-64 UNIX, Windows NT on Intel and Alpha systems, OpenVMS, Solaris, HP-UX, AIX, and IRIX and other popular platforms.

Storage system monitoring is accomplished through agents that feature IP address security to eliminate the risk of loss of data. In addition, storage system configuration has IP address security and password-protected GUI access through single-use encrypted keys used between the GUI and agents.

Conclusion

Today's enterprises encompass mission-critical environments that demand the highest levels of availability, reliability, performance, and scalability. Compaq is addressing these needs through its *NonStop*TM eBusiness strategy. Today, Compaq StorageWorks is supporting this strategy through its ENSA vision.

The Compaq StorageWorks product family encompasses the storage requirements of enterprise customers that range from embedded, multi-gigabyte configurations to multi-terabyte SAN and WAN-based enterprise configurations. StorageWorks offers superior performance, flexibility, modularity, and scalability. Compaq is now shipping solutions that leverage Fibre Channel switched networks and provide complete disaster-tolerant data infrastructures with industry leading price/performance. Compaq is also shipping virtualization and replication capabilities that increase application availability while simplifying the management of storage.

StorageWorks_{now} provides a family of open, modular storage solutions with clearly defined evolutionary upgrade paths that protect customer investments as storage and other technologies continue to evolve. In addition StorageWorks' focus on simplified management through integrated, intelligent tools offers customers lower lifecycle cost of ownership.

Compaq's global consulting, integration and support services teams cooperate with partners to provide customers with complete *NonStop*TM eBusiness storage solutions. Throughout the IT lifecycle, Compaq Services offers service and support to help customers plan, design, implement, and manage storage as part of their overall computing environment, including systems, storage, and networks. At any point in the lifecycle, customers can choose storage-related consulting and support services from Compaq.