VERITAS SAN Solutions

BUSINESS WITHOUT INTERRUPTION™

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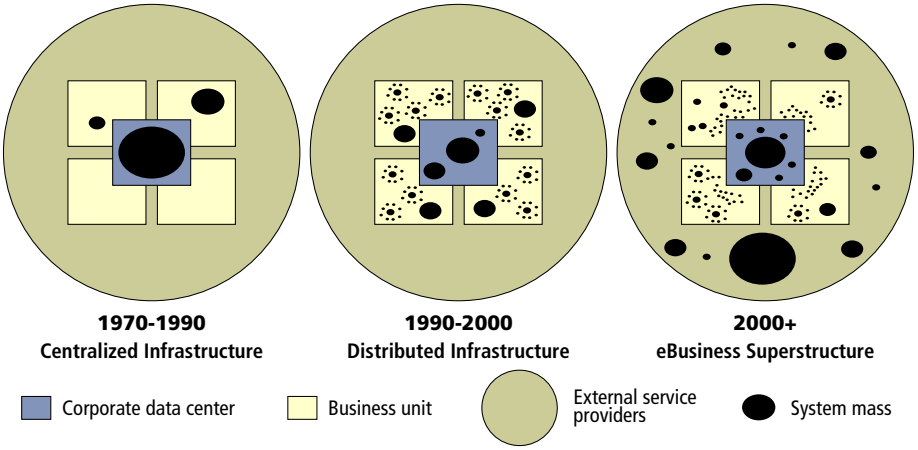
Introduction

A Digital Economy – the Emergence of eBusiness

The business world's embrace of the internet continues to accelerate. Virtually every organization has found that surviving in a highly competitive market requires it to quickly capture, analyze and share electronic data both internally as well as with their external partners. For many companies, the data is the business. This fundamental shift is happening both in nimble new internet startups, as well as established corporations that are investing heavily in solutions to lower their costs through supply chain management or direct marketing. This sharing of critical electronic information to support business-to-business operations is referred to as "eBusiness", and Forrester Research predicts that eBusiness growth with double every year for the next five years. Never before has the fundamental infrastructure for global business so quickly changed and on such a large scale.



New technology services built for the net offload system mass

Function	When mainstream	Example service providers
Web hosting	Now	UUNET, Frontier GlobalCenter, Exodus,
Email	2000	Allegro, Critical Path, Interliant
Packaged applications	2001	Corio, Oracle Business Online, USinternetworking, IBM
Storage hosting	2001	Storage Networks (1999), CLECs, utility companies (2001)
Data analysis	2002	EDS, NCR, Oracle, SAS
Systems management	2002	Entex, EDS, Inacom, manage.com – using tools from CA, FirstSense, Motive Communications, Tioga, Tivoli

Four keys to eBusiness superstructure

Key	Description	Benefit
Server cooperatives	Consolidated computing resource managed by IT but funded by business units	Lowers computing costs and raises service levels while maintaining flexibility
Federated storage networks	Mission-critical enterprise SAN bridged to multiple business productivity SANs through an integration layer	Mission-critical SAN guarantees scalable data availability; business productivity SANs reduce cost
IT as a services company	IT acts as a general contractor for external service providers	Decrease costs and increase agility by offloading infrastructure chunks to service providers
IT pacts	Bidirectional service level agreements with impact on individual compensation	Drive service provider teams inside and outside the company toward common business goals

Source: Forrester Research, Inc.

The New Server Landscape, Forrester Research, Inc, August 1999

The Data Explosion

Due partially to the fact that electronic information shared in today's eBusiness environment is now rich with graphics, audio and video, the amount of information stored in a data center may double or triple a single year, with total capacity exceeding hundreds of Terabytes. In addition, with the advent of internet-based commerce an organization's customer base can grow more rapidly than ever before or experience huge temporary peaks, often causing data center managers significant grief as they attempt to navigate the rapid and unpredictable growth of storage. As a result, the total cost of managing all that data is growing exponentially as server-attached storage often exceeds the cost of the server itself, and management costs increase the total cost of ownership up to seven times the procurement costs. Most challenging of all, executives, customers, business partners, and internal users expect virtually "24 by forever" access to information.

SANs At the Core of the eBusiness Revolution

This shift towards eBusiness is already forcing a revolution in data center operations in which storage area networking (SAN) will play a large role. The traditional data center typified by most Global 100 companies has been viewed as something of a "glass house", housing large mainframe class computers with stable and carefully managed infrastructure to serve internal corporate users. However, the new internet-driven data center, and particularly storage systems, is being designed to accommodate the rapid change necessary to keep pace with eBusiness growth. The SAN is becoming a key component of this new data center. IT managers are looking beyond traditional storage architectures and towards sophisticated storage management software operating over a SAN to enable critical business applications in a flexible new environment. SANs promise to bring mainframe-class storage management functionality to the open systems world, meeting needs for the flexibility, high availability, lower cost and vendor choice that today's rapidly changing IT infrastructure demands.

The Promise of SANs – Virtualization and Visualization

Today SAN applications are solving the point storage problems resulting from the eBusiness revolution. Specific SAN applications such as clustering and backup (see page 8) provide the dramatic increases in performance and availability necessary to support the realignment of business operations around electronic information. However, the true promise of storage networking has yet to be fulfilled.

First Fibre Channel technology enabled storage networking with increased connectivity and flexibility. The next step in SAN evolution is now to simplify the additional complexity that will result from the growth of SANs. By virtualizing additional physical storage devices and applications through centralized management and automation, the total cost of managing these new systems will continue to decrease, even as physical complexity increases. In addition, as SAN management tools appear in the near future to provide a multi-server, "global" view of the SAN, the power of centralized SAN visualization will be realized.

Centralized SAN visualization and management may sound far-fetched for an industry in which basic, mutli-vendor integration still presents issues. However, it is possible to virtualize networked storage resources now through centralized SAN management and automation. VERITAS currently offers logical volume manager software that provides non-disruptive online storage management over SANs and SAN-attached storage, allowing the data center manager to centralize a variety of critical tasks. VERITAS Volume Manager (see page 8) provides remote mirroring, logical LUN "zoning", path failover, load balancing and performance optimization capabilities – all of which simplify SAN management today.

Furthermore, development on more advanced SAN functionality is already in progress. Due in part to legacy server OS behavior and more complexity in Fibre Channel storage devices, new standards-based technology is being developed by VERITAS to enable SAN management, embedded SAN services, and global storage applications. These new technology initiatives will feature common, non-proprietary APIs across OS platforms for VERITAS products and, ultimately for third-party applications and devices to support a heterogenous client-server market.

The true promise of SAN will be realized once organizations are enabled with the tools to achieve centralized SAN visualization and management, and VERITAS is leading the charge through innovation and industry participation. Along the way, VERITAS is providing a number of powerful, realistic options to reduce the cost and complexity of managing the electronic information explosion.

The State of SANs

Promises and Challenges
SANs have the potential to deliver high levels of availability, all while maintaining costs and adapting to unpredictable change into today's eBusiness environment. In fact, many customers are already deploying large SAN installations and realizing substantial benefits. In this centralized environment, a much smaller, highly trained staff equipped with advanced storage management tools can manage significantly larger amounts of stored data than in a traditional, highly distributed environment. However, as with any new technology the reality of early SAN deployments does not yet live to up to all the promises. The SAN industry still faces certain challenges, including:

- The integration of multi-vendor SAN configurations to provide data center class reliability and service
- Distributing SAN and Fibre Channel technology knowledge to the marketplace
- Still evolving standards for storage management software and hardware
- The development of "extensions" for existing storage management softˆware in order to fully exploit SAN capabilities and realize the next level of SAN management

The SAN and Fibre Channel industry continues to move forward, solidifying standards and distributing knowledge through the education of IT staff and resellers. VERITAS Software is also addressing these challenges by investing in the following areas:

- Providing SAN reference platforms by pre-testing multi-vendor SAN solutions with existing VERITAS storage management software in well-defined Fibre Channel configurations. By extending our strong relationships with storage industry players and forging new alliances with Fibre Channel component vendors, VERITAS is defining and rigorously testing SAN configurations that can deliver ROI today.
- Qualifying and training channel partners who can install and service SAN solutions. This group of VERITAS SAN Partners includes enterprise resellers, integrators and enterprise storage and server vendors.
- Providing leadership in all SAN industry forums including the Storage Networking Industry Association (SNIA), JIRO, DMTF, and the Fibre Alliance. VERITAS is on the board of directors for SNIA and is the co-specification lead for the JIRO initiative.
- Delivering solutions that leverage standards and existing investments in storage management solutions, as well as create new SAN technologies that will extend existing storage management applications to make them truly "SAN aware". This combination will of products and technology will deliver on the true promise of SANs (see inset this page).

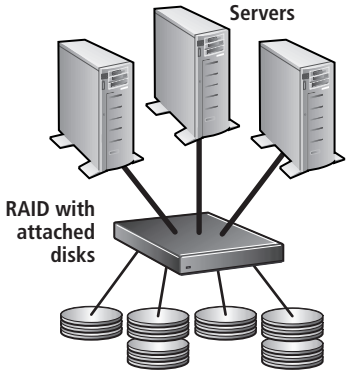
Realizing Return on Investment Today
Despite the challenges it is possible to deploy early SAN installations today to solve specific storage issues and realize a return on the investment. By adhering to the guidelines below, an organization can realize the significant benefits of storage networking applications today, as well as ensure its chosen architecture will evolve to support the true promise of SANs tomorrow:

1. Identify one application or part of your data center infrastructure that is pushing the limits of existing storage architectures, and choose a corresponding SAN application to solve that particular issue.
2. Choose a small group of strategic vendors to design and deploy your SAN configuration. Wherever possible, source Fibre Channel components through a reseller, integrator, or enterprise storage vendor who has already rigorously tested a specific configuration based on those components. Also, make sure to choose vendors that are investing in the future of SAN technology in order to reap the benefits of new SAN features as they become available.
3. Deploy a proof of concept SAN configuration to prove the robustness of the configuration before implementing the solution in a production environment. SANs are not yet plug-and-play, so changing drivers or topologies without performing regressions testing or enlisting the help of an integrator or consulting services organization puts the robustness of a SAN configuration, and the data it supports, at risk.

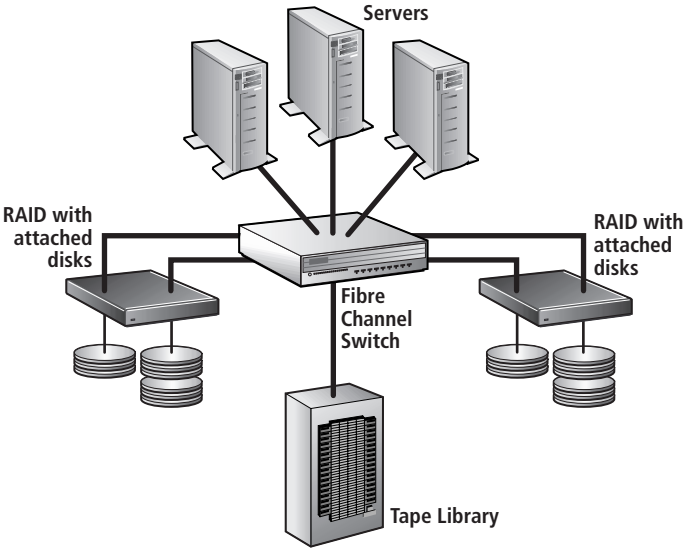
By rolling into production while carefully managing the configuration and topology, a SAN configuration will deliver the additional flexibility, performance and long-term cost-reduction necessary in today's rapidly changing eBusiness environment.

The State of SAN Topologies Today

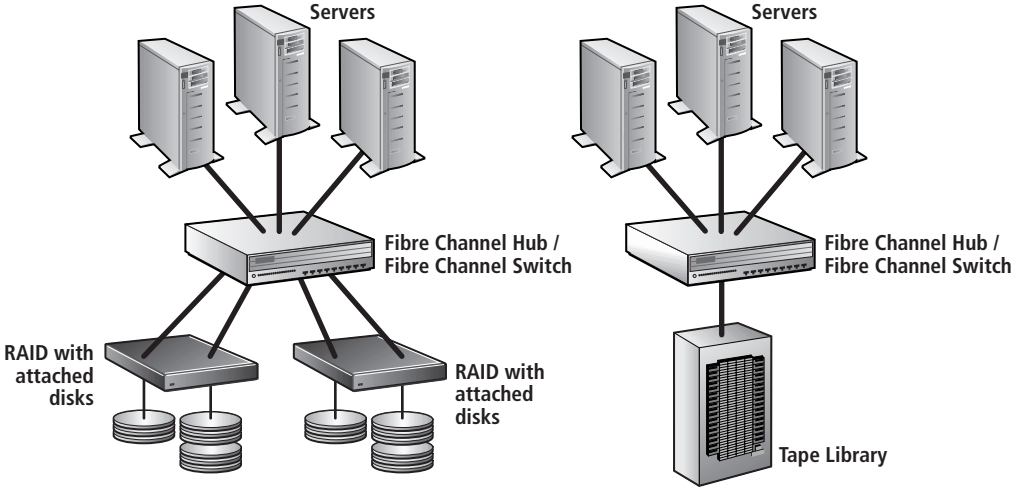
Many of today's SAN topologies are fairly simple. However, SAN topologies are providing increased performance, distance, and connectivity while creating a first generation SAN platform. Existing storage management applications can be ported onto these SAN configurations since Fibre Channel networks encapsulate the legacy SCSI protocol. As a result, SAN-attached devices appear to be SCSI devices. Most early SAN configurations fit into one of the following topologies:



Widespread Point-to-Point Fibre Channel



Multiple application and vendors through manually "zoned" switch and arrays in marquis sites.



Single hub or switch for fan-out topologies or shared devices

The most complex topologies use one more Fibre Channel switches with multiple storage management applications. These configurations are made possible by using a technique commonly called "zoning" in which the Fibre Channel network is partitioned to create multiple, smaller virtual SAN topologies. By doing this, the Fibre Channel network looks like a simple SAN configuration to the host storage management application. Zoning techniques and tools vary widely at this point, but are available from virtually every Fibre Channel vendor.

SAN Applications

Reducing Total Cost of Storage with SANs
SANs reduce costs by providing a better management infrastructure for storage in a centralized data center. Two examples of cost savings due to centralized SANs are peripheral sharing and capacity management.

Peripheral sharing
According to a June, 1999 Dataquest survey, 56% of respondents reported using less than 50% of RAID capacity due to the inability to share the devices among many servers. As a result, they estimate an IT manager in a distributed storage environment can manage only one-third the storage capacity managed in a centralized environment.

The most obvious way in which SANs help reduce costs is by facilitating sharing of sophisticated peripherals between multiple servers. External storage is commonplace in data centers, and sophisticated peripherals are generally used to provide high performance and availability. An enterprise RAID system or automated tape library can be 5 to 10 times more expensive than a single server, making it prohibitively expensive to use a one-to-one devices attach approach. Even with multiple channel controllers in the peripheral, the cost equation is often not attractive.

Fibre Channel-based storage networking provides three key features to facilitate peripheral sharing. First, flexible many-to-many connectivity using Fibre Channel hubs and switches improves the fan-out capabilities of a peripheral, allowing multiple servers to be attached to each channel. Second, the increased distance capabilities of fiber optic cables break the distance restrictions of SCSI, allowing servers to be located up to 10Km from the peripheral. Finally, Fibre Channel hubs and switches support improved isolation capabilities, facilitating non-disruptive addition of new peripherals or servers. This avoids unnecessary downtime for tasks such as installing a new I/O card in a server.

However, storage management software is also required in combination with Fibre Channel networks to deliver true SAN functionality. Software tools are used to allocate portions of an enterprise RAID to a server in a secure and protected manner, avoiding data corruption and unwanted data access. Storage management software also can also provide dynamic resource sharing, allocating a tape drive in an automated tape library to one of many attached servers during a backup session on an as needed basis.

Capacity Management
With traditional locally attached storage, running of out disk space means that new storage must be physically added to a server either by adding more disks to an attached RAID or adding another I/O card and a new peripheral. This is a highly manual and reactive process, and leads IT managers to deploy large amounts of excess capacity on servers to avoid downtime due to re-configuration or capacity saturation.

SANs allow many on-line storage peripherals to be attached to many servers over a FC network. Using tools to monitor disk quotas and free space, administrators can detect when a server is about to run out of space and take action to insure storage is available. Using storage allocation software, free space on any RAID can be allocated to a hot server putting the storage where its needed most. As existing SAN-attached peripherals become saturated, new peripherals can be added to the SAN hubs or switches in a non-disruptive way allowing free space to be allocated as needed.

Increased Availability Without Exponential Costs
Delivering high levels of availability without exponential costs is a key requirement for the new internet-driven data center. SANs promise three techniques to achieve this: multi-server availability clusters, virtualization of SAN resources to minimize application disruption, and the automation of manual storage tasks to avoid re-active management.

Virtualization of Physical Storage to Minimize Application Disruption
Minimizing disruptions to applications while storage configurations change is key to achieving near-continuous availability and performance. This can be a challenge, as new storage must be added to keep up with capacity demands, or storage configurations must be changed to optimize performance or improve availability levels. With traditional locally attached storage, external RAID controllers can be used to isolate configuration changes from the host maintaining application uptime. However, downtime still has to be scheduled to add new RAIDs, and map the new storage to applications. External RAID controllers, which comes at a premium to JBOD.

As noted, SAN-attached, external storage can be added to Fibre Channel hubs or switches and portions of the new storage can be mapped to one or more servers. The characteristics of Fibre Channel allow these new storage

peripherals to be added without breaking a SCSI chain. However the server application is still unaware of this new storage since it must be stopped and re-started to access new volumes. Storage virtualization software, such as advanced logical volume managers, can allow an existing application volume to dynamically grow to include the new SAN attached storage. This completes the process of adding new storage to a server without disrupting application up-time. With logical volume management, an application volume can physically exist in one more peripherals or peripheral types. Virtualizing physical storage into logical volumes is key to minimizing disruptions.

SANs will also allow a large number of varying types of storage to be available to a server farm. Available storage will vary in terms of cost, performance, location, and availability attributes. By virtualizing physical SAN-attached storage in terms of its attributes, administrators will be able to add and re-configure storage based on its properties rather than performance configuration through device level mapping tools. Allowing administrators to dynamically re-configure and tune storage while applications are on-line improves application performance and dramatically reduces the likelihood of unplanned downtime. In addition, these attributes allow administrators to set policies that automatically allocated unused storage to servers and applications where necessary.

Reducing the Cost of Availability with Multiple Paths to Storage
Implementing high levels of availability require that server applications recover from failures as quickly as possible. Traditionally server clusters with replicated data sets have been used to ensure that when failover software re-starts the application on a new server, an up-to-date copy of the data is readily available and the application can be quickly re-started. Advanced clustering tools allow fail-over between multiple servers, providing more flexible and robust implementations. However this increases the cost of storage, as every server must have a copy of the data locally attached.

Fibre Channel networks facilitate many-to-many connectivity between multiple servers and multiple peripherals. This means that each server can have a physical path to the storage of each server in an availability cluster. When an application fail-over occurs, a path from the new server can be provisioned to the failed servers' data, and the application can be re-started. Since the storage does not need to be replicated behind each server, it is possible to implement increasing levels of availability without significantly increasing storage costs.

Automation of Manual Tasks using Policies
Several of the examples already discussed demonstrate how storage management tools, combined with SAN-attached storage, can lower the administrative cost of application availability. Increasing the automation of these tasks will keep a lid on management costs. Policy management refers to the use of a policy administration tool, in which an IT manager assigns high level rules to storage management applications and storage resources, as well as to policy agents which enforce those rules.

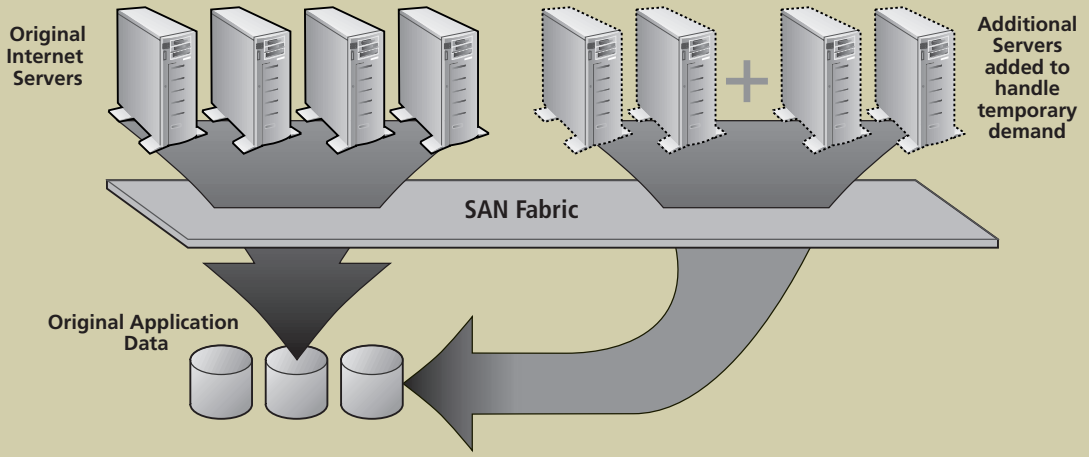
For example, a capacity management application could define that 50% of all new storage added to a SAN is allocated to a hot application. The policy agents running on the SAN would detect the new storage, automatically map the volumes to the hot server, and grow the application volumes to include the new capacity. Similarly, a data protection application can define that every time a file system grows to a certain size a backup is performed to the highest performance, most-available tape library attached to the SAN.

SANs provide many more resources to monitor and configure data, thus creating a more complex storage environment. By using policies to automate storage management, IT managers can ensure that the benefits of SANs are fully realized, while the total cost of managing these new systems does not increase as additional levels of complexity are introduced.

A SAN Example: Increasing Availability Using Clustering

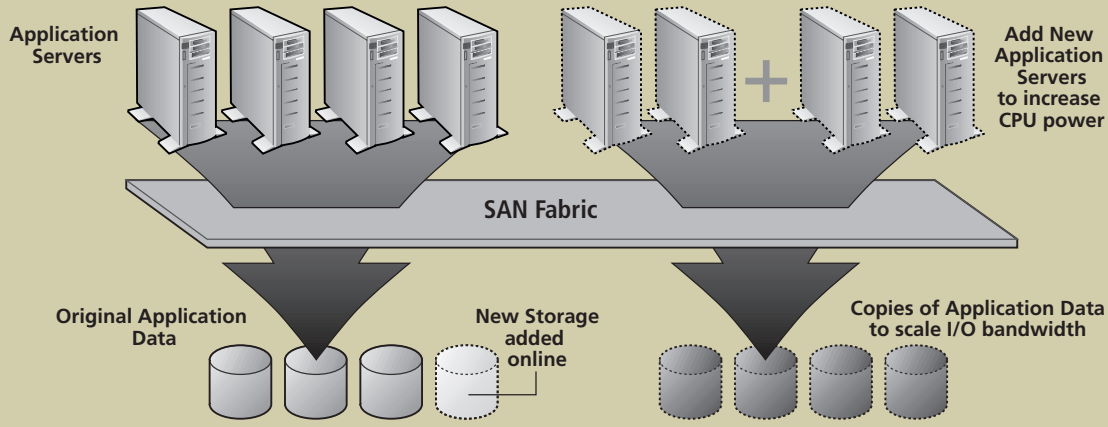
A new promotion for an eCommerce site requires that the organization's data center facilitate additional business processes for a short time, both internally and externally via the internet. In support of the campaign, twenty new servers must be brought on-line to deal with the short-term increase in demand, even though the additional storage capacity will peak after a period of months, then slow down until the next promotion. As a result, the data center manager must be prepared to do two things: re-purpose application servers and plan for multi-dimensional growth.

Re-purposing servers to accommodate temporary peaks in data access can be very labor intensive and potentially costly. Data must be replicated to many servers and storage configurations have to be tuned for each server. Performing extensive re-configurations results in a loss of productivity as use of the application servers is suspended and a significant amount of administrative labor is invested in the process.



However, as shown in the diagram above, implementing a SAN can allow server farms to share access to a storage farm. With storage management tools applications can be moved to different servers and still have access to their data. For read-only applications, a single copy of data can be shared between multiple application servers removing the necessity of replicating data. And because this can all be done while applications are on-line, productivity losses are minimized.

SAN architectures can also accommodate multi-dimensional growth. Capacity management techniques can be used to ensure new storage can be added continuously, so server applications always have storage capacity they need. If more processing power is needed, more servers can be added to the SAN to provide better access to stored data. For higher read performance access to data, multiple copies of data can be created on the SAN, thus eliminating bottlenecks to a single disk.



VERITAS SAN Solutions

Online Storage Management: The SAN Virtualization Layer
Virtualization of physical storage is necessary to ensure that SAN applications remain on-line as storage configurations change. VERITAS has been delivering enterprise class storage virtualization with VERITAS Volume Manager (VxVM) for UNIX for over ten years, and is developing the volume manager bundle for Microsoft's Windows 2000. VxVM has many intrinsic features that allow it to immediately take advantage of SAN configurations. Some key capabilities applicable to SANs are:

- Create, synchronize and fail-over to a Remote Mirror while the application remains on-line.
- Dynamic growth or shrinkage of application volumes allowing non-disruptive addition or deletion of SAN storage
- Performance optimization to allow hot disk locations to be moved or RAID configurations to be changed while the application remains on-line.
- Capability to assign ownership of disk groups to a single server, preventing unwanted storage access from another server on the SAN
- Dynamic Multi-Pathing to provide non-disruptive path-level fail-over and load balancing over multiple Fibre Channel links between a server and storage peripheral.

VxVM can perform all of these operations for both JBOD and RAID peripherals on a SAN today and even mix and match between peripheral types. By building applications on top of VxVM, these intrinsic virtualization features can be made available without the server application being aware of the physical SAN configuration. This includes other VERITAS applications such VERITAS File Server, Foundation Suite Editions for Oracle, and other third-party applications.

LAN-Free Backup: Reducing the Backup Window
Improving backup and recovery performance, and minimizing disruption to applications, is often considered the "killer app" for this first generation of SANs. The most often requested capability is to share tape libraries, and tape drives in those libraries, between multiple servers. This is sometimes also called "LAN Free Backup" since most backup data is now transferred to tape using a SAN topology instead of a LAN. VERITAS provides two LAN Free Backup solutions using the VERITAS Shared Storage Option add-on feature:

- VERITAS BackupEXEC SSO for NT and NetWare (department and workgroup application)
- VERITAS NetBackup 3.2 SSO for NT and UNIX (enterprise applications)

There are four benefits of LAN Free Backup. Since the many-to-many connectivity of Fibre Channel allows a tape library to be shared by multiple servers, LAN Free Backup amortizes the cost of that resource over multiple servers, making it much more affordable for mid-range UNIX or NT servers to have direct access to a library. It also minimizes disruption by removing backup traffic from the production LAN and onto the SAN, avoiding saturating the client-server LAN with backup traffic and allowing normal LAN operation to continue. Removing backup traffic from the LAN also increases performance by reducing the backup window, since data is backed-up and restored via a 1Gbps Fibre Channel-based SAN rather than across a 10/100 Mbps Ethernet network. In addition, VERITAS' LAN Free Backup products increase automation by intelligently scheduling backup jobs - dynamically sharing tape libraries based on specific backup policies. Since tape resources can be dynamically allocated to backup sessions on each server, intelligent scheduling can optimize the use of shared drives.

Clustering for Improved Availability
As an example, many internet-centric organizations rely on the availability of data to aquire and retain their customers. A customer stays as long as the site is available and repsonsive. When disappointed by downtime, that customer will goes elsewhere and rarely returns.

Improving availability through clustering while containing costs is also a key capability of SAN architectures. Applications must be able to fail-over from one server to any other in a server farm and re-map the application data to

the new server, avoiding the necessity to replicate the storage to every server. VERITAS Cluster Server (VCS) provides the ability to create multiple 32-node application fail-over clusters today in a SAN environment for Solaris and HP/UX, and multiple 64 NT node clusters to be managed all from one common cluster console. VCS for Solaris and HP/UX are available today, and VCS for NT will be available by the end of 1999.

To implement a VCS SAN installation, the application must be able to configure paths to all storage on the SAN. This can be done in two ways. The first is to use VCS in conjunction with VERITAS Volume Manager (VxVM). VxVM permits all servers to see the storage on the SAN, but the storage isn't explicitly mapped to the server application unless it has ownership of the data. Tight integration between VCS and VxVM allows VCS to quickly re-map the failed servers' storage to the new server. The second technique requires VCS to be aware of how to configure SAN equipment to setup the new path.

VCS for Solaris, HP/UX and Windows NT

- Scales to 32 node clusters
- Java management interface
- Heterogeneous management
- One-time configuration with replicated configuration file
- Multi-threaded cluster communication protocols
- Enterprise agents for:
  - Oracle 8.x, 8I
  - Sybase x.x
  - Informix x.x
  - VERITAS NetBackup 3.x, 3.2
  - SAP
  - Exchange, IIS, SQL
  - Lotus
  - Checkpoint Firewall - 1

LAN Free HSM to Shared Tape Libraries

One key element of managing storage costs is optimizing the use of expensive storage. Hierarchical Storage Management (HSM) is a technique common in mainframe environments in which infrequently accessed data is automatically migrated to lower performance peripherals or removable media. Although HSM has traditionally been seen as expensive to implement, SAN configurations can be used to lower this barrier. VERITAS Storage Migrator/Shared Storage Option for UNIX allows multiple HSM servers to share automated tape libraries. Storage Migrator is implemented as an add-on product to VERITAS NetBackup, leveraging VERITAS NetBackup SSO SAN installations to provide even more SAN capabilities. In effect, Storage Migrator provides LAN Free HSM.

Just as in LAN Free Backup, LAN Free HSM to shared tape libraries amortizes the costs of sophisticated tape libraries over multiple servers, as well as costs between both backup and restore and HSM applications. It also minimizes disruption to client-server traffic on the LAN as more HSM traffic is transferred over the high-speed SAN. Like LAN Free Backup, HSM over a SAN also increases automation by intelligently scheduling HSM sessions to shared tape drive resources.

VERITAS SAN 2000: The Next Generation

To create the next stage in the evolution of SAN, VERITAS is creating new technologies to improve the ability of SANs to virtualize storage resources, increase automation, and adapt to change. Building on storage management standards as they evolve, VERITAS is focusing on the following areas:

1. Creating a standard services and API layer that will make existing storage management applications SAN-aware. For example, VCS will be able to dynamically re-configure SANs to provision paths to storage. Or VERITAS Volume Manager will be able to discover performance and availability attributes of SAN-attached storage to determine the best software RAID configuration. Providing a common service layer will allow all VERITAS applications to exploit SANs over multiple operating systems.

2. Embedding intelligent storage management functions into new types of SAN devices. With the many-to-many connectivity of Fibre Channel networks and the increases in processing power, new types of devices can implement storage management functions such as storage migration, virtualization, or replication. For example, VERITAS Volume Manager can be used to provide virtualization functionality in a RAID controller.

3. Creating central, SAN-wide management applications that can improve visualization of SAN resources and increasingly automate storage management. Optimizing performance and availability across multiple servers and storage peripherals in a SAN requires a centralized management application to co-ordinate functions such as capacity management and automatic capacity allocation.

4. Creating clustered versions of VERITAS Volume Manager and VERITAS File Server products to realize multi-server shared data access in a SAN. Lastly, some high performance applications will benefit from distributing applications over multiple servers and operating on shared read/write data.

5. Create extensions to VERITAS data protection products that maximize application availability in a SAN. Using secondary hosts to backup snapshots of a production application server's data, or using embedded SAN fabric copy agents to move data directly between on-line and off-line storage, will minimize the disruption to application clients during a backup operation, increasing the overall information availability of the data center.

Summary

eBusiness is changing the face of the data center. This dramatic shift towards information-centric business operations is forcing a restructuring of the static model of recent years to a hyper-dynamic, flexible data center superstructure that can shift rapidly to meet the needs of today's internet-driven organizations. SANs will play an important role in this new model as the need to access increasing volumes of stored information becomes more and more crucial to the survival of any organization.

For all the promise SANs hold to deliver the performance and flexibility necessary to support new eBusiness operations, the technology is still relatively new and is not yet plug-and-play. However, as we have seen, it is possible to deploy SANs today by choosing strategic vendors who have invested in pre-testing storage components and applications, and working with resellers and service organizations who implement best practices before rolling early SANs into a production environment. In fact, many customers are already implementing a wide range of SAN applications and realizing significant benefits.

There are a number of SAN applications currently available that will increase availability and performance – all without exponential costs. In fact, online storage management to virtualize physical SAN resources and minimize disruption, clustering technology for increased availability, and, of course, LAN Free Backup applications are all available for Fibre Channel-based storage networks today. VERITAS provides five different software products to enable all of the applications listed above, plus LAN Free HSM, which allows customers to share the cost of expensive tape libraries.

In spite of all the benefits Fibre Channel-based SANs can provide now, the true promise of storage networking has yet to be fulfilled. The virtualization of storage resources through centralized management and automation available today is just the first step towards creating a multi-server, "global" view of the SAN. The ultimate goal of centralized SAN visualization and management will be enabled through the delivery of additional, non-proprietary technology layers, as well as advanced SAN management, embedded SAN services and global storage applications. VERITAS Software is working closely with industry standards bodies and vendor partners to deliver all these additional software components in the near future, all while providing pre-tested SAN reference platforms today to solve specific storage pain points today.

For more information on VERITAS SAN solutions today, contact your local VERITAS representative or visit our web site at **http://www.veritas.com**.

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