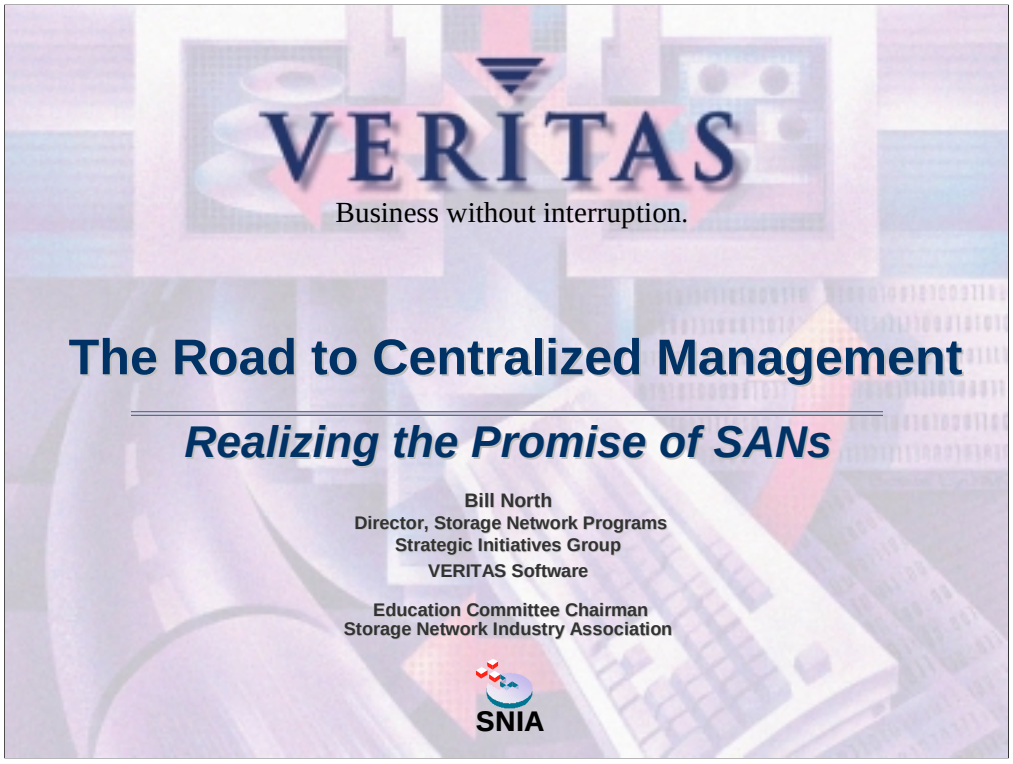
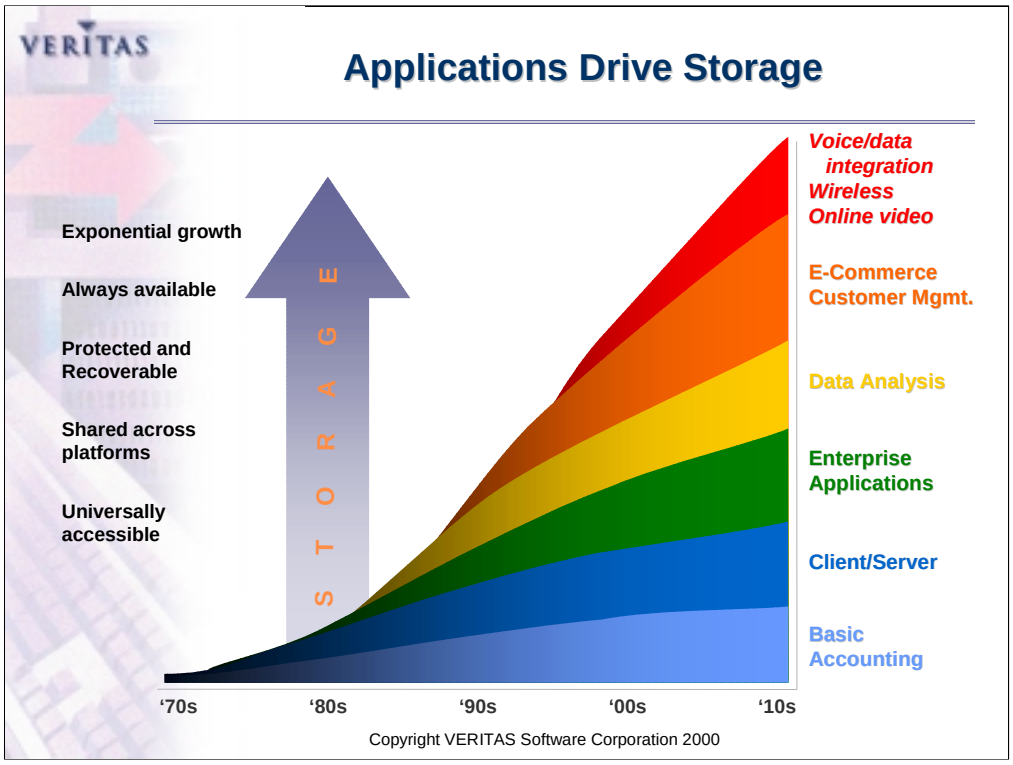


ABSTRACT

The presentation provides an executive overview of VERITAS SAN strategy. It does not require a nondisclosure, but is not intended for wide spread distribution. The emphasis is on products and SAN solutions that can be delivered today, and on the value proposition they offer to the user. The presentation covers:

- Need for SAN architecture
- Potential benefits of SAN deployment
- Role of storage management software for SAN
- Challenges in deploying SAN technology
- VERITAS role in the development of SAN standards and interfaces
- VERITAS approach to delivering working SAN solutions
- Current VERITAS SAN-enabled products
- VERITAS SAN road map and future direction
  - -Migrating from older technologies
  - -Cluster Volume Manager
  - -Cluster File System
  - -GeoCluster
  - -Administrative Tools
  - -Application Servers
  - -Cross Platform Support
- -Synergies With Other VERITAS offerings
- -Comparison of Competitive Offerings
- -Discussion & Wrap-up


VERITAS
Applications Drive Storage
Exponential growth
Always available
Protected and Recoverable
Shared across platforms
Universally accessible
STORAGE
Voice/data integration
Wireless
Online video
E-Commerce
Customer Mgmt.
Data Analysis
Enterprise Applications
Client/Server
Basic Accounting
'70s
'80s
'90s
'00s
'10s
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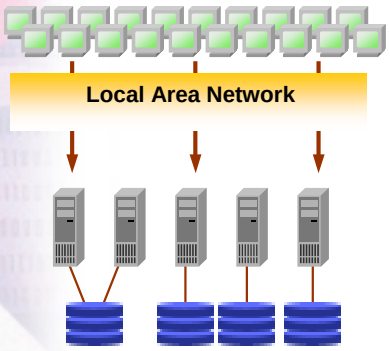
Traditional LAN

Client/Server Architecture

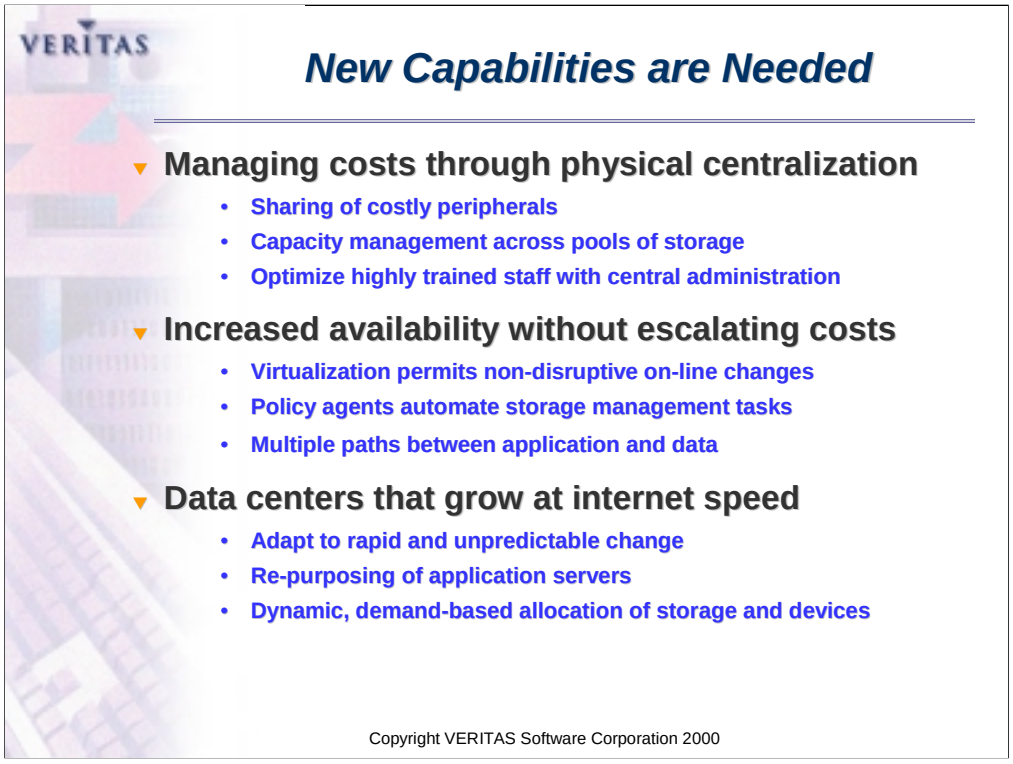


"Any-to-any" LAN-based connectivity

but...

"Point-to-point" storage architecture

- **Limited scalability**
- **High availability is prohibitively costly**
- **Difficult, costly management**
- **Fragmented and decentralized storage**



Key Message : VERITAS customers have been saying they expect three provable benefits from SANs.

1) Preventing exponential cost of ownership while storage capacity explodes

2) Deliver continuous data availability on all platforms without huge costs

3) Adapt to rapid change that e-business causes in data centers

Examples to use on how SANs should help in a server farm….

1) Management of Costs

- high end RAID or robotic tape library can be 10 times the cost of a single mid-range NT server - need to share it between many servers

- capacity can be optimized across multi-peripheral in a storage farm shared over a SAN

- cheaper for a few highly trained experts to manage physically centralized storage than many less trained admins managing highly distributed storage

2) Availability

- add or re-configure storage without disrupting the server application

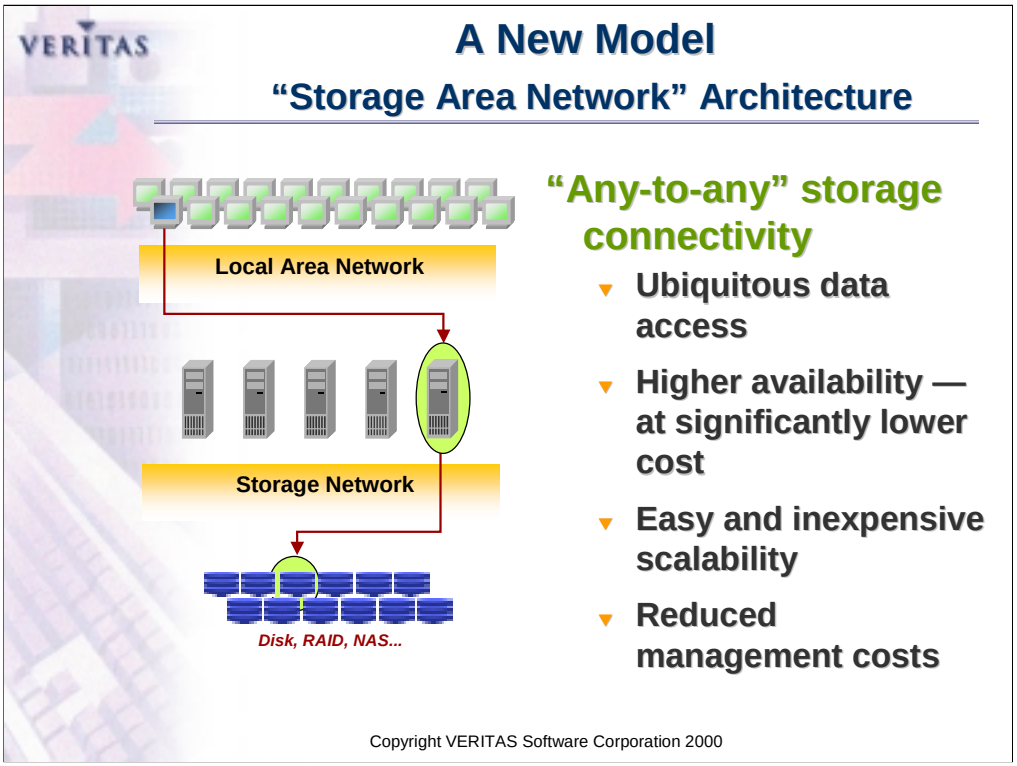
- policies administered from a central console define how big an application can get, storage is allocated automatically when needed within these bounds

- network connectivity provides multiple paths between application and storage preventing downtime due to failures.

3) Rapid Change

- data centers can scale in the dimension that is most needed : more CPUs or more storage or higher levels of availability

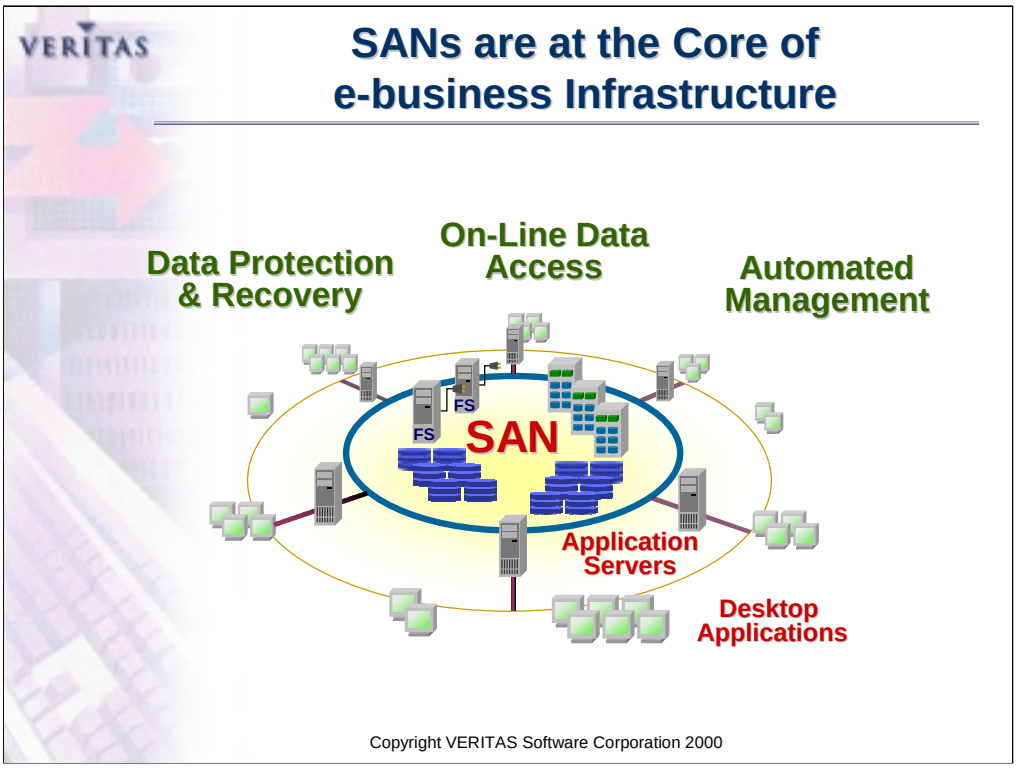
- in e-business sites, servers are often re-deployed to meet changing needs due to web promotions or addition of new business partners



I believe that availability and manageability (reduced management costs) are the most important factors. We put too much emphasis on reduced HW costs.

I would suggest something like this:

- distributed shared storage paradigm
- higher availability
  - more robust interconnect & scalable clusters
- reduced management costs
  - distributed access to centralized storage pool
- improved scalability
  - modular growth & higher connectivity



Key Message : SANs are a new architecture at the core of the e-business revolution.

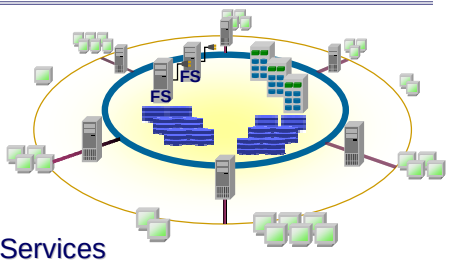
All businesses, large and small, must adopt e-business practices to stay competitive. This is causing dramatic change in data centers, which must now provide:

- "24 x forever" data availability to internal and external customers
- large terabyte pools of storage for web server, e-commerce databases, and media-rich content
- adapt to rapid change as number of customers, web-hits, or business partnerships change
  - no longer the staid data center with purchases that are carefully planned over several years

SANs are a revolutionary new storage architecture that promise to dramatically improve the ability to meet these new demands.

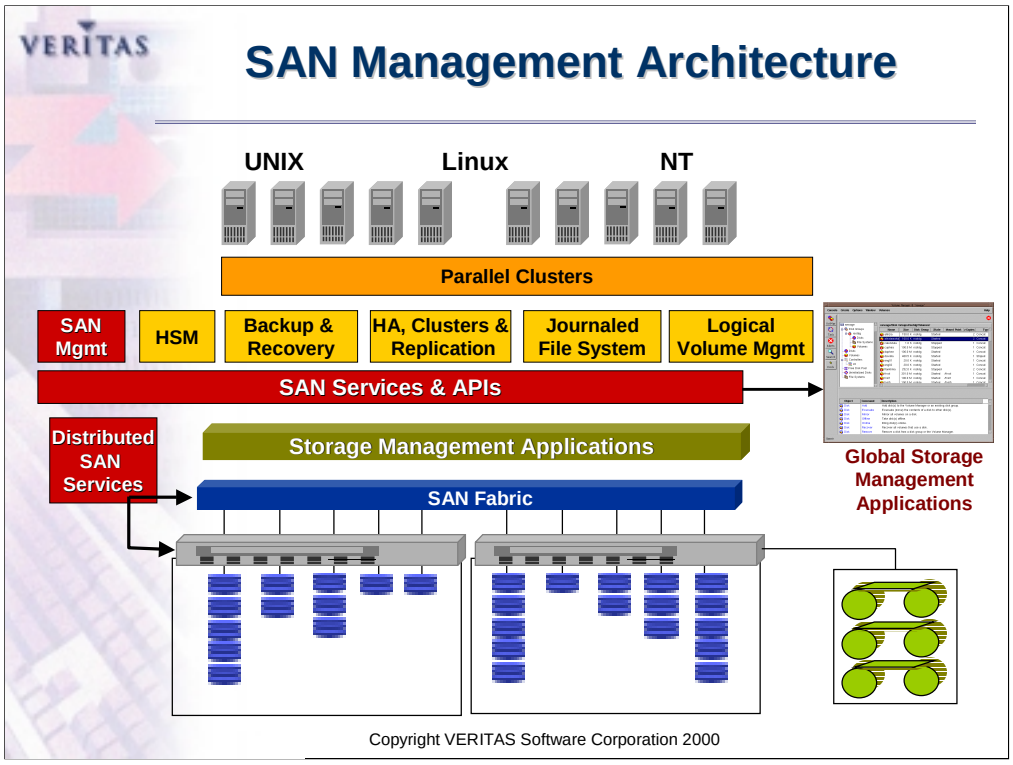
VERITAS tools for Data Protection, On-Line Data Access, Automated Management can be married to SAN technology to deliver Business Without Interruption™

Ideal SAN Characteristics



- Thousands of devices
- Arbitrary interconnection
- Scalable bandwidth
- Dedicated to and optimized for storage I/O
- High Availability of Applications & Services
- Dynamic Device Management and Detection
- Long Distance Interconnects
- Fault tolerance
- Disaster Recovery
- Enterprise Class Access Control and Security
- Shared storage access between heterogeneous systems
- Current applications and OS's run without modification

But…
SANs are inherently more complex environments



Key Message : VERITAS has a broad range of sophisticated storage management applications that help improve data availability. These are being married to the new FC SAN infrastructure to allow customers to take the first step in the evolution to SANs.

VERITAS products already provide high performance, virtualization, and automation in a SCSI environment. These capabilities allow them to be “ported” to a FC network, which encapsulates legacy SCSI, without radical change to the design.

VERITAS is testing all of our products with the new FC equipment to make sure they work properly. Since FC is still a new technology and introduces a lot of new attributes into the storage architecture, this is essential to ensure quality.

VERITAS has the most breadth and depth of any storage management ISV, providing a range of on-line and off-line applications for NT, multiple flavors of UNIX, and Netware.

Note : emphasize the specific VERITAS applications that hit the specific customers hot buttons.

VERITAS

VERITAS V³ SAN Initiative

Virtualization in a SAN Environment

- **Delivering virtualization *technology* for the SAN environment**
- **Standards-based "glue" for SANs**

- **V³ SAN Access Layer**
- **V³ Storage Appliance Software Suite**
- **V³ SAN Management Tools**

Storage Management

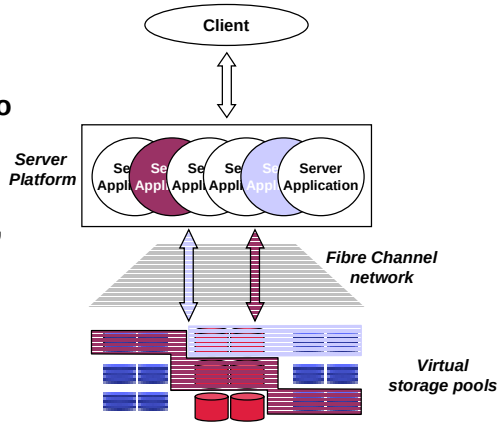
Ensures Server Applications

Have the Right Quality of Storage to support

the Quality of Service Demanded by Clients

What *is* SAN Virtualization?

- **The process of organizing multiple *storage resources* into logical - or virtual - entities to better manage capacity, automate procedures, and increase performance**



- ***SAN virtualization enables management of more complex installations while controlling and reducing cost of ownership***

Storage Management

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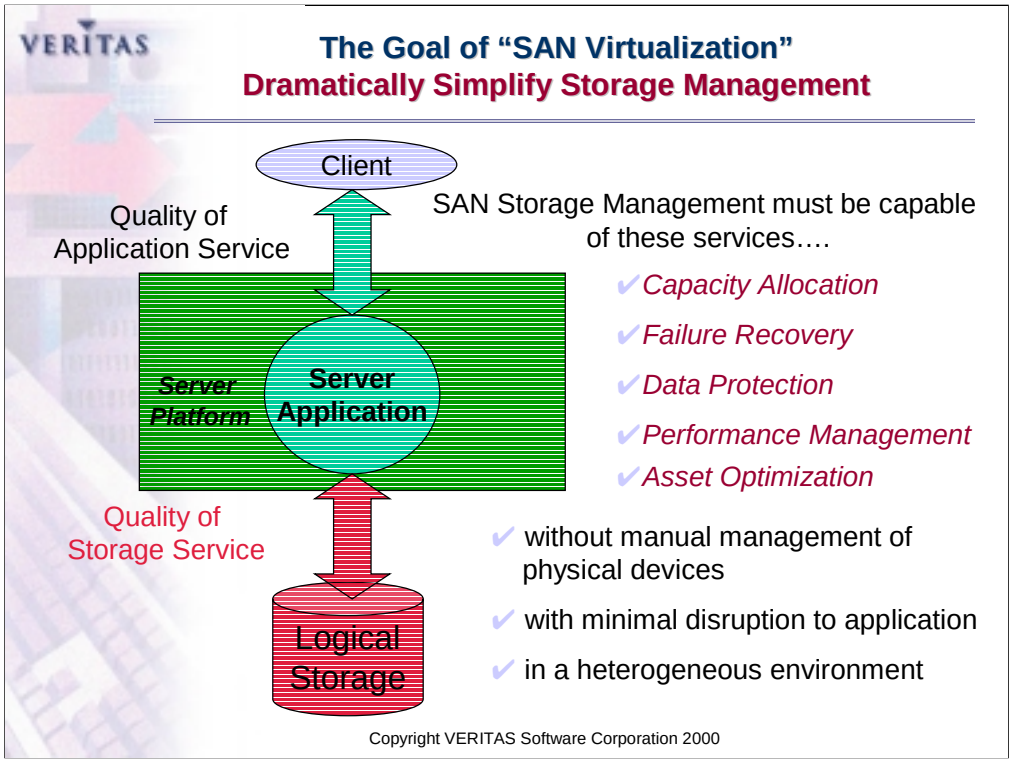

Storage Management

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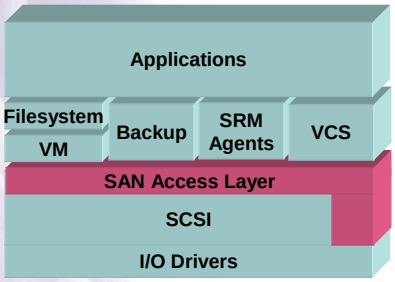
The VERITAS V³ SAN Access Layer Creates SAN-Aware Storage Management

V³ SAN Access Layer is a new host-based technology that provides a virtual interface into the more complex SAN environment



- "Client API" for host applications are common across NT/UNIX
- "SAN API" for communication with SAN Fabric,Devices, Services
- Complements more limited legacy SCSI I/O services

Enables SAN Discovery Services

SAN APIs based on de-facto and formal standards… with vendor specific extensions added as needed

Key Message : VERITAS has realized that a new technology layer is required that will allow all of our applications to be aware of the new properties of SANs. We are creating this layer, which will provide common APIs across OS platforms, for our products and working with industry forums to ensure consistency with new standards.

NOTE : THE SAN ACCESS LAYER IS NOT FOR SALE TO END USERS.

SAN Access Layer will allow storage management applications to "discover" the following attributes

- SAN topology map and detection of any changes, such as new storage nodes

- attributes of SANs such as distance from a server to a disk.

- "Zone" configuration

- a "zone" is a SAN term that refers to a configuraton of SAN resources into a single logical group. Servers that are not part of a "zone" cannot see these resources, providing a secure mechanism to partition large SANs into many small virtual SANs.

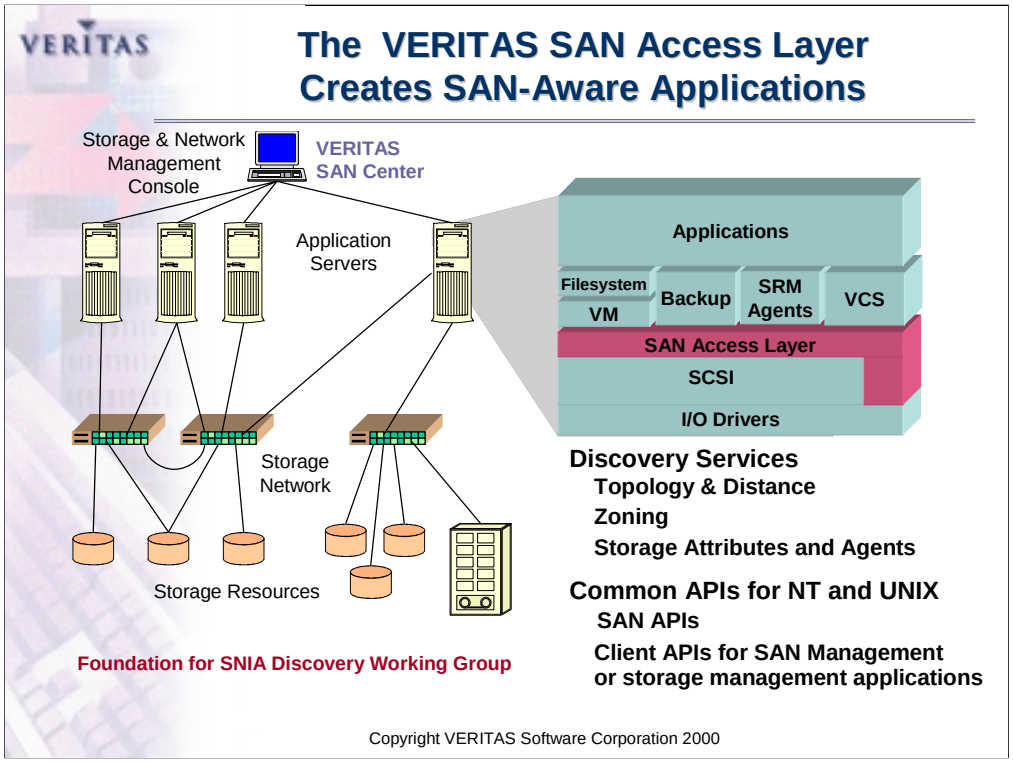
- today, this is done with a variety of GUIs and proprietary applications

- the SAN Access Layer will provide a single client API to a SAN management application simplifying this task.

SAN APIs to communicate with SAN equipment are being developed between VERITAS and FC vendors, with initial focus on switches. These will eventually be based on standardized APIs as defined by SNIA.

The first VERITAS SAN application to use the SAN Access Layer will be a VERITAS SAN Management application (an SRM tool for SANs). --- planned for 1H00

Shortly thereafter, VM and VCS will make use of this new layer.



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Shortly thereafter, VxVM and VCS will make use of this new layer.

VERITAS

SAN Discovery Services

SAN Discovery Services capture, correlate, and maintain capabilities & attributes of a SAN configuration and presents a common service API

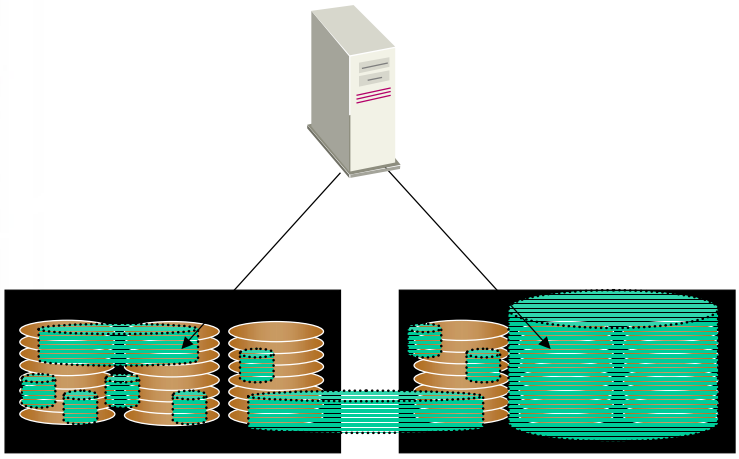
- **Properties that are discovered and used….**
  - ✔ **Device and host names**
  - ✔ **Topology/distance & SAN configuration state changes**
  - ✔ **Zoning Configuration & Control**
  - ✔ **Off-host Agents and Services (ie 3rd Party Copy)**
  - ✔ **Storage Attributes (cost, RAID level, performance)**

Using the V³ SAN Access Layer to Enable SAN Capabilities

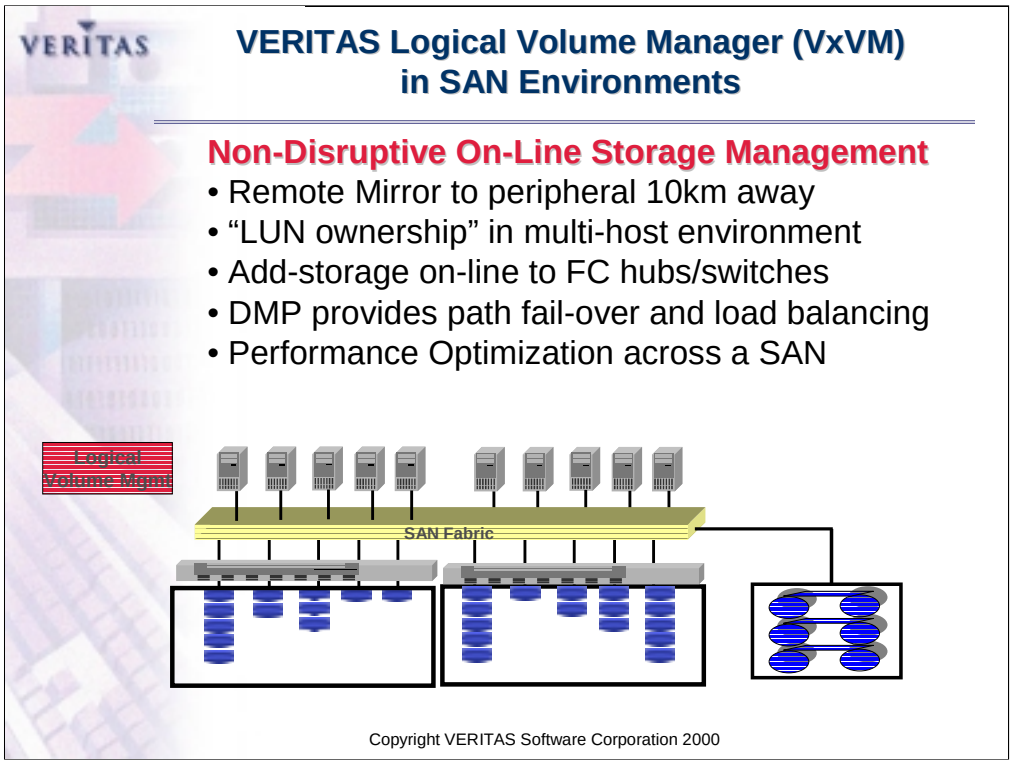
- **V³ SAN Management Tools**
  - ✔ **Single centralized application for zone administration**
- **High Availability Cluster Server**
  - ✔ **Automatically re-configures zone to provision a new path to failed application's storage**
- **Logical Disk / Volume Manager**
  - ✔ **Finds free disks to allocate to a growing application based on cost/performance needs**
- **Backup and Storage Migration**
  - ✔ **Finds the best 3rd Party Copy agent for LAN-free data movement**

VERITAS

Logical Volume Manager
An Example of Storage Virtualization



Virtualizes disk storage to allow creation and online modification of logical storage free of hardware and OS restrictions



Key Message : VxVM provides non-disruptive management of on-line storage (RAID or JBOD) for SANs by virtualizing physical SAN and SAN-attached storage. The increased connectivity of SANs increase the physical complexity of server-attached storage, making VxVM essential.

VERITAS VxVM is the leading Logical Volume Manager, used by OSVs such as MSFT and SUN, as well as major storage vendors (HDS, EMC,STK). This is key differentiator vs. Legato.

All these functions can be done while app is on-line….

- Remote Mirror to FC attached array up to 10km away (can create mirror on a remote disk, keep in synch using copy-on-write,assign the local RAID as a preferred read device to improve performance)

- LUN "zoning" - each server can "see" all LUNS, but VxVM assigns ownership to specific host. This ensures only one host has ownership for these LUNs.

- Add storage - using SANs, a new array can be added to a hub/switch without taking down the server. With VxVM, an existing LUN can be "grown" to include the new storage; VxVM allows LUNs to span multiple RAIDs allowing this feature to scale up in a SAN environment

- Performance - can use s/w RAID striping function of VxVM to stripe across multiple FC attached RAID or JBOD for high throughput applications. Provides another dimension of performance management.

Intelligent Storage Appliances

Virtual Consolidation of SAN Resources

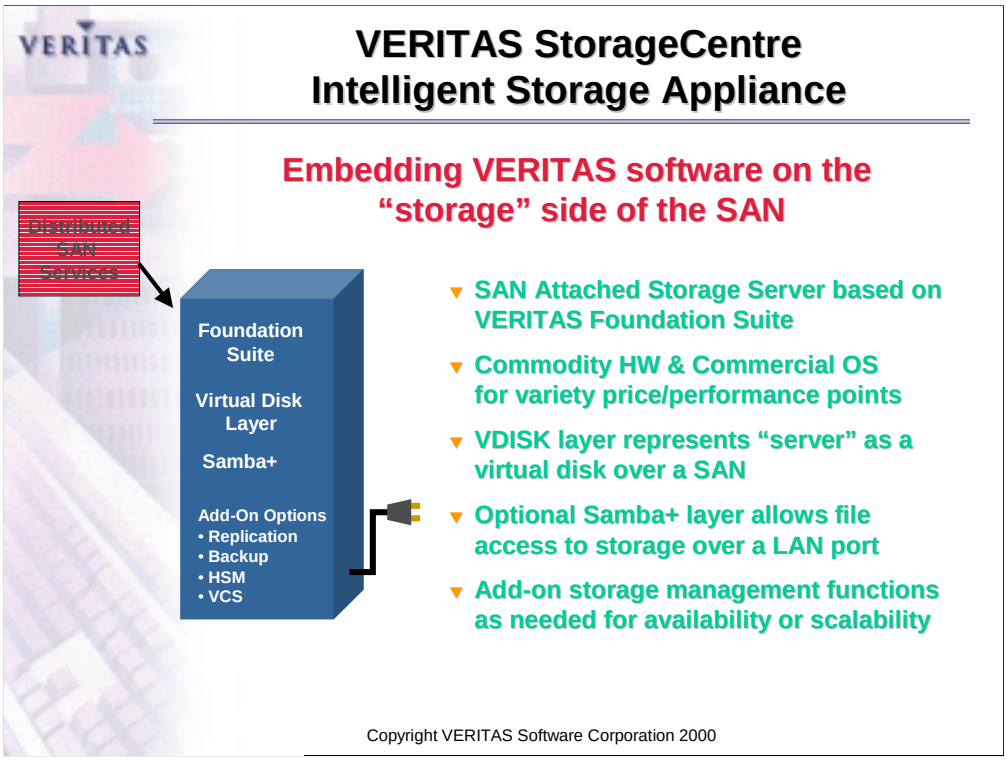
- **V³ Storage Appliance Software Suite**
  - **The power of VERITAS products together in one software suite and integrated into 3rd party intelligent storage servers (or *appliances*)**
  - **All centrally managed via V³ Storage Appliance's *Virtual Disk Manager***
  - **Based on FS, allows multiple virtual disks to be more efficiently managed**
    - **Other VERITAS products such as Backup and VCS to be provided as options -- all managed via one central console**
  - ***Virtual consolidation point improves manageability***
  - ***Maximizes uptime by minimizing impact of physical SAN configuration changes***
  - ***Provides the basis for "host free" data movement between intelligent storage devices***

Storage Management

Ensures Server Applications

Have the Right Quality of Storage to support

the Quality of Service Demanded by Clients



Key Message :SANs create an opportunity to physically centralize large amounts of storage in a single box and represent all this storage a one or more virtual disks to many servers. StorageCentre is a VERITAS software solution delivered with key hardware OEMs to manage physically centralized storage.

StorageCentre is based on Foundation Suite providing a well proven, feature rich platform for storage server functions. This provides core features such as dynamic volume management and quick error recovery.

This software is bundled with a off-the-shelf CPU, disks and enclosures, , interface cards and a commercial OS (Solaris, NT, LINUX) to create a storage server.

A "VDISK" layers allows the storage server to look like on or more virtual disks to the hosts on a SAN.

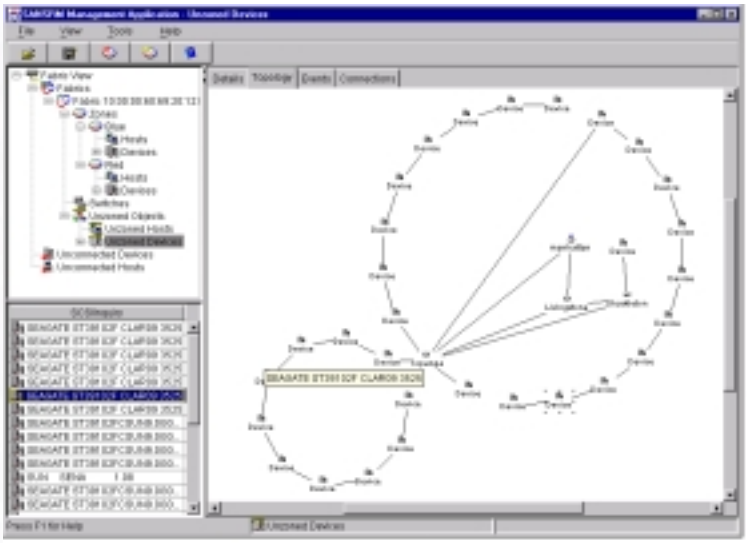
A SAMBA layer is also optionally provided to create a file system access to centralized storage, as in a NAS box. SAN and NAS functionality can be used at the same time. Samba allows both UNIX and NT hosts to access the storage.

Other VERITAS products, such as Netbackup, can be bundled with StorageCenter providing true off-host backup functions.

NOTE : this product is only available to strategic OEMS, but it represents a new area of influence for VERITAS by being on "both sides of a SAN"

SAN Center

SAN Visualization and Zone Administration



VERITAS

SAN Management Strategy

Enabling New Global Storage Applications

- **Goal : Reduce Complexity of SAN Administration**
  - ✔ **Manage *logical* SAN storage resources**
    (use device views as the exception)
  - ✔ **Deploy functional applications for zone management and capacity allocation**
  - ✔ **Make policy management pervasive to reduce reactive and manual management**

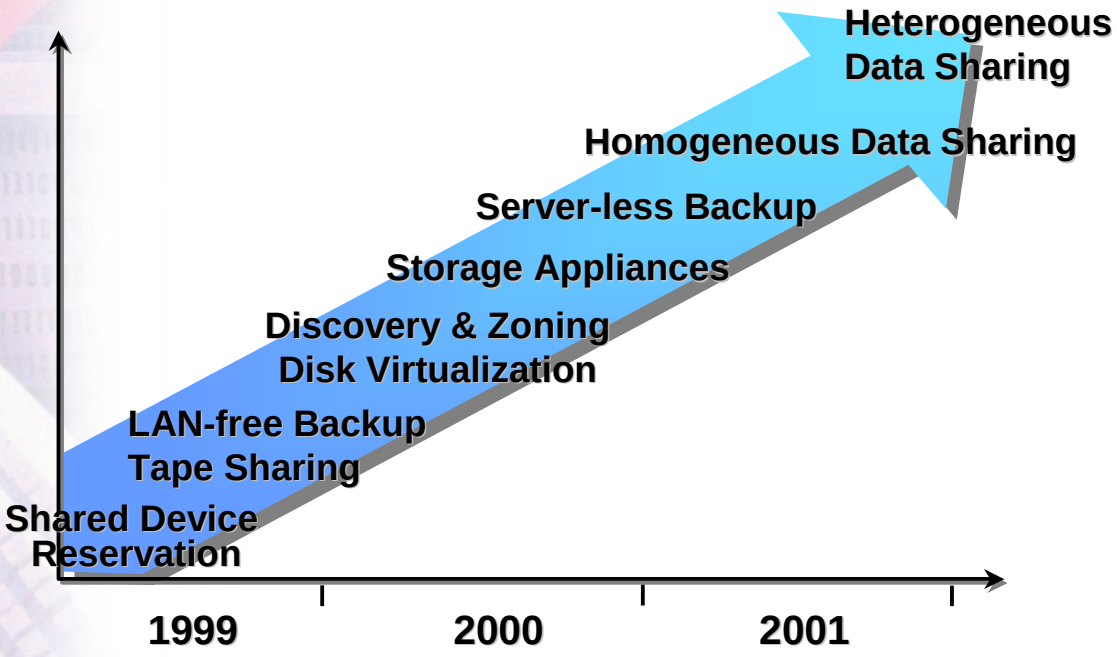
- **Modular Agent/Application architecture**
  - ✔ **Scales from point application management to large SANs using optional central repositories**
  - ✔ **Built on standards (JIRO, CIM, WMI, DMTF, SNIA) & installed base of frameworks (Tivoli,CA, HP, BMC)**

V^3 SAN Management Tools

Components used in VERITAS and OEM products

- **Administration built on V^3 SAN Access Layer**
  - SAN Visualization with multiple views
  - Zone management from a single application
- **VERITAS Application Management**
  - "SRM" agents and JAVA applications for VM, VxFS, NetBackup
  - Reporting, monitoring, policy automation
- **Common Services**
  - Event notification : e-mail, pager, SNMP
  - Policy administration and enforcement
  - Platform adapters: Systems Mgmt or OEM

SAN Evolution



We see several industry phases in the development of SANs. The initial deployment of SAN addressed sharing of tape libraries among multiple servers and LAN-free backup and recovery. Current development is centered around protecting connected storage from being accessed by all connected hosts. Hard and soft zoning provide a first line of defense, while logical unit management provides a last line.

While LAN-free backup suggests a major change to the flow of backup data, the data path is essentially the same as it always has been. Data still flows through the application host and the backup server on its way to the tape device. The next level of SAN exploitation, Server-less backup (or third-party copy), will actually shorten the backup/recovery data path by removing the application host and backup server, to allow direct data transfer from disk to tape.

Subsequent phases will support shared concurrent access from hosts running the same operating system initially, and then hosts running different operating systems.


VERITAS
Business without Interruption