



Microsoft®
Windows®
Storage Server 2003

Microsoft Windows Server 2003 and
Microsoft Windows Storage Server 2003:
Meeting the Storage Challenges of Today's Businesses

Microsoft Corporation

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Abstract

Businesses of all sizes are seeking cost effective storage management solutions that keep critical data protected and highly available. This white paper outlines the major storage challenges facing today's businesses, and shows how the integrated storage services in Microsoft® Windows Server™ 2003 and Microsoft Windows® Storage Server 2003 provide manageable, reliable and cost effective solutions designed to meet those challenges.

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Introduction

Data is a business's most valuable asset. The rich media content of static and dynamic web pages, huge volumes of email, 24x7 year-round demands of e-commerce, and the dependence on massive relational databases have all contributed to the explosion of mission critical data. For the system/storage administrator, managing an organization's growing wealth of information has become an increasingly complex, high pressure undertaking.

Key to the storage administrator's success is ensuring that information is:

- Available to those who need it when they need it.
- Protected from security risks, system failure or catastrophic events.
- Rapidly recoverable should the need arise.

The system administrator must accomplish these tasks in the context of rapidly changing storage technologies. While there are many storage solutions available today, not all solutions scale well with organizational growth, nor are all equally capable of delivering cost-effective high performance solutions.

The new and enhanced data and storage management capabilities of Microsoft® Windows Server 2003 and Microsoft Windows Storage Server 2003 are critical tools in helping system and storage administrators do more with less. This white paper discusses the storage challenges that face businesses today and the benefits of using the Windows Server platform to meet those needs.

Windows Server 2003 and Windows Storage Server 2003: Robust Storage Solutions

Windows Server 2003, Microsoft's newest release of the Windows server operating system, is a multi-purpose server designed to handle a diverse set of server roles, including file and print, mail, web, terminal and directory services. The integrated storage services in Windows Server 2003 have been enhanced and expanded to include a number of new features which help businesses control storage management costs and increase availability of data. Features such as the Volume Shadow Copy Service (VSS) and the Virtual Disk Service (VDS) make it easier to manage and maintain disks, helping lower total cost of ownership (TCO) especially in complex multivendor storage environments. Point-in-time imaging capability through VSS simplifies and speeds up both backups and restores. And, the Shadow Copies for Shared Folders feature of VSS enables end users to restore their own files and folders without IT intervention. High availability is enabled through multipathing and clustering.

Windows Storage Server 2003 is a network attached storage (NAS) operating system, built upon the Windows Server 2003 operating system. Windows Storage Server 2003 lets original equipment manufacturers (OEMs) build appliances optimized for file serving, since applications unnecessary to the file serving and storage tasks are not activated. Storage Server NAS devices are headless (without monitor, keyboard or mouse) and can be managed through a Web-based user interface. Designed for ease of deployment and seamless integration into the existing network, Windows Storage Server 2003 can provide expanded storage capacity to users on the network in less than 15 minutes. The Storage Server NAS solution especially appropriate for organizations that do not wish to put extensive IT resources into setting up multiple file servers and managing them.

Storage Challenges

The storage administrator in all businesses, large or small, is faced with a number of key problems:

- Ensuring that as an organization's data grows, storage capacity scales to accommodate it.
- Ensuring that mission-critical data is well protected from the risk of hardware failure, security breaches, or disaster; and that data is available on an on-demand basis.

The sections that follow explore these needs in greater detail.

The Need for Scalable Solutions

Embedded hard drives or directly attached external disks—referred to as DAS (directly attached storage)—is the most common way to store data on desktops, workstations and servers. The simplest solution to the demand for more storage capacity is to add more hard drives, upgrade to higher capacity disks, or to purchase additional computers each with more DAS. While DAS solutions can be effective for many businesses, they are often only temporary fixes, and result in a number of challenges for the storage administrator.

Decentralized Data

As the number of DAS systems grows, data is increasingly dispersed throughout the company, making it difficult for users to know what resources exist and where to find them. This is an especially troublesome problem with data stored on desktops, since unless individuals allow file sharing, there is no simple means of making the data accessible to others. Even with sharing enabled, there is no effective mechanism to determine exactly where information is stored, or which version of a document is the most up-to-date.

Migration of a company's critical data to a centralized server helps the situation somewhat since the data can be readily shared across the network. But as more servers are added to increase storage capacity (and to provide redundancy in the event of hardware failure), without a mechanism to unify the presentation of directories and file shares, users still have the problem of not being able to find the data that they need—or in some cases even knowing that it exists.

Underutilization of Storage Resources

Directly attached storage can only be accessed by the computer to which the storage is attached. Effective storage planning requires accurate predictions about which users and applications will require more storage capacity, and those resources must be provisioned before disk capacity is exceeded. Unfortunately, directly attached storage always scales poorly over the long term. Some computers inevitably exceed their storage capacity, while others have excess capacity but no means to effectively share those resources.

Adding more servers does not eliminate the problem of inefficient utilization of storage space between servers. Storage remains local to each server; thus space may be available on one server but capacity exceeded on another. Anticipating growth and implementing storage solutions that scale with growth remains a problem.

Proliferation of Storage Equipment

Adding servers to meet the need for greater storage capacity is an effective solution as long as the number of servers an administrator can handle remains manageable. Servers must be maintained, backed up and serviced, all of which rapidly becomes a management headache for the system administrator. And as long as storage remains directly attached to the server, each server must have its own directly attached tape drive for backups; a very costly solution for equipment that is only in use during the backup and restore process.

Ensuring Compatibility with Storage Networking Solutions

The best storage solutions not only meet today's storage needs, they also scale well with more advanced storage solutions, such as network attached storage (NAS) and storage area networks (SANs).

The Need for Fault Tolerance

More and more businesses rely on making their services and information available for access 24x7 year round. Failure in any of a number of hardware components—storage devices, storage interconnects, cabling, network interconnects, processors, motherboards and power supplies—can result in a temporary or permanent loss of data. Fault tolerance can be achieved through redundancy of hardware components, and is one means by which to ensure highly available data.

Redundant Disks

Externally attached storage devices can be made highly redundant using RAID (redundant array of inexpensive disks) subsystems. Redundancy can be achieved in a number of different ways, including mirroring, which replicates the data on one disk to one or more additional disks. Should one disk fail, the system can “failover” to a second disk with the replicated data.

Redundant Hardware through Clustering

A cluster is two or more computer systems that act and are managed as one. Clustering allows applications to remain online, even if a server goes down. Users are redirected to another computer without any loss of services.

The Need for Protected Data

System administrators must protect data not only from hardware failure, but also from data corruption, user error, and disasters. The most common means of protecting data from these problems is through tape backups and restores. Unfortunately, this solution provides only partial protection.

Poor Protection of Desktops and Laptops

Directly attached storage must be backed up by the individual user. However, users are rarely effective in performing regular backups, and for that reason, system administrators strongly advocate storing documents and data that is critical to the company on the server, where it can be properly backed up.

Open File Backup Constraints

While management of backups can be simplified using a centralized backup server, the time required to perform backups conflicts with the demand for continuously available data. Trying to back up an open file can result in data corruption. As a consequence, those files must either be skipped (meaning that the backup is incomplete) or users must close their applications during backups. Preventing data corruption during the backup process has meant that the backup period must be restricted to when users are not trying to access their files across the network—typically just evenings and weekends. As organizations produce more and more data that must be backed up, the time it takes to backup data can exceed the nightly or even weekend backup times.

The Need for Manageable Solutions

System administration can become enormously complex, especially in midsize and large organizations. Administrators are responsible for managing web, application and database servers and for clustering those servers to ensure effective performance and high availability. They are also responsible for managing dedicated storage networks (SANs) that host multi-vendor storage devices, each with a vendor specific disk management application. These management consoles are not standardized, making training and usage unnecessarily complex. Administrators are responsible for managing utilities for such tasks as backup, data mining and testing. Since applications are not storage-aware, managing data for backup and transport can be a complex and inefficient process. Finally, although many organizations require multiple platforms to support various applications, there are increasing demands that data be shared among users irrespective of whether they use Windows, Unix or some other operating system.

The Need to Control Costs

Organizations are demanding that system administrators deliver robust, reliable and scalable storage solutions within a budget that remains flat or has declined. Among the most effective ways to control costs and still deliver effective storage solutions is to consolidate resources. Network attached storage solutions provide a cost effective means to add storage capacity while consolidating equipment. As many as 10-25 file servers can be consolidated into a single NAS device, depending on the amount of data consolidated. Not only does this mean that equipment and licensing costs are curtailed, it also enables the consolidation of related equipment such as backup devices and the reduction in management overhead.

Solutions that automate or speed up storage provisioning, backups and general maintenance all decrease the need for administrator interventions, saving the administrator time and effort. These costs can be directly passed on to the business, lowering total cost of ownership and ensuring the most effective utilization of existing storage resources.

Advantages of the Windows Storage Platform

Both Windows Server 2003 and Windows Storage Server 2003 provide businesses with reliable storage solutions that are designed to keep data protected, highly available, and easily managed—without huge capital expenditures. Windows Server 2003 and Windows Storage Server 2003 help businesses to reduce their total cost of ownership by:

- **Lowering IT Intervention Costs.** The accidental deletion or overwriting of files has long the bane of system administrators charged with the time intensive and costly task of locating and restoring single files from tape. The Shadow Copy for Shared Folders feature of the new Volume Shadow Copy Service (VSS) enables users to easily restore their own deleted files, without IT intervention.
- **Managing Backups and Restores More Effectively.** As organizations produce more information, backing up data becomes an increasingly time intensive and potentially disruptive operation. Tape backups have the additional drawback that it is only during the restore process that data corruption becomes apparent—making data recovery impossible. With the new Volume Shadow Copy Service (VSS), open file backups are enabled, thus making unnecessary the disruptive practice of shutting down applications during backup to prevent data consistency issues. The process of creating shadow copies is designed to ensure data integrity prior to the tape backup process, thus ensuring that the data is complete, uncorrupted and able to be restored.

In the case of catastrophic system failures—cases where the hard drive loses all operating system information and is effectively stripped down to the bare metal—Automated System Recovery makes possible rapid restore of the system's original state.

- **Increasing Availability and Security of Data.** Making data highly available throughout an organization requires data redundancy. The Volume Shadow Copy Service allows administrators to schedule making regular copies of data stored on disk, and makes it painless for users to access consistent point-in-time copies of data. Moreover, since only the *changes* to the data are saved¹, Shadow Copies take up very little disk space, enabling companies to make copies of whatever data is needed.

The File Replication Service controls replication and synchronization of data. This data can be made highly available to remote sites using the Distributed File System.

- **Managing Multi-Vendor Storage More Effectively.** Multi-vendor storage device management has required that the system administrator manage each device independently—and use a different vendor supplied interface to do so, thus adding another layer of complexity to the system administrator's job. With the introduction of the new Virtual Disk Service (VDS), the system administrator can use a single interface to configure storage from multiple vendors. (This solution is fully implemented in partnership with the storage hardware vendors.)²

¹ This is true when using shadow copy capabilities through the operating system. Hardware provider solutions may be different.

² Hardware vendors create the hardware provider (the component that controls the storage device), and use the VDS application programming interfaces (APIs) to provide hardware specific VDS functionality.

- **Increasing the Effectiveness of File Sharing.** The Distributed File System (DFS) helps to make the end user's process of locating and accessing files distributed across an organization effortless. With the Windows Server 2003 release, DFS has been enhanced to allow for multiple DFS root directories on each server. This capability means that it is no longer necessary to add an additional server for each additional DFS root directory. DFS also offers closest site selection, ensuring access to the nearest available copy of the data at the lowest cost.
- **Leveraging Existing Network Infrastructure for SAN Storage.** Windows support for iSCSI technology allows users to connect computers to consolidated storage devices using existing Ethernet technologies, rather than having to install a separate Fibre Channel network. Microsoft's enabling of this technology will help bring the advantages of storage area networking (SAN) to midsize and small businesses that otherwise could not afford the extra cost and management of running a separate Fibre Channel network. SAN technology based on IP also removes the physical limitations of moving data further than the current 10 km limit imposed by Fibre Channel technology.

In addition to enabling less expensive SAN solutions, the Windows storage platform now provides better support for SANs. Administrators can now control volume mounting to protect volumes from unintentional access. Handling of Fiber Channel SANs has been improved, as has SAN Host Bus Adapter (HBA) interoperability, both of which further ease administration complexities. Lastly, boot from SAN, with vendor support, is greatly enhanced in Windows Server 2003.

Windows Server 2003 and Windows Storage Server 2003 give businesses cost-effective, highly manageable and scalable storage solutions, designed to meet a range of business needs and helping to ensure that the cost of managing storage does not exceed storage capital expenditures. The next section details the new storage features and enhancements to existing functionality.

New and Enhanced Storage Solutions

The key to reliable storage solutions lies jointly with managing disks and data effectively. Windows Server 2003 and Windows Storage Server 2003 provide a number of services and tools that the system administrator can use to effectively manage both data and storage, thereby maximally exploiting a company's storage investments.

VDS for Storage Disk Management

Virtual Disk Service (VDS) is *new* to Windows Server 2003 and Windows Storage Server 2003.

VDS enables storage solutions that are:

Scalable	✓	Configures storage devices on NAS and SAN
Fault tolerant	✓	Configures RAID (mirroring, striping or striping with parity) for data redundancy
Manageable	✓ ✓	Provides a single interface for multi-vendor storage ³ Controlled mount points for SANs

VDS is the foundation supporting the Disk Management user interface (UI) and a number of scriptable command line interfaces (CLI) for disk management. VDS enables disk management of DAS, NAS and SAN devices, and is especially helpful in simplifying system administration of multi-vendor storage devices on SANs.

Disks can be housed singly (as is the case with embedded disks) or grouped together in large storage subsystems. The disks within a storage subsystem can be configured as:

JBOD systems

JBOD systems are "just a bunch of disks." Early disk management software could format, partition and assign drive letters to each disk individually. However, prior to technologies like VDS, there was no means by which to manage these disks as a unit.

RAID systems

Not only are these disks physically housed together, but with the appropriate disk management software, these disks can be variously configured such that virtual disks are created across multiple physical disks. So configured, each virtual disk acts as a single logical unit, numbered for identification (hence they are referred to as LUNs). Each RAID type (most commonly RAID 0-5) is associated with a particular level of data redundancy, which translates into enhanced performance and data protection. RAID devices can be further distinguished by where the RAID controller software lies:

- **Software RAID.** The intelligence for creating the RAID types lies in the host operating system. All processing control resides in the OS.

³ Where supported by hardware providers.

- **Hardware RAID.** Control for configuring RAID types does not lie within the host OS, but is either on an internal RAID adapter card or it is external to the host computer system, residing on the external disk subsystem itself.

DISKPART

DISKPART is a scriptable CLI, which provides the commands for managing the creation, extension and deletion of partitions on both basic and dynamic (expandable) disks. The utility can be used to configure both simple volumes (which span a single partition) and multi-partition volumes (which can span multiple partitions on a single disk or on multiple disks). Multi-partition volumes can be configured to provide different levels (RAID types) of data redundancy for data protection and performance improvements. Software RAID devices are controlled by DISKPART.

Volume extension is particularly important in those instances when a volume has nearly reached allocated capacity but there is still free unallocated disk space available on a single disk or RAID array. Volume extension allows for an increase in the size of the volume, with no loss of data.

DISKRAID

DISKRAID is a scriptable CLI available through the Windows Server 2003 Resource Kit or the Deployment Kit. It is used with VDS and vendor specific hardware providers to configure virtual disks (logical disks that span two or more physical disks) on hardware RAID devices.

Multi-vendor Disk Management

Multi-vendor disk management on SAN systems has, until now, been a complex undertaking. Configuration of storage devices on the SAN has previously been through vendor specific management applications. These applications are not standardized, and require that storage administrators be trained on how to use differing interfaces. VDS overcomes this lack of standardization by providing a single standardized interface by which to manage multi-vendor storage devices.

VDS's scriptable command line interfaces allow administrators to automate storage operations across storage systems from multiple vendors. Using the CLI, the administrator can create a script to add storage to the network. Although this script works with multi-vendor storage hardware, no vendor specific training was necessary to create the script. When new drives are added to the storage array, the administrator can run the script which automatically configures the disks for use. VDS multi-vendor disk management requires a "hardware provider"—software from the vendor which translates VDS abstractions into hardware RAID specific instructions for configuring RAID sets.

VSS for Effective Data Protection

Volume Shadow Copy Service (VSS) is *new* to Windows Server 2003 and Windows Storage Server 2003.

VSS enables effective:

Data Protection	✓ ✓	User-enabled Shadow Copies for Shared Folder file restores Open-file backups
System Management	✓ ✓ ✓	With third party support, shadow copies can be transported to other systems for backups, data mining or testing Faster backups Faster restores
Cost Control	✓	Fewer staffing resources needed

The Volume Shadow Copy Service provides the infrastructure for creating high consistency point-in-time copies of single or multiple volumes. The service provides effective data protection to both system administrators and end users.

Open File Backup

VSS coordinates with business applications, backup applications and storage hardware to provide application-aware data management. Previously, there had been no means by which backup applications could prepare data for backup—applications either had to be shut down to prevent data corruption or files were simply not backed up. Now, with VSS, open file backups are possible and application users do not have to worry about closing files or being unable to use their applications.

Data Integrity

With VSS, the storage administrator no longer has to worry about missing data during the backup process, or about the possibility of undetected data inconsistencies. If there is a problem during shadow copy creation, the administrator is notified immediately of an inconsistency between the original data and the shadow copy. This enables the administrator to reschedule shadow copy creation before committing the backup copy to tape, rather than discovering during the restore process that the backup had been unsuccessful.

User-Enabled File and Folder Restores

Shadow Copies for Shared Folders (SCSF) allows end users to use the “Previous Versions” UI to restore deleted or overwritten files (or whole folders of files) without the need for system administrator intervention. The process of creating shadow copies does not impact the way that users work, since the process is transparent to users. However, should a file be deleted or overwritten, the user is empowered to manage their own files, recovering lost data and fixing mistakes without having to rebuild the file or wait for IT to restore it from tape. Restored files retain the permissions and file preferences associated with the original files. Moreover, since SCSF works with any type of file built with any application, all users can benefit.

Data Transport

Using third party software, shadow copies can be made available to other servers that share a common storage pool. Transport of data among systems is virtual, and done through the process of LUN masking and unmasking, under VDS control. Virtual transport of data enables servers to share data for more effective backups, data mining and testing.

FRS for Remote Replication

File Replication Service (FRS) is *enhanced* in Windows Server 2003 and Windows Storage Server 2003.

FRS enables:

Highly Available Data	✓	Failover to replicated disk in the event of hardware failure

The File Replication Service is used to copy and maintain files and shared folders on multiple servers simultaneously. When changes occur, local site content is synchronized immediately; remote site content is changed according to an administrator set schedule. FRS, in conjunction with DFS, makes data highly available, even to remote sites.

It is important to note that FRS is not an effective means of providing data protection from software bugs, viruses or other causes of data corruption, since the corrupted data is replicated to failover disks as well.

DFS for File Sharing

Distributed File Sharing (DFS) is *enhanced* in Windows Server 2003 and Windows Storage Server 2003.

DFS enables storage solutions that are:

Scalable	✓ ✓	Enables consolidation of distributed shared folders into a single namespace Simple integration of new servers and storage into namespace
Manageable	✓	Users can readily locate and share data
Fault tolerant	✓	Active Directory information is used to provide failover to alternate site
Highly Available	✓	Load balancing helps keep user files highly available
Cost Effective	✓	Failover to least expensive alternate site

DFS simplifies locating and managing data multiple network servers. This is especially important to users who must access widely distributed data on different servers, but do not want to be hampered with having to remember and provide the server address that data lies on in order to access it.

Unified Namespace

The Distributed File System (DFS) enables end users to readily find data housed on different disks by presenting a single view of physical storage, as if the data were only on a single machine. The system administrator accomplishes this by set up a single unified system of naming (the “namespace”) such that users can share and access files, whether they are on the same machine, in different departments, or at branches of an organization across a country.

Simple Migration

As organizations move existing data to newer, more powerful servers, the namespace organization remains the same, without requiring additional user education.

DFS has been enhanced by directing clients to the closest available DFS server, rather than having them accessing a distant share if one is available nearby or even locally. Not only does this help businesses control costs, it also ensures the best network performance for each client.

ASR for Rapid Disaster Recovery

Automated System Recovery (ASR) is *new* to Windows Server 2003 and Windows Storage Server 2003.

ASR enables effective:

Disaster Recovery	✓	Allows complete recovery of OS and system settings

While backing up data to tape protects mission critical data from catastrophic events such as fire or massive electrical surges, it does nothing to protect system software stored on the hard drive, since that information is not copied during the backup process. A critically damaged hard drive will lose all critical registry information, system files, and disk partition information; nothing remains but the bare metal. Restoring the base operating system plus the backup application (the minimum required to restore backed up applications and data) is time intensive process.

With Automated System Recovery, the system administrator prepares for such a disaster by saving to floppy disk a complete backup set of information about the how the server was configured, including any volume information. In the event of system failure, this backup set is used with the ASR restore CD (which contains the necessary software and drivers to allow the restore) to rapidly restore all system setup information.

ASR is also useful when upgrading to a more powerful server, since it eases the process of migrating system information from the old server to the new.

EFS for Secure Data

Encrypted File System (EFS) is *enhanced* in Windows Server 2003 and Windows Storage Server 2003.

EFS enables effective:

Data Protection	✓	Data protected even on mobile units

EFS encrypts data as it is stored to disk, preventing it from being accessed or read by user who lack the appropriate authorization. Encryption can be enabled by the user without any administrative intervention. Backup copies of encrypted files are also encrypted. To encrypt data traveling over the network, Internet Protocol security (IPsec) is also available. Encryption is especially useful for mobile units which are highly vulnerable to theft.

EFS has been enhanced to prevent the removal and mounting of storage volumes onto a different system. In Windows 2000, because encryption had been enforced at the file and directory level, security protection could be bypassed. In Windows Server 2003 and Windows Storage Server 2003, the data itself is encoded, preventing such security breaches.

Administrators can authorize additional users to access encrypted files, as well as enable users to encrypt Web folders, thus provide a simple and highly secure method for users to share folders.

iSCSI for Storage Area Networking

Internet SCSI (iSCSI) is new to Windows Server 2003 and Windows Storage Server 2003.

iSCSI provides storage solutions that are:

Scalable	✓	Enables block based (SAN) storage on existing IP networks
Manageable	✓	Leverages existing networking technologies
Cost Effective	✓	Dedicated Fibre Channel equipment unnecessary
	✓	No specialized training required

Conventional networking technology enables network file transfer. However, for some applications (such as databases) it is more effective to transfer data to storage in its more granular form of blocks rather than files. While parallel SCSI interconnects enable transfer of block level data, both the number of storage devices that can connect to a computer, and the distance those devices can be from the computer, are highly restricted. Fibre Channel uses the serial SCSI protocol which enables block transport, and FC interconnects facilitate the attachment of many devices over long distances (10 km at 1Gbs in standard implementations). Both these factors have combined to make Fibre Channel the dominant technology for SAN solutions.

The following are disadvantages of Fibre Channel:

- The infrastructure (wiring, interconnects, switches etc) tend to run on proprietary firmware.
- Specialized training (which is difficult to obtain) is necessary for effective SAN management.
- Fibre Channel imposes a 10 km distance limitation on data transfer; iSCSI, on the other hand, enables data transfers over WAN distances.

The development of iSCSI—block-based storage over IP networks—is a technological breakthrough that can leverage a company’s existing infrastructure to provide a storage area network solution. Microsoft’s iSCSI initiator enables computers to access storage on the network, to determine if the storage is available for use, and to transport data securely over the internet to the storage device. Microsoft’s iSCSI initiator, available for free and downloadable from the internet, helps bring high end solutions—like SAN—to mid and small sized businesses.

MPIO for Highly Available Data

Multipath Input/Output (MPIO) is new to Windows Server 2003 and Windows Storage Server 2003.

Multipath I/O provides:

Highly Available Data	✓	Failover to an alternate path in case of path failure
Fault Tolerance	✓	Redundant hardware enables failover

MPIO, multipathing or redundant paths for I/O channels, provides an alternate connection to the storage devices in case of failure of the primary I/O path. Optimally, MPIO can provide multiple paths (up to 32) to stored data in order to improve performance through load balancing. Path redundancy has long been critical to enterprise scale organizations.

Microsoft’s MPIO solution is only available through the driver development kit (DDK), which allows storage vendors to create interoperable multipathing solutions in their hardware products. System administrators and end users benefit from using these products, since they help ensure that end users have highly available data even in the event of a failure of a component in the path between the client and storage. Users can also benefit from increased performance.

Enhanced Support for SANs

With the appropriate interconnect technology (iSCSI or Fibre Channel), deploying a storage area network in a Windows environment is much simpler using Windows Server 2003 operating system than it had been for previous versions of Windows.

- **Ability to boot from the SAN.** Previous versions of the Windows platform required that the boot operation be conducted using the storage attached to the main server. If that server failed, however, another server had to reboot the system, which could be a time consuming and difficult process. In combination with SAN vendor support, the Windows Server 2003 operating system enables the system administrator to reboot across the storage area network, thus reducing downtime.
- **Flexible Volume Mounting.** In the past, in the shared disk environment of SANs, if Windows was able to detect a virtual disk, it would attempt to claim it for its own, failing to recognize another system's prior ownership. This limitation could result in loss of data. By controlling mount points, Windows is prevented from accessing volumes that are not assigned to the OS.

Summary

Companies of all sizes are searching for cost effective solutions to their storage management challenges. Many of the high end storage solutions—including the consolidated storage network model itself—were first worked out to solve the business problems of large companies. These storage customers have demanded the most advanced technologies available to solve their storage problems, and have driven the development of many technological innovations.

Windows Server 2003 and Windows Storage Server 2003, together with Microsoft's OEM and independent software vendor partners, deliver advanced storage management solutions to a diversity of companies. Snapshots and remote replication capabilities are no longer the exclusive tool set of high-end (and high-priced) storage solutions. These powerful capabilities are built into Windows Server 2003 and Windows Storage Server 2003, making advanced storage solutions available to midsize and even small organizations.

Microsoft also provides advanced storage solutions to enterprise organizations. For many years enterprises had been locked into using a single hardware or software provider for all of their storage needs, regardless of the fact that not all needs required enterprise level solutions. As greater interoperability becomes part of the storage standard, lower cost options from multiple vendor sources are possible. Microsoft's robust storage platforms provide one such option.

Related Links

See the following resources for further information:

- Microsoft Windows Network Attached Storage Home at <http://www.microsoft.com/windows/storage/default.aspx>
- Technical Overview of Windows Server 2003 Storage Management at <http://www.microsoft.com/windowsserver2003/techinfo/overview/storage.aspx>
- Windows Server 2003 Storage Services at <http://www.microsoft.com/windowsserver2003/technologies/storage/default.aspx>