

APPLICATION NOTE

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Sun StorEdge™ NAS solutions: The business case for network-attached storage (NAS)

ABSTRACT

Network-attached storage (NAS) systems are designed to provide a storage and data consolidation platform for files that can be shared between heterogeneous clients and servers. This paper describes how Sun StorEdge™ NAS technology can provide efficiencies in storage utilization, management, and costs. It also provides an overview of the Sun StorEdge NAS product line.

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1 Executive summary

Sun StorEdge™ network-attached storage (NAS) systems are designed to add storage to your network and allow for file sharing without having to provide other server-centric activities, such as e-mail or file management. NAS hard disks are set up with their own network addresses rather than being attached to the central computer that serves applications to network users. Removing storage access and its management from the department server reduces competition for processor resources, thereby enhancing both application performance and file serving.

NAS, as a platform for the consolidation of storage and data, provides a number of benefits, including:

- Increased collaboration
- Business and regulatory compliance
- Improved performance, business continuance, and disaster recovery
- Increased data availability
- Improved reliability
- More efficient utilization of storage resources
- Improved scalability and security
- Simplified administration
- Centralized backup
- Reduced costs

This paper will expand on each of these key advantages, describe common NAS network configurations, and provide an overview of the Sun StorEdge NAS product line.

2 Business storage-related challenges

In today's business environments, increasing demands on storage are being driven by increased data generation, numerous business and regulatory compliance requirements, and the ever-increasing retention of e-mails. Storage capacity requirements are increasing, on average, by 52% per year¹ — this means that storage doubles every 18 to 24 months.

While storage demands increase, estimates show IT budgets are either growing by only 2% to 5% or are stable from year to year. The result: administration staffs have to manage the growing IT environment with static resources.

Management isn't cheap. The typical cost of managing traditional direct-attached storage (DAS) is estimated at three to five times the actual cost of the storage itself. There are numerous management tasks, including:

- Finding available storage
- Determining usage patterns
- Migrating and replicating data
- Adding new storage
- Backing up and archiving data
- Restoring data when requested from end users

The challenge for business is to perform these functions cost-effectively with reduced IT staffing. A change in storage strategies may be the answer.

With storage requirements doubling every 18 to 24 months, business must look for smarter storage and management options.

¹ IDC, *Worldwide Disk Storage Systems Forecast and Analysis*.

2.1 Common storage environments today

Of the total storage shipped over the past four years, 48% was direct-attached storage² — meaning that storage is either within a server or SCSI-attached to a single server or desktop. This requires that backups are performed on a server-by-server and desktop-by-desktop basis. Often, storage is not interchangeable between servers, and it is not uncommon for storage to be under-configured or over-configured for a particular server's workload.

According to market analyst IDC, companies in 2002 spent \$6.4 billion on general-purpose servers used for file sharing while spending only \$1.3 billion on network-attached storage. This can ultimately lead to service challenges, as general-purpose servers are not optimized for storage performance or scalability. (For example, many systems share files by actually copying them between servers and desktops via e-mail or FTP. This results in duplicate versions of data that waste space and can be changed by multiple user simultaneously, leading to confusion as to who has the latest or most accurate copy.) Furthermore, as application needs expand, contentions between application processing and file sharing arise.

Many storage configurations today employ general-purpose servers that can't provide needed high-end reliability and performance.

2.2 Typical storage environment problems

A challenge with typical storage environments is that every server or desktop must be separately managed with disparate applications and graphical user interfaces (GUIs). This requires administrators to learn numerous tools, resulting in an increased learning curve, higher incidences of human error, and ineffective usage of resources. Moreover, DAS storage utilization is estimated at around 30% because direct-attached storage cannot be shared. Thus, to avoid capacity shortages, administrators deploy excess amounts of DAS to each server. Ultimately, such guesswork results in most servers having more capacity than required while some servers starve for more.

Typical servers deployed for file sharing do not provide high-availability features; therefore, application failures that cause server downtime result in loss of access to the data stored on that server. Also, adding storage in this configuration is difficult and time-consuming, typically requiring downtime for server reconfiguration. And when a server's useful life is over, there is typically no method of preserving the storage on that server. This forces administrators to migrate data to another server prior to retirement.

Finally, due to capacity limitations of general-purpose servers, more and more physical systems are required to manage the increasing body of data. And with Windows environments, client-access licenses must be acquired for each server added to the "storage farm" — not to mention general licensing for operating systems, backup software, management tools, and an increased cost in tape drives to allow backup from each individual server.

3 Storage consolidation platforms

Today there are two separate storage architectures that provide alternatives to DAS: storage area networks (SANs) and network-attached storage (NAS). Both enable the consolidation and sharing of storage resources and provide for increased storage performance and availability through RAID configurations. This section briefly describes the two architectures and how they differ.

² IDC, *Worldwide Disk Storage Systems Forecast and Analysis*.

While SANs represent an advance over DAS, NAS has distinct advantages over SAN implementations.

3.1 Storage area networks

SANs can be based on Fibre Channel (FC) or IP (iSCSI). For Fibre Channel SANs, a separate network is required and consists of specialized hardware (host bus adapters for endpoints that require connectivity to the SAN and SAN switches). iSCSI SANs can utilize pre-existing networks, but are best designed as dedicated IP networks to avoid contention between storage and client/server traffic.

Regardless of whether the SAN is Fibre Channel or iSCSI-based, SANs provide only for the consolidation of the physical storage resources and in every other way resemble a DAS environment. Each server still owns its respective file system, and data is still shared by the general-purpose server and must be backed up on a server-by-server basis.

SANs are beneficial when applications require the speed of direct-block access and are typically implemented for large-scale database applications.

3.2 Network-attached storage

NAS is a specialized server and operating system that is optimized for fast file access and heterogeneous file sharing with facilities for high availability, rapid recovery, data protection, ease of management, and data backup and recovery.

NAS devices can have their own, integrated storage or they can share SAN storage. When sharing SAN storage, the NAS system provides the facilities for file sharing while leveraging the previously consolidated pool of SAN storage.

NAS is beneficial when there is a need to share files to different servers and desktops; it is typically implemented for messaging, development applications, business and regulatory compliance, and general file sharing.

4 Benefits of migrating to Sun StorEdge NAS systems

Now that you have some background information on current business challenges, typical storage environments, and the applicability of SAN and NAS architectures, this section provides a discussion of the benefits of migrating to a Sun StorEdge NAS environment.

4.1 Storage and data consolidation

As we have seen from the descriptions of SAN and NAS, NAS provides a platform for not only consolidating storage but also for consolidating data. With Sun StorEdge NAS systems, a single copy of a given file can be shared between multiple systems via standard protocols such as Network File System (NFS) for UNIX® systems, Common Internet File System (CIFS) for Windows systems, and File Transfer Protocol (FTP) for file downloads from practically any platform.

In addition to allowing access to shared files from heterogeneous systems, Sun StorEdge NAS systems also provide unified security between platforms so that file permission changes in UNIX are also reflected in Windows Access Control Lists (ACLs) and vice versa.

4.2 Increased collaboration

By maintaining a single copy of each file (rather than multiple copies), users can be assured that they have access to the latest version of relevant business information or the latest copy of source code for collaborative development efforts. Any updates made to the file will be immediately available to others who have access permissions to that file.

It's hard to overstate the importance of regulatory compliance — Sun StorEdge NAS systems can help ensure your data is there then you really need it.

4.3 Business and regulatory compliance

Sun StorEdge NAS systems offer optional Sun StorEdge NAS Compliance Archiving software. The Sun StorEdge 5310C NAS appliance is composed of the Sun StorEdge 5310 NAS appliance and the Compliance Archiving software. This system allows administrators to assign write-once, read-many (WORM) properties to files along with strictly enforced retention periods. The Sun StorEdge 5310C NAS appliance has been evaluated by Kahn Consulting, Inc. as meeting Securities and Exchange Commission requirements for electronic storage media, as articulated by 17 CFR § 240.17a-4.³ These rules are among the most stringent compliance requirements in the industry today.

4.4 Improved performance

There are two areas in which Sun StorEdge NAS systems provide an overall improvement in performance:

- Sun StorEdge NAS systems are purpose-built NAS appliances with a specialized operating and file system for storing and delivering files that, in most cases, will provide an increase in file sharing performance over a general-purpose server.
- Application servers regain processing cycles that would otherwise have to be dedicated to managing and accessing storage and can apply those resources solely to application processing.

4.5 Business continuity

Sun StorEdge NAS systems can improve business continuity by increasing the availability of data. By consolidating data on Sun StorEdge NAS systems, data remains available when individual servers fail due to hardware, application, or operating system failures. Also, consolidating data reduces the number of potential points of failure.

Sun StorEdge NAS systems also provide many built-in features that help assure data availability:

- Dual redundant components, including high-availability clusters to increase system availability
- File system journaling to provide data integrity and rapid recovery of the system should a reboot be required
- File system checkpoints to provide virtual point-in-time copies of data for ease of data restoration
- Remote data replication to allow rapid recovery in the event of a site failure

4.6 Increased data availability

As was mentioned above, consolidating data on Sun StorEdge NAS systems eliminates many potential points of failure brought about by deploying DAS on individual servers. Thus, when a server fails, the data is still accessible from the Sun StorEdge NAS system, thereby eliminating the need for time-consuming file system integrity checks when the server is back online. This level of data accessibility translates into a reduced need to purchase high-availability features for each individual server.

Most data failures are not catastrophic, but can still end up costing your company millions of dollars.

³ Kahn Consulting, Inc., "An Evaluation of the Sun Microsystems, Inc. StorEdge Compliance Archiving System," January 2005

In addition to the consolidation and reliability benefits, the backup of critical production data can commence at any time by utilizing the Sun StorEdge NAS file system checkpoints (virtual point-in-time copies), which require little to no downtime to start the backup process. Therefore, access to production data is ongoing while the most current point-in-time checkpoint copy is being preserved to tape or optical media.

4.7 Improved reliability

Sun StorEdge NAS systems offer numerous features for improved reliability, including:

- RAID configurations to protect from single-drive failures
- Dual-redundant RAID controllers to protect from RAID controller failures
- Port aggregation and failover software to protect from network failures
- Dual-redundant power supplies and UPS monitoring to protect from power failures
- High-availability clusters to protect from system failures

4.8 Disaster recovery

In addition to all of the standard and optional features to protect from component and system failures, Sun StorEdge NAS systems also provide remote data replication. In the event of the failure of the source system or site, administrators can quickly promote the mirrored copies of data to primary copies and give users full read/write access.

4.9 Improved utilization of storage resources

With data consolidation on Sun StorEdge NAS systems, administrators can make more efficient use of storage resources without having to worry about application contention on individual application servers. Islands of discrete, under-utilized, direct-attached storage are eliminated while all users can access and share centralized storage capacity through the Sun StorEdge NAS appliance.

In addition to the physical resource benefits of consolidating to NAS, quota capabilities provided with Sun StorEdge NAS systems limit the amount of space that can be used by individual users, groups, and/or directories. This allows administrators to easily control data growth with management guidelines.

4.10 Improved scalability

Sun StorEdge NAS systems provide three storage configurations — 6.1 terabytes (TB) of storage using SCSI disk drives, up to 134 TB of storage using Fibre Channel disk drives, or up to 179 TB of storage using serial ATA (SATA) drives. File systems can be dynamically expanded when storage demands increase. Moreover, since time-consuming file system integrity checks are not required with the Sun StorEdge NAS journaling file system, new hardware can be added with minimal downtime via quick reboots.

4.11 Improved security

Sun StorEdge NAS systems offer a number of features for improved security, including the ability to define which users have access to the system, segregate files into separate file systems, and apply security policies to individual files and directories. Thus, with Sun StorEdge NAS systems, security can be more easily managed at a central location (rather than on individual file servers), allowing improved control over who has access to data.

In the event of a disaster, Sun StorEdge NAS systems can help your organization get back on its feet quickly.

For complete peace of mind, Sun StorEdge NAS systems support policies to control who accesses data and when.

4.12 Simplified administration

Administration is simplified not only by having a central platform for data consolidation, but also by the Sun StorEdge management's easy-to-use interface. Sun StorEdge NAS systems provide an intuitive graphical user interface and wizards for volume creation and file system creation, as well as file system checkpoint policies. File system checkpoints (virtual point-in-time copies) enable end-user file restore capabilities, which also reduce the administrative burden involved in restoring end-user files from backups.

4.13 Centralized backup

Sun StorEdge NAS systems provide an ideal platform for backing up desktop system data as well as for consolidating home directories. Combine this with the consolidation of server data to the Sun StorEdge NAS system and all data is now easily backed up from a single centralized platform, reducing administration and increasing data availability.

4.14 Reduced costs

When you combine all of the previously described capabilities, Sun StorEdge NAS systems can greatly reduce IT costs by allowing greater use of capital resources, increasing flexibility and agility for deploying and redeploying application servers, and increasing the useful life of storage by allowing it to survive beyond the useful life of application servers.

Further savings on licenses are realized by implementing a highly scalable storage platform that does not require expensive application licenses or additional client access licenses when you add storage.

Simply put, you can manage and protect a greater amount of storage with fewer administrative resources, thereby containing IT costs while accommodating increasing storage demands.

5 Sun StorEdge NAS product line overview

The Sun StorEdge 5000 NAS Family of products is composed of four products: the Sun StorEdge 5210 NAS appliance, the Sun StorEdge 5310 NAS appliance, the Sun StorEdge 5310C NAS appliance, and the Sun StorEdge 5310 NAS Gateway System. In this section, we first introduce each product in the Sun StorEdge 5000 NAS Family before describing shared components.

5.1 Sun StorEdge 5210 NAS appliance

Designed especially for entry-level departments, workgroups, and distributed enterprises, the Sun StorEdge 5210 NAS appliance is a heterogeneous file server storage device that provides simple manageability, quick deployment, seamless integration, and flexible, policy-based data services. The easy-to-use appliance is built for simple operation and, using its intuitive installation wizard, can be typically set up in less than 15 minutes. The 5210 NAS appliance integrates seamlessly with UNIX and Microsoft Windows environments, making it easy to share data across heterogeneous platforms. Policy-based data services — including integrated file management and snapshot/point-in-time copy — provide advanced data protection.

The 5210 NAS appliance is delivered as a base system that includes the Sun StorEdge NAS system platform populated with six internal 146-gigabyte SCSI drives with a raw capacity of 876 gigabytes (GB). For network connectivity, the system platform includes two built-in copper Gigabit Ethernet ports, and an optional NIC can be added that provides two optical MMF Gigabit Ethernet ports.

More capacity can be added by installing up to three 5210 NAS appliance expansion units — each populated with twelve 146-GB SCSI drives with a raw capacity of 1752 GB. This allows for a total system capacity of 6132 GB (6.1 TB).

The bottom line is always the same. If a system doesn't save you money, why implement it?

Designed for workgroups and distributed enterprises, the Sun StorEdge 5210 NAS appliance scales to 6.1 TB.

Both the base system as well as the 5210 NAS appliance expansion units include preconfigured RAID groups with spares. This allows for time savings during the installation and implementation of both the system and the addition of incremental storage. These RAID volumes are automatically recognized by the system after the storage is connected, and file system volumes can then be easily created to utilize the incremental storage.

5.2 Sun StorEdge 5310 NAS appliance

Designed for multiprotocol IT environments seeking to reap the benefits of storage consolidation and centralized backup, the Sun StorEdge 5310 NAS appliance supports UNIX, Linux, and Microsoft Windows clients, simplifying file sharing between disparate platforms. It combines advanced business continuity functions such as file system journaling, checkpointing, remote mirroring, clustering, and full system redundancy with a full 2-gigabit Fibre Channel RAID array to deliver very high levels of availability and performance in almost any open environment. Like the 5210 NAS appliance, it is easy to operate and manage, typically installing in less than 15 minutes.

Using Fibre Channel connectivity, the Sun StorEdge 5310 NAS appliance supports UNIX, Linux, and Microsoft Windows clients.

The 5310 NAS appliance differs from the 5210 NAS appliance in that the storage subsystem is based on Fibre Channel connectivity. As such, all storage is external to the base system (which includes no internal storage). External storage is utilized for both single systems as well as clustered systems to allow for storage access in the event of a system failover.

While the 5210 NAS appliances relies on internal PCI RAID controllers, the 5310 NAS appliance (whether in single-system or clustered configurations) provides increased availability and reliability by utilizing Sun StorEdge 5310 RAID expansion units (REUs). Each REU contains dual-redundant, active-active RAID controllers connected with either one or two dual-port Fibre Channel HBAs within the base system. Each REU also has the capacity to be populated with fourteen 300-GB Fibre Channel disks.

Combined with the REUs are Sun StorEdge 5310 expansion units (EUs), each populated with fourteen drives that can be either 300-GB Fibre Channel drives or 400-GB SATA drives. Each external RAID controller can support a total of 112 homogeneous drives (either all Fibre Channel or all SATA) behind a given REU. Fibre Channel and SATA drives can be mixed in a single system provided that all groups of drives are behind their own specific REUs.

Each Fibre Channel HBA within the base system can support a single REU. When two HBAs are present and two external REUs are configured, each HBA connects to each REU so that a data path is available in the event of a single RAID controller or HBA failure. In Sun StorEdge 5310 NAS clustered configurations, each Sun StorEdge 5310 NAS system is configured with a connection to each REU, which allows for an available data path in the event of a system failover.

With the addition of a Fibre Channel switch, a maximum of four REUs are supported for a total of 448 external disk drives. With 146-GB Fibre Channel drives, this allows for a maximum raw capacity of 134.4 TB and with 400-GB SATA drives, a maximum raw capacity of 179.2 TB. Like the 5210 NAS appliance, storage included with the 5310 NAS appliance is delivered in preconfigured RAID arrays to provide easy and timely installation and configuration of new storage.

Additionally, some companies require a storage network to address database application requirements for direct access to block-level storage capacity. The iSCSI protocol technology allows block-level storage access across simple, low-cost Ethernet. Hence, the 5310 NAS appliance includes iSCSI support, providing a unified network storage solution that can simultaneously attach to both the IP-SAN (providing block-level storage access) and to the LAN for file-level data requirements.

The Sun StorEdge 5310C NAS appliance gives you WORM capabilities that meet the most stringent federal regulations.

5.3 Sun StorEdge 5310C NAS appliance

The Sun StorEdge 5310 NAS appliance with FC or SATA also supports the optional Sun StorEdge Compliance Archiving software — together, they form the Sun StorEdge 5310C NAS appliance, an ideal solution for government regulatory and business compliance applications. There is an ever-increasing need to be able to demonstrate that archived data has not been altered or accessed by anyone other than an authorized user — in other words, that it is “trustworthy.” For example, these records may be relevant in the event of an audit or lawsuit. The Sun StorEdge 5310C NAS appliance meets these rigorous requirements by enabling features for authenticity, integrity, ready access, and security.

5.4 Sun StorEdge 5310 NAS Gateway System

The Sun StorEdge 5310 NAS Gateway System is capable of accessing storage capacity in a Fibre Channel SAN and acting as a file server repository to LAN-based clients. The Gateway System allows an FC-SAN to provide both block-based and file-based storage access from a single storage network. The 5310 NAS Gateway System can be configured with direct connections or fabric connections to back-end SAN storage subsystems and has the intelligence to tolerate and recover from SAN high-availability features, such as LUN failovers. The Gateway System comes configured as a clustered pair or as a single system.

5.5 Sun StorEdge NAS shared components

Core to the value of the Sun StorEdge NAS product line is the Sun StorEdge NAS OS (operating system), which provides common features throughout the product line. In addition to the NAS OS, all Sun StorEdge NAS systems share a common Intel Xeon-based system platform with a number of redundant components for high availability.

5.5.1 Sun StorEdge NAS OS

Included as standard features in the Sun StorEdge NAS OS (and therefore available throughout the product line) are file-sharing protocols, a specialized file system and file system services, directory services and other enterprise integration services, Windows-specific features, backup services, network services, and various management interfaces and management protocol support. In addition to these standard features, the NAS OS also provides optional capabilities for high-availability clustering⁴ and remote replication.

The following tables describe these features in more detail.

Table 1. Sun StorEdge NAS OS File Sharing Protocols.

Feature	Description and benefits
NFS v2, NFS v3	Network File System (NFS) is the primary file sharing protocol for all UNIX systems. The Sun StorEdge NAS systems provide support for all NFS v2-compatible and NFS v3-compatible UNIX systems.
SMB/CIFS	Server Message Block (SMB) and Common Internet File System (CIFS) are the basis for file sharing in Windows environments. With SMB/CIFS, the Sun StorEdge NAS systems provide support for all currently supported Microsoft Windows platforms.
FTP	File Transfer Protocol (FTP) is a prevalent method for sharing files over the Internet. The Sun StorEdge NAS systems can be configured to share files via FTP to secured as well as anonymous FTP users.

⁴ High-availability clustering is only available for the 5310C NAS appliance and 5310 NAS Gateway System.

Table 2. Sun StorEdge File System and Services.

Feature	Description and benefits
64-bit journaling file system	Provides file system consistency and fast recovery in the unlikely event of an unplanned system failure.
File system checkpoints with automated scheduling	Provides for automatically scheduled and immediate online volume backups (virtual point-in-time copies) plus fast file recovery without tape. This is a convenient way to “freeze” a larger file system in a consistent state for backing up a live file system to tape.
Dynamic volume expansion	Provides scalability without requiring system downtime.
File system size up to 16 TB and up to 512 file systems	A necessity for ever-growing data centers. This is also a prerequisite of a scalable data server.
Unified lock management and unified security	Cross-platform file locking makes Sun StorEdge NAS systems viable storage solutions for heterogeneous environments where both Windows and UNIX clients access the same set of files. In addition to the unified lock management, Sun StorEdge NAS systems provide unified security across UNIX and Windows systems through user and group credential mapping, which means that users are granted (or denied) access to critical files whether they are accessing the Sun StorEdge NAS system from Windows, UNIX, or FTP.
Directory tree, user, and group quotas	With the support of soft and hard quotas by file system directory or subdirectory, individual users, and/or groups, Sun StorEdge NAS systems can easily manage and limit total storage capacities. When increases are needed, managers can increase these quotas without service disruption.

Table 3. Sun StorEdge NAS OS Directory Services.

Feature	Description and benefits
NIS and NIS+	Support for Network Information Services (NIS) provides the ability for Sun StorEdge NAS systems to integrate easily into environments utilizing the central management capabilities of NIS or NIS+ for defining users and hosts. Besides allowing for the centralized definition of users and hosts, Sun StorEdge NAS systems also support the Netgroups functionality of NIS and NIS+, allowing resource allocation and authorization for predefined groups.
LDAP support	Lightweight Directory Access Protocol (LDAP) services on Sun StorEdge NAS systems provide both centralized management and server-side options. Centralized management takes advantage of LDAP directories to support distribution, inheritance, synchronization, and replication. This infrastructure supports push technology (such as hot object or folder replication and system notification), which radically reduces the administration overhead involved in setting up and maintaining multiple Sun StorEdge NAS systems — including geographically remote sites. Server-side applications include generic directory service or database virtualization to allow LDAP-enabled applications to treat Sun StorEdge NAS systems as a heterogeneous object repository.
Active Directory support	Active Directory is the directory service provided with Windows versions 2000 and later that provides centralized access to domain resources such as users, groups, and shared data. Active Directory support in the Sun StorEdge NAS systems provides the ability to make shares available via Active Directory while allowing users to be authenticated by Active Directory prior to accessing those shares.
Windows Domain support	Support for Windows Domains allows Sun StorEdge NAS systems to pass all authentication requests to the Domain Controllers and provides secure access to resources using the full set of Windows Access Control Lists (ACLs).
WINS support	Configuring Sun StorEdge NAS systems and all Windows servers and workstations to use the Windows Internet Naming Service (WINS) speeds CIFS name resolution and improves network performance by reducing broadcast traffic.

Table 4. Sun StorEdge Enterprise Integration Features.

Feature	Description and benefits
NTP and RDATE support	Sun StorEdge NAS systems can be configured to synchronize the time with either Network Time Protocol (NTP) or an RDATE server. NTP is an Internet protocol used to synchronize the clocks of computers to a reference time source, such as a radio, satellite receiver, or modem. Typical NTP configurations use multiple redundant servers and diverse network paths to achieve high accuracy and reliability. The RDATE time protocol provides a site-independent date and time. It is a protocol that can retrieve the time from another machine on your network. RDATE servers are commonly present on UNIX systems, and allow you to synchronize the Sun StorEdge NAS systems' server time with RDATE server time.

Table 5. Sun StorEdge Windows-Specific Features.

Feature	Description and benefits
Autohome share creation	The SMB/CIFS autohome share facility is an ease-of-use feature that removes the need for an administrator to predefine a home directory share for each Windows user that has access to the system. The Sun StorEdge NAS system automatically creates shares when a user logs on to the system and removes them when the user logs off. Thus, there is no need to modify the Sun StorEdge configuration when user accounts are created or disabled in Active Directory or on the Primary Domain Controller (PDC).
Windows DFS support	Microsoft DFS (Distributed File System) is a hierarchical file system that allows files to be stored across multiple servers and managed as a single group. The Sun StorEdge NAS system can serve as a DFS target. This means that DFS referrals can redirect clients to the Sun StorEdge NAS system.
Windows iSCSI support	iSCSI (Internet Small Computer System Interface) is a storage networking standard based on Internet Protocol (IP) for linking data storage facilities that was developed by the Internet Engineering Task Force (IETF). It enables any machine on an IP network (initiator) to contact a remote dedicated server (target) and perform block I/O exchange just as it would do with a local hard disk. By carrying SCSI commands over IP networks, iSCSI is used to facilitate block-based data transfers over intranets and to manage storage over long distances. The iSCSI protocol is among the key technologies expected to help bring about rapid development of the SAN market.

Table 6. Sun StorEdge Network Services.

Feature	Description and benefits
Network port aggregation	Port aggregation provides the flexibility to scale network I/O over a number of ports or to provide NIC port redundancy for high availability. Port aggregation is also known as "channel bonding" or "trunking." This type of bonding allows the scaling of network I/O by joining adjacent NIC ports. It forms a single network channel of high bandwidth from two or more channels of lower bandwidth.
IP aliasing	When consolidating storage from multiple systems to a single Sun StorEdge NAS system, it may be desirable to have multiple IP addresses assigned to the Sun StorEdge NAS system. This assignment minimizes the amount of client modification required to access the files that are migrated to the Sun StorEdge NAS system. With IP aliasing, up to 10 IP addresses can be assigned to each NIC port.

Table 7. Sun StorEdge Backup Services.

Feature	Description and benefits
NDMP v2 and NDMP v3	<p>The Network Data Management Protocol (NDMP) provides a standard interface with backup applications that also support the NDMP protocol, allowing for:</p> <ul style="list-style-type: none"> · Local backup (with tape attached to the Sun StorEdge NAS system to provide LAN-free backups) · Remote backups (with tape attached to the backup server to allow for sharing the tape library resource for all systems being managed by the backup server but requiring LAN-based backup) · 3-way backups (with tape attached to a single Sun StorEdge NAS system, which provides for LAN-free backup on that system but also supports the backup of other Sun StorEdge NAS systems without locally attached tape)

Table 8. Sun StorEdge Management Interfaces.

Feature	Description and benefits
Graphical user interface	The Sun StorEdge Web Administration interface is intuitive and includes setup wizards for Sun StorEdge NAS systems.
Support for Telnet and SSH for command-line interface	Sun StorEdge NAS systems provide alternative management tools via a command-line interface (CLI) available from Telnet or SSH interfaces.
SNMP support	Sun StorEdge NAS systems support the Simple Network Management Protocol (SNMP) by providing a Management Information Base (MIB) and support for traps for alert notification.
SMTP support	Notification and diagnostic information can be sent automatically to a predefined set of recipients via e-mail with the use of the Simple Mail Transfer Protocol (SMTP).
Local or remote logging	Sun StorEdge NAS systems can be configured to generate a log file either locally or to a remote system.
UPS monitoring interface	Sun StorEdge NAS systems provide uninterruptible power supply (UPS) monitoring. When a power failure requires the Sun StorEdge NAS system to rely on the UPS system for power, the system dynamically reconfigures to allow greater data reliability.

Table 9. Optional Features of the Sun StorEdge NAS OS.

Optional feature	Supported platforms, description, and benefits
Anti-virus protection	Sun StorEdge NAS systems provide an anti-virus scan of CIFS files to provide data integrity and increase data center security. The Sun StorEdge NAS OS can detect if a file has been scanned or not and, if not, automatically invokes the external scan engine prior to allowing access. The scan engine is external to the system and must be separately licensed from Symantec. Qualification of other anti-virus vendors is currently in progress.
Clustering and failover	Available on the 5310C NAS appliance and 5310 NAS Gateway System, dual active-active system clustering support provide systems without a single point of failure and 24 x 7 service time.
Sun StorEdge File Replicator	Available on the 5210 and 5310 NAS appliances, the 5310 NAS Gateway System, and clustered systems, file system replication provides asynchronous mirroring capabilities between Sun StorEdge NAS systems in one-to-one, many-to-one, and bi-directional configurations that can be applied to disaster recovery, backup, and data distribution solutions.
NAS Compliance Archiving software	<p>Available on the 5210 NAS appliance, the 5310 NAS appliance in single and clustered systems, and the 5310 NAS Gateway System, the Compliance Archiving software converts the NAS appliance into a “compliance archiving system” positioned for government regulatory and business compliance applications. The Compliance Archiving software enables write-once, read-many (WORM) capabilities on the file system. There are two options available:</p> <ul style="list-style-type: none"> · The stringent design (mandatory enforcement) implements system modifications so that specified retention periods are enforced to meet rigorous SEC 17a-4 regulation requirements. · The flexible design (advisory enforcement) implements system modifications so that specified retention periods are met, but can be reduced by an authorized administrator. <p>While the Compliance Archiving software comes with both mandatory and advisory enforcement for both the 5210 and 5310 NAS appliances, the software provides only advisory enforcement for the 5310 NAS Gateway System.</p>

5.5.2 Sun StorEdge NAS system platform

The Sun StorEdge NAS system platform provides the memory and processing power for the 5210 and 5310 NAS appliances and the 5310 NAS Gateway System.

Figure 1. Front view of the Sun StorEdge NAS system platform.



Figure 2. Rear view of the Sun StorEdge NAS system platform.



The Sun StorEdge NAS system platform includes a number of redundant components and other features that are described in Table 10 below.

Table 10. Sun StorEdge System Platform Features.

Feature	Description
Motherboard	Intel Xeon class server motherboard with 533-MHz front side bus and dual PCI-X 64bit/100 bus
Processor	Intel Xeon 3.06 GHz with 512-KB Level 2 cache
Maximum number of CPUs	1
Default memory	4 GB, DDR RAM
Expansion slots	6 PCI-X
Network ports	Dual embedded 10/100/1000 Gigabit Ethernet ports; optional MMF (optical fiber) 1-port or 2-port 10/100/1000 Ethernet NIC; optional 10/100 Fast Ethernet 1-port NIC for clustered system heartbeat
Boot disk	Reliable 256-MB Flash media
Hard disk drives	6 hot-swappable Ultra160 SCSI LVD, 1-inch high (low-profile) (supported only in the 5210 NAS appliance)
Supported drives	146-GB SCSI, 10,000rpm (5210 NAS appliance) 300-GB FC, 10,000rpm and 400-GB SATA, 7200 rpm (5310 NAS appliance)
Hardware RAID	Up to two 2-port Ultra320 SCSI with battery-backed cache
RAID level support	RAID 5
LCD keypad interface	LCD interface on the front of the unit for easy setup and visual status notification
Bezel	Supplied with standard configuration
Cooling	Redundant fans
Power supply	Dual 500W redundant, hot-swappable power supplies
Rack height	2U (3.5")
Dimensions	H 3.5" x W 19" x D 25.51"
Warranty	2 years, first year onsite, second year 15 day return to depot

6 Competitive review

Sun's leadership in NAS architecture design is illustrated in the following competitive matrix. Unlike other leading NAS products on the market today, Sun's offering provides the best return on investment in both the short term and long term. For example, the asking price for the 5310 NAS appliance is usually 35% lower than the asking price of comparable NAS products.

Many protocol features that come standard with the 5310 NAS appliance must be purchased as separate licenses through other NAS vendors. Moreover, the Sun NAS offering can scale capacity well beyond the capabilities of other vendors, and performance scales as capacity grows. In order to achieve better performance as capacity scales, other vendors require expensive component replacements. Additionally, competitors must take their product off-line to add capacity or replace performance components. The 5310 NAS appliance scales non-disruptively, allowing you to add additional components while online.

Finally, while other companies require you to purchase one system for compliance data (WORM-protected) and another system for non-compliance data, the 5310 NAS appliance allows you to store both compliance and non-compliance data on a single storage repository.

No competitive offering provides the features and reliability of the Sun StorEdge 5000 NAS Family of appliances.

Table 11. Competitive Summary.

	Sun StorEdge 5000 NAS Family appliance	Network Appliance	EMC
Multiple RAID controller support	Yes, scales to 8 RAID controllers for added performance	No, software RAID only	No, single pair of RAID controllers
Scalability to 179 TB SATA	Yes, utilizes 400 GB SATA drive technology	No, only to 100 TB and only on 980	No, Centerra scales to 209 TB using older parallel ATA technology
Software features included without charge	Yes, NFS, CIFS, NDMP, FTP and checkpoints with no OS licensing fees	No, licensed options	No, licensed options
Online expansion without performance loss	Yes, easy storage capacity expansion without downtime or degradation	No, NAS filer head must strip RAID sets due to software RAID	No, must stripe RAID sets upon connection
Active-active cluster failover	Yes, multi-level fault tolerance; no single point of failure solution	Yes, increased overhead due to software RAID and NVRAM journal	No, active-passive in a cluster environment
Customer definable FC and/or SATA storage	Yes, SATA and FC in the same array and shelf	Yes, but only with 3020 and 3050 models	No, separate systems
Volume-specific compliance and archiving	Yes, customer definable	Yes	No, separate systems
Performance scaling architecture	Yes, multiple pathing RAID arrays eliminate bottlenecks	No, requires expensive systems and software upgrades	No, must purchase larger system

7 Conclusion

Most of the data explosion during the 1980s and 1990s was from structured data with database applications. This proved the primary driver for SAN implementations. In the early part of this century, however, we have seen business, regulatory, and legal compliance requirements drive an increased demand for retaining unstructured (or file-based) data, which is quickly becoming the primary driver for storage — and for which NAS is ideally suited. The Sun StorEdge 5000 NAS family of products helps consolidate storage resources as well as data, resulting in a number of significant business benefits, including reduced costs for storage management and server management, improved application and data availability, and an overall reduction in costs.

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