IBM Netfinity Storage Area Networks

Central management, access and storage for business-critical information

Executive Summary

In February 1999 IBM announced details of its Storage Area Network (SAN) initiative and introduced a series of high-end SAN-related products. This initiative is designed to help customers manage, track and more easily share the ever-increasing volume of data being created by e-business applications. The IBM SAN initiative will also help customers manage their technology resources—application servers, storage servers, network hardware and storage management software—virtually anywhere, anytime, and share information across storage networks regardless of which vendor supplies the systems and applications. SAN technology can lead to lower total cost of ownership by allowing storage resources to be consolidated and shared by several servers.

Several factors are making the ability to manage resources and share information crucial. Among them are the growth of data-intensive applications such as data warehousing, data mining and enterprise resource planning. Add to this the increasing presence of the Internet in commerce, and the need for companies to be open for business 24 hours a day, 7 days a week in multiple time zones—nearly around-the-clock access to business data is obvious. In this environment, data storage is rapidly becoming a central component of corporate technology strategies.

But data backup and recovery procedures can slow operations and affect end users across the enterprise network and, ultimately, affect a company's profitability. Hence the need to create a form of storage that is reliable, powerful, secure and separate from the LAN. The result is the SAN, which allows data-intensive storage processing without affecting network operations. A SAN is a dedicated Fibre Channel infrastructure of servers and their adapters, external storage devices, hubs, switches and network and storage management tools. As IBM continues to develop its initiative, the IBM Netfinity® SAN will provide to the industry-standard server environment the connectivity, management, exploitation and support outlined in the IBM Storage Systems Division (SSD) SAN white paper available at **www.ibm.com/san**.

IBM has been a leader in computer technology since its inception. We lead in the high-end RS/6000®, S/390® and AS/400® server systems, and our SSD leads in high-end storage. IBM Netfinity systems are among the best in the Intel processor-based environment and have been developed with elements of our high-end systems obtained from IBM's Netfinity X-architecture.

IBM's Netfinity SAN solutions include the hardware components to build the SAN best suited to your needs, and the software tools to help you fully exploit a SAN in your business. Further, through IBM Global Services, IBM offers the opportunity to appraise your current storage solution, and to plan, design, install and maintain your SAN.

This paper gives an overview of IBM's Netfinity SAN strategy. Because of the dynamic nature of the computer industry, changes may occur in IBM's actual implementations and timing of product announcements.

Introduction

IBM's Netfinity Storage Area Network (SAN) initiative has been developed to help businesses manage, track and more easily share the complex and ever-increasing volume of data being created by the Internet and e-business applications. In addition, the IBM SAN initiative will help companies manage their technology resources—application servers, storage servers, network hardware and storage management software—and share information across storage networks regardless of vendor computing systems and software applications. By using SAN technology, businesses can reduce the cost of computing by consolidating and sharing storage resources.

The phenomenal growth in storage requirements is being driven, in large part, by the data explosion fueled by e-business, the commercialization of the Internet, the emergence of data-intensive technologies such as multimedia and data warehousing, and the focus on server and storage consolidation. These customer requirements are driving technologies such as Fibre Channel-attached storage subsystems, SANs, four- to eight-way Intel® Xeon based systems, server clustering and faster, higher capacity disk drives. Each of these advancements separately would drive incremental storage requirements, but taken together, they mean an unprecedented demand for capacity and performance.

IBM's SAN initiative is the next step in the evolution toward providing centrally managed, open software and hardware solutions designed to help companies get the most value out of their business information and IT infrastructures. SANs offer an open architecture that allows customers freedom of choice in deploying data access and data sharing capabilities across the enterprise; consolidation of servers and storage; increased data availability; centralized storage management; the ability to back up and migrate data without affecting enterprise network performance; the increased reliability offered by clustering technology; and the security and protection of data in the event of disaster or computer hackers.

Basic SAN technology began with our ESCON® attached storage subsystems that have been used for many years by IBM S/390 mainframe systems. Then, having achieved a leadership position in the high-end arena, in 1998 IBM introduced Netfinity Fibre Channel technology, thus providing basic SANs in the Intel processor-based market. IBM's SAN initiative will deliver SAN products over time to support a heterogeneous SAN that will support interoperability across all IBM platforms including S/390, RS/6000, AS/400 and Netfinity.

IBM's Netfinity SAN solutions are designed and optimized to complement the full range of product offerings in the Netfinity line. IBM's Netfinity Options by IBM portfolio of storage products is the broadest in the industry, with leadership technology that is constantly being refreshed and improved. Products in the portfolio include:

- Hard disk drives (HDDs)
- Tape backup solutions
- Fibre Channel connectivity and storage solutions
- Storage expansion solutions
- IBM rack solutions

- Clustering solutions

Fibre Channel combines the standard SCSI command set and protocol used by storage devices with the flexibility and connectivity of networks. Its ability to attach large numbers of devices using physically longer and smaller cables than traditional SCSI, combined with its ability to transmit data at up to 100MBps, makes it an attractive alternative to SCSI in many cases. Its architectural flexibility enables it to handle different protocols simultaneously. This allows a Fibre Channel network to serve as a high-speed LAN supporting network protocols such as TCP/IP and to support attachment of storage devices simultaneously. For more information about IBM's Fibre Channel technology implementations, see the white paper titled "IBM Netfinity Fibre Channel Directions" at **www.ibm.com/netfinity**.

IBM has an unparalleled history of technology leadership, service and support in the enterprise systems marketplace. Not only did IBM invent magnetic disk storage, we currently hold some 650 patents and many awards for our storage technology and customer solutions in the past 40 years. As customers in the Intel processor-based server environment expand their networks into business-critical arenas, IBM is applying its vast experience in storage and storage management to help meet their needs.

IBM's storage patent leadership and long-term involvement with every facet of Enterprise Storage enable us to understand the diverse challenges that you face in this environment. It also helps us develop solutions to meet these challenges and take advantage of business intelligence, increased Web performance, tape backup, high-speed communications and disaster recovery solutions.

IBM solutions make this possible with Netfinity X-architecture, which brings the outstanding characteristics of mainframe and midrange computing to industry-standard servers: high availability, powerful performance, massive scalability, redundancy, centralized storage and problem prevention through alerts and notifications of potential disruptions.

IBM Netfinity X-architecture and SANs

IBM is committed to delivering products with proven, reliable technology while helping you reduce the total cost of ownership of enterprise-class computing. This commitment is expressed in IBM's Netfinity X-architecture, which takes the best management capabilities from larger IBM systems and adapts them into a framework that will integrate with a wide range of industry-standard, customer-chosen management and operating system environments.

The following is a summary of the key elements of Netfinity X-architecture that have been incorporated into selected Netfinity servers.[1] They include powerful processors, core logic, reliable and highly available memory systems, scalable I/O, advanced caching software and world-class silicon and module technology. Netfinity X-architecture also includes clustered systems featuring technology from IBM's industry-leading S/390 and RS/6000 SP™ product lines, as well as interoperability with existing large and midrange systems.

Netfinity X-architecture is evident in these enterprise storage features in selected Netfinity servers:

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[1] *To learn more about Netfinity servers, see "Additional Information" at the end of this paper and visit the Netfinity Web site at: **www.ibm.com/netfinity**.

- Fibre Channel-attached storage options for scalable, highly available, cluster-enabled storage, improved security and disaster protection
- Hot-plug HDDs, power supplies and fans for availability and reliability
- Clustering solutions for continuous system availability and performance scalability
- Light-Path Diagnostics to improve availability and serviceability
- Integration with enterprise systems management software such as Tivoli™ Management Software, Microsoft® SMS and Intel LANDesk® for management flexibility
- Predictive Failure Analysis® (PFA) for alerts before component failure

To turn the advantages of Netfinity X-architecture into a SAN solution, we look next at the Netfinity SAN solution components.

IBM Netfinity SAN Components

IBM Netfinity is poised to deliver on the vision of SAN technology by combining the best of IBM and industry-standard technologies using IBM's experience from decades of mainframe, UNIX® and Intel processor-based computing in cooperation with strategic industry partners.

Fibre Channel Switch. The switch, available as an 8- or 16-port model, enables the interconnection of various storage servers and devices. It optimizes the advantages of Fibre Channel technology for distance, performance and heterogeneous connectivity. It uses the latest technology with an advanced, non-blocking switch architecture and delivers multiple, concurrent 100MBps connections for large-block transfers, with reliability and data integrity. It provides scalability from small- to very-large-size SAN environments, with virtually limitless bandwidth. It also has an embedded Web server for easy browser-based setup, configuration and ongoing management. And last, it offers the option of a second power supply that supports dual-power source installations to minimize outages, and non-disruptive maintenance if one power supply fails. IBM plans to announce the Fibre Channel Switch in late 1999.

Fibre Channel SAN Data Gateway Router. The router provides a simple, entry-level connection between Fibre Channel-enabled hosts to new or existing SCSI tape libraries (thereby offering investment protection for existing SCSI libraries) to support sharing of tape devices by several servers and/or remote location of tape backups for disaster protection. Two models are available to support two Ultra SCSI single-ended or differential bus connections routed to a single Fibre Channel connection. Additional SAN Data Gateway models are available to support higher numbers of SCSI and/or Fibre Channel connections. As with the Fibre Channel Switch, IBM plans to announce the SAN Data Gateway Router in late 1999.

Fibre Channel Hub. The hub has seven ports for short- or long-wave optical connections provided by optional hot-pluggable short- and long-wave gigabit interface converters (GBICs). The hub supports N-way clustering, and four short-wave GBICs are included as standard.

Fibre Channel PCI Adapter. With 100MBps speed and Fibre Channel direct drive short-wave optical cable to 500m (1640ft) rather than the 25m (82ft) limitation imposed by copper cable, the adapter eliminates electrical interference and ground shift problems caused by copper cable, which is still used by some other vendors; the optional long-wave optical cable drives 10km (6mi.), and a 64-bit PCI bus master transfers data up to 264MBps. The adapter is also compatible with 32-bit PCI.

Fibre Channel RAID Controller. The failsafe RAID Controller Unit is a single hot-pluggable controller (standard), with a dual, active redundant controller as an option, thus eliminating the problems caused by a single point of failure that can exist in other companies' products. The controller supports RAID levels 0, 1, 3 and 5, and 128MB RAID cache per controller (scalable to 256MB with 128MB mirrored), plus battery-backed write cache. It has 6 Ultra2 SCSI (also known as low voltage differential SCSI or LVDS) drive channels supporting up to 60 HDDs (as opposed to the limit of 8–12 in other solutions) and redundant, hot-pluggable power supplies and fans.

As enterprise storage requirements continue to increase—especially as more companies compete in the ever-growing, high-demand, no-room-for-errors arena of worldwide e-business—IBM intends to continue to enhance the performance, capacity and reliability of IBM Netfinity Fibre Channel storage solutions to help businesses keep up with information demand.

IBM Netfinity SAN Solutions

IBM's Netfinity SAN solutions are intended to help you store and manage your vital data resources with ease and security. They comprise tape and disk pooling and backup, and HDD expansion and pooling.

Tape pooling solutions. Netfinity server consolidation allows multiple servers in diverse locations to share one or more tape drives or libraries using IBM and vendor software. With a Netfinity Fibre Channel SAN Data Gateway Router, server consolidation supports "LAN-free" backup to help reduce backup time and improve client network performance. It allows centralized management of backup operations, which can be located at a remote site for disaster protection. The following diagram (Figure 1) illustrates Netfinity tape pooling solutions.

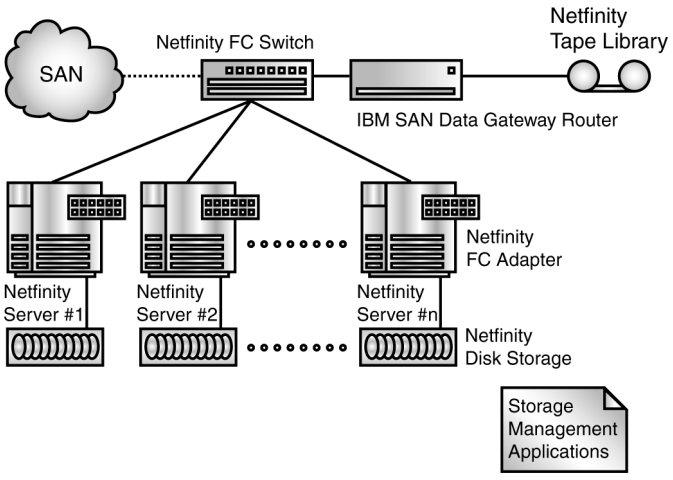

Figure 1. Netfinity tape pooling

Tape backup solutions. Reliable, high-capacity tape backup solutions that protect your data are essential. You can restore availability to users across your system in the event of a system failure. Tape backup can help avoid an estimated **$3000 per MB** re-creating lost data.

For a total backup solution, the value and proven reliability of IBM tape backup technology makes good sense for your business. Tape offers the lowest cost per GB for backup and archival storage and uses the lowest-cost media. IBM offers a complete line of tape products in most popular industry-standard tape formats and capacities (4GB to 1TB). Available formats are: DLT, DAT, Magstar®, 8mm and Travan NS.

External tape backup solutions. As backup needs increase, consider the storage management possibilities of IBM tape libraries, which deliver up to 1050GB of data backup capability. IBM now offers two tape backup solutions for the DLT platform: the IBM 108 DLT Autoloader and the IBM 314 DLT Library:

- 108 DLT Autoloader—designed for customers who need to extend backup capacity; equipped with one DLT 35/70 drive and 8 cartridges; total compressed capacity of 560GB; compatible with the 314 DLT Library for upward migration if needed
- 314 DLT Library—answers the need for more capacity and the problem of a shrinking backup window; 1 DLT 35/70 drive standard, can be upgraded with 2 additional drives; increasing the compressed backup rate from 36GB per hour with 1 drive to 108GB with 3 drives decreases the time it takes to back up the system; rack-mountable unit and includes 2 seven-inch cartridges for maximum compressed capacity of 980GB

Hard disk drives. IBM invented the first hard disk in 1956 and has remained the industry leader for more than 40 years. Our extensive line of HDDs includes industry-leading hard-swap hard drives, with storage capacities up to 36.4GB at rotational speeds up to 10,000rpm (Netfinity servers were among the first to make 10,000rpm HDDs available to customers). And we have multiple, high-quality sources for our HDDs to help ensure continuity of supply, unlike the single-sourcing of HDDs by other vendors.

SCSI HDD expansion solutions. For increased HDD expansion, look to the enterprise-class 10-bay Netfinity EXP15 Storage Expansion Unit. The 3U[2] rack-mountable EXP15 offers high data availability thanks to redundant components that include powerful, hot-pluggable fans and power supplies. Further, by allowing increased cable distances (because of support for Ultra2 SCSI technologies), the EXP15 can be located away from the server, promoting the growth of DASD farms and other flexible storage configurations. The Netfinity EXP15 also offers investment protection by providing a high-performance platform for mounting future generations of HDDs required by your growing business—allowing up to 5TB of storage in a single rack.

The IBM Netfinity EXP 200 Storage Expansion Unit will provide another expansion solution.[3] It will provide flexibility, high availability, high performance and scalability for the Netfinity 8-way server. The EXP 200 will support full Ultra2 performance of 80MBps at 20m (60ft) cable lengths to meet enterprise storage expansion requirements. The EXP 200 will support 10 half-high or slim-high HDDs in a rack, stack or tower configuration. The EXP 200 will also support clustering, PFA and systems management.

Disk and tape pooling. Server consolidation with disk and tape pooling allows sharing of disk and tape subsystems by multiple servers in diverse locations. It enables cross-platform data sharing and supports scalable and fault-tolerant clusters using shared-disk or shared-nothing models. It supports “server-free” direct data backup from disk to tape to improve server performance and improve backup time. It also allows centralized management of storage resources.

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[2] *A single “U,” or rack unit, is 44.45mm or 1.75 inches.

[3] IBM intends to make the Netfinity EXP 200 Expansion Unit generally available in the fourth quarter of 1999.

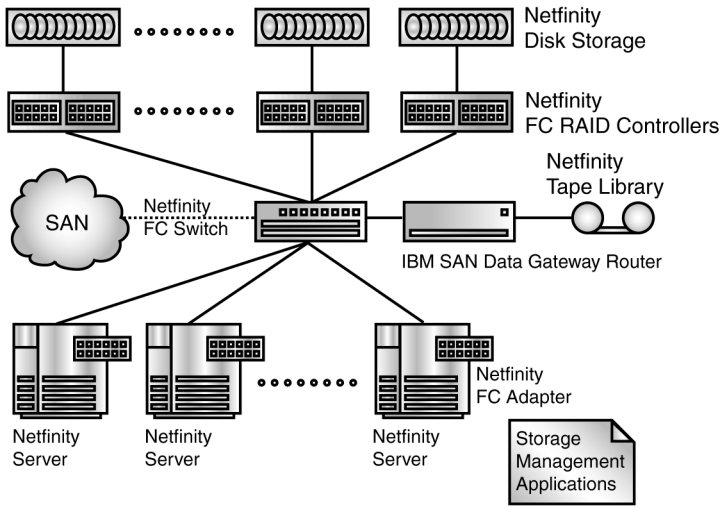

Figure 2. Netfinity disk and tape pooling

There are a number of software-based disk and file pooling solutions available today to exploit this capability of SAN technology. IBM intends to develop and support a variety of disk pooling solutions. Additional features such as remote mirroring and other forms of copy services will be supported in the future.

IBM Netfinity Clustering Solutions

System and application availability is a critical factor for almost every industry in today's electronic world. Because a company's operations might be based on one computer system staying up and running, its failure to perform even for a short time can result in significant losses. Productivity of an entire enterprise can be interrupted if one server goes down, especially if it runs supply chain or other equally demanding applications. According to an estimate made by Standish Group, the average cost per minute of downtime is $10,000 in revenue, productivity or profit.[4] Because of this potential threat to businesses' competitive edge in the marketplace, there is a growing demand for application solutions with increased reliability and availability. And these applications may require businesses to operate 24 hours a day, 7 days a week and 365 days a year.

In such environments, choosing the most available computer system becomes a vital business decision. And more and more businesses are deciding to buy Intel processor-based servers. They are less expensive than large-system servers, conform to industry standards and, usually, help lower businesses' total cost of ownership.

Many businesses today are connecting servers together into clusters, which are rapidly becoming a preferred configuration in demanding environments. In these environments, having the right clustering software is as important as having the right hardware. Today's Netfinity

[4] Standish Group Research Note: Pound Foolishness, 1998 High Availability Forecast.

clustering technology offers the reliability, availability, scalability and manageability that enterprises need to help achieve:

- High availability through PFA by notifying you of a failing component and initiating automatic recovery mechanisms
- Access to data and shared devices
- Improved performance and the ability to manage future growth
- Workload balancing
- Single point of control and management
- Elimination of single points of failure

Single points of failure can lead to costly unplanned downtime, and even planned downtime for upgrades or maintenance can put a cluster out of action. IBM's Netfinity products have been designed to leverage the high-availability technology of our large servers to help customers greatly reduce or even eliminate both planned and unplanned downtime.

Two recent IBM initiatives also help customers maintain a highly reliable, available cluster. These are the IBM ClusterProven™ Program on Netfinity and IBM Netfinity Availability Extensions for Microsoft Cluster Server (MSCS).

IBM ClusterProven Program on Netfinity. IBM is the leader in clustering technology. That leadership has been reinforced by the IBM ClusterProven Program on Netfinity, which is focused on providing robust and effective support to qualified Netfinity solution developers to join the high-availability trend through delivery of a wide range of proven, highly available software applications. These clustering solutions for Netfinity server products will be tested so that they meet IBM's strict standards for high availability, and will be identified in the IBM Global Software Solutions Guide, accessible online by customers.

In the first half of 1999 the ClusterProven Program on Netfinity will focus on solutions for Microsoft Windows NT and MSCS. In the second half of 1999 and beyond, IBM intends to expand the program to include additional clustering platforms.

IBM Netfinity Availability Extensions for MSCS. The Netfinity Availability Extensions provides the ability to extend Microsoft's two-node implementation of MSCS across multiple MSCS clusters. This allows for the expansion of support from three to eight nodes. For more information, please see the "IBM Netfinity Availability Extensions for Microsoft Cluster Server" white paper at **www.ibm.com/netfinity**.

MSCS's primary function is to allow resources (which can include physical hardware devices such as disk drives and network adapters, or logical items such as logical disk volumes, TCP/IP addresses, applications and databases) that are dedicated to one server to move to another, backup server, in case of failure or planned downtime. In the event of failure or downtime, clients using the server resources experience little or no interruption in service because the resource functions are moved from one node to another.

The new IBM Netfinity Availability Extensions complements and extends MSCS capabilities. Delivering a virtual multinode cluster that manages a collection of MSCS clusters as if they were one, Availability Extensions facilitates failover between clusters with support for three to eight nodes in an odd or even configuration. Binary compatibility is maintained with the MSCS Cluster Services API and with MSCS Resource DLLs. This means that applications that are MSCS

cluster aware are supported with minimum to no modification. The Netfinity Availability Extensions enables customers to exploit the combined advantages of Windows NT Extended Edition and reliable Netfinity servers.

The configuration for the IBM Netfinity Availability Extensions for MSCS is as shown in Figure 2 on page 7.

Storage Management

For storage management, the IBM Netfinity SAN solution incorporates the Tivoli Information Integrity Initiative, which includes the following key elements in its Tivoli Storage Management application (formerly IBM's ADSTAR Distributed Storage Manager):

- Integration that allows data management and data protection functions to work together
- Management that allows distributed data (including local and remote storage systems) to be managed from a centralized point within the enterprise
- Interoperability that supports the heterogeneous SAN environment and enables high availability, helping ensure that you get the intended benefits of enterprise storage
- Scalability that supports ever-increasing amounts of data and types of enterprise applications
- An enterprise storage management solution with automated, unattended backups, long-term data archives and hierarchical storage management (HSM) operations
- Easy-to-use Web browser and graphical user interfaces (GUIs) for daily administrative and user tasks
- Online, incremental backup and recovery for Lotus® Notes® databases
- HSM capability to automatically move infrequently used data from workstations and file servers onto an ADSM storage management server, reducing expensive workstation and file server storage
- A Disaster Recovery Manager (DRM) feature to help plan, prepare and execute a disaster recovery plan

Tivoli Ready branding for IBM Netfinity SAN components. "Tivoli Ready" hardware and software makes technology deployment easier by providing customers with out-of-the-box management capabilities. Tivoli Ready functionality is already available on a number of IBM hardware products including all new Netfinity servers.

From host-based middleware to e-business applications, customers will have the capability to manage and control end-to-end business applications and systems across the enterprise through a single management console.

To support the "Tivoli Ready" initiative, IBM has established Tivoli Competency Centers to speed the development and branding certification process and to serve as a model for other companies wanting to certify their products as Tivoli Ready. For more information about Tivoli Ready, visit the IBM Web site at **www.ibm.com**.

IBM Netfinity Manager. IBM Netfinity Manager is a powerful software suite designed to manage networked Intel processor-based servers and other components in the enterprise storage environment you currently have. One of the most important elements of Netfinity Manager for

enterprise storage is PFA, with its extensive alerting and real-time diagnostics: PFA can detect actual and potential future system component failures—and send notifications about them—to prevent problems before they occur and keep your business up and running.

This technology is resident in selected Netfinity servers and includes power supplies and fans, as well as all of the HDDs supported on Netfinity systems. PFA coverage also includes processors, system memory, power subsystems and voltage regulator modules.

IBM Netfinity ServerProven program. The IBM Netfinity ServerProven® program, part of the Netfinity Enterprise Storage Solution strategy, gives companies the confidence to implement a robust SAN solution tested and optimized for Netfinity systems in industry-standard, heterogeneous environments.[5] Hundreds of products from Options by IBM and other leading industry vendors have been tested for compatibility with IBM Netfinity products, so you can add new capabilities with confidence.[6] And we have expanded our ServerProven program to incorporate ServerProven Solutions, a commitment by IBM to work with independent software vendors and industry-leading hardware manufacturers to provide you with fully integrated solutions that meet your business needs.

A Service-driven SAN Strategy, from IBM

Although the implications of falling behind—not keeping pace with technology—can be devastating to a business's ability to compete, the impact of a major architecture change can be huge and potentially disruptive. The margin for error is thin, the technology is still largely unproven, standards are not yet fully ratified and many interoperability issues have yet to be resolved, and the data management is complex.

IBM Global Services' commitment is to providing open, vendor-neutral solutions that fit a company's technology profile and address short- and long-term business objectives. From early consulting, planning and design through integration and testing, IBM Global Services can offer end-to-end service solutions for SAN deployment designed to maximize the benefits of information sharing across the enterprise. Plus, IBM Global Services' business and technology consultants understand the key role that a storage infrastructure must play to enable business-critical applications such as enterprise resource planning, e-business, business intelligence, customer relationship management and supply chain reengineering.

Leveraging our extensive experience, knowledge base and lessons learned in IT planning, design and implementation, IBM Global Services can help you:

- Protect your current investments in people skills, hardware and software
- Enable the integration of new technologies as they emerge, mature and become more affordable by deploying a building block infrastructure
- Apply experience and lessons learned from the mainframe arena, like systems management, storage concepts and switched fabric management, to the open systems environment
- Support multiplatform interoperability

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[5] IBM makes no representations or warranties, expressed or implied, regarding non-IBM ServerProven or ClusterProven products and services, and disclaims all such warranties including but not limited to Year 2000 readiness and the implied warranties of merchantability and fitness for a particular purpose. These products are offered and warranted solely by third parties.

[6] A complete list of ServerProven Solutions and ServerProven options can be accessed at **www.pc.ibm.com/us/netfinity/serproven_index.html**.

- Minimize the risks of unproven technology by providing the “mix and match” freedom of choice to deploy what makes most sense for your unique environment

In addition, IBM Global Services will provide the services and education required to support multivendor SAN implementations, allowing companies to manage their technology resources—application servers, storage servers, network hardware and storage management software—and share information across storage networks regardless of vendor computing systems and software applications.

To learn more about IBM Storage Services or other IBM Global Services solutions, contact your local IBM sales representative or Business Partner, or visit our Web site at **www.ibm.com/services**.

Conclusion

The SAN is the next generation in the evolution of enterprise storage solutions. Its development has become necessary as a result of worldwide customer requirements for data storage and processing around the clock in multiple time zones—storage and processing that are reliable, powerful, secure, and separate from the enterprise LAN.

IBM’s Netfinity SAN components and solutions are among the leading products in the industry. We bring our decades of experience and expertise in mainframe technology to the Intel processor-based environment with our Netfinity family of servers and our Options by IBM’s broad portfolio of storage products. Both our Netfinity servers and Options by IBM installed on them are covered by our limited, three-year onsite warranty,[7] which provides hardware problem determination onsite, as well as remotely, with IBM’s latest technology and tools.

We also provide the software management tools that help you fully exploit the value of a SAN in your business and make your business intelligence work for you. And the IBM ServerProven Program on Netfinity gives businesses the confidence to implement robust SAN solutions tested and optimized for Netfinity systems in industry-standard, heterogeneous environments.

IBM Global Services provides the capability to help you plan, design, set up, integrate and test your SAN, as well as the ability to help you support and manage multivendor technology resources across your enterprise.
The long-term vision of IBM’s SAN initiative is to provide interoperability across computing platforms and operating systems. To achieve that strategic goal, companies can find no better partners than IBM, Netfinity servers and Options by IBM to implement disaster-tolerant, anywhere, anytime access to highly available and easily managed data.

As in the past, IBM is again playing a leadership role in the development of a new industry-standard technology. Our heritage with enterprise computing and storage, our IBM Global Services and our worldwide service and support, help you build and exploit the SAN you need to take advantage of your business-critical data now and in the future.

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[7] For terms and conditions or copies of IBM’s limited warranty, call 1 800 772-2227 in the U.S. Limited warranty includes International Warranty Service in those countries where this product is sold by IBM or IBM Business Partners (registration required). Telephone support may be subject to additional charges.

Additional Information

For more information on IBM Netfinity directions, products and services, refer to the following white papers, available from our Web site at **www.ibm.com/netfinity**.

Management

Implementing IBM Netfinity Server Management
Integrating IBM Netfinity Manager with Microsoft System Management Server
Integrating IBM Netfinity Manager with Intel LANDesk Server Manager
IBM Netfinity Manager 5.2
IBM Netfinity Manager Plus for Tivoli Enterprise Overview
IBM Netfinity Advanced Systems Management
IBM Netfinity Advanced Systems Management for Servers
IBM ServerGuide for Netfinity and PC Server Systems

Other Topics

Capacity Planning for Netfinity on Windows Terminal Server
Enterprise Storage Solutions
IBM Chipkill Memory
IBM Netfinity Availability Extensions for Microsoft Cluster Server
IBM Netfinity X-architecture
IBM ClusterProven Program on Netfinity
IBM Netfinity Predictive Failure Analysis
IBM Netfinity Cluster Directions
IBM Netfinity Web Server Accelerator
Lotus Domino Clusters Overview
Lotus Domino Clusters Installation Primer
Implementing Microsoft IIS on Netfinity 5500 M10
IBM Netfinity ESCON Adapter
IBM Netfinity PCI Hot-Plug Solutions
IBM Netfinity Storage Management Solutions Using Tape Subsystems
IBM Netfinity 8-Way Server Directions
IBM Netfinity Fibre Channel Directions
IBM Netfinity Server Ultra2 SCSI Directions
IBM Netfinity Server Quality
IBM Netfinity 5000 Server
IBM Netfinity 5500 Server Family
IBM Netfinity 7000 M10 Server
Achieving Remote Access Using Microsoft Virtual Private Networking
At Your Service...Differentiation beyond technology

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IBM Netfinity systems are assembled in the U.S., Great Britain, Japan, Australia and Brazil and are comprised of U.S. and non-U.S. components.

For terms and conditions or copies of IBM's limited warranty, call 1 800 772-2227 in the U.S. Limited warranty includes International Warranty Service in those countries where this product is sold by IBM or IBM Business Partners (registration required).

Are you Year 2000 ready? Visit **www.ibm.com/pc/year2000** or call 1 800 426-3395 (and request document number 10020 from our faxback database) for the latest information.