

# IBM Information Infrastructure Solutions Handbook

Information compliance, availability, retention, and security

IBM System Storage products and services

Smarter Planet and the Dynamic Infrastructure



Sangam Racherla  
Vikas Bajaj  
Emile Knebel  
Glenn Korn  
Anna Kutepova  
Gary Newell  
Sebastian Szumczyk

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International Technical Support Organization

**IBM Information Infrastructure Solutions Handbook**

June 2010

**Note:** Before using this information and the product it supports, read the information in "Notices" on page ix.

#### **First Edition (June 2010)**

This edition applies to the IBM Information Infrastructure solutions offered by IBM as of November 2009.

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# Preface

An information infrastructure is comprised of software, servers, storage, and networks, integrated and optimized to deliver timely, secure, and trusted information throughout the organization and to its clients and partners.

With the explosive growth in data and information—coupled with demands for projects with rapid ROI—IT infrastructures and storage administrators are reaching a breaking point. IBM® can help with the changes needed to manage information availability, security, and regulatory and compliance requirements on a tighter budget. And because the health of any business often depends on its ability to take advantage of information in real time, a sound, intelligent information infrastructure becomes critical to supporting new growth initiatives.

IBM offers an innovative approach to help you manage information growth more effectively and mitigate risks with a dynamic infrastructure that efficiently and securely stores and protects information, and optimizes information access. You can control, protect, manage, and gain new intelligence from your information with the IBM leading-edge Information Infrastructure products, services and integrated solutions, supported by world-class expertise and access to top experts from around the world.

This IBM Redbooks® publication provides an overview of the IBM Information Infrastructure solutions that are designed to help you manage the information explosion and address challenges of information compliance, availability, retention, and security. This will lead your company toward improved productivity, service delivery, and reduced risk, while streamlining costs.

## The team who wrote this book

This book was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

**Sangam Racherla** is an IT Specialist and Project Leader working at the International Technical Support Organization, San Jose Center. He holds a degree in electronics and communication engineering and has nine years of experience in the IT field. He has been with the International Technical Support Organization (ITSO) for the past six years and has extensive experience installing and supporting the ITSO lab equipment for various Redbooks publication projects. His areas of expertise include Microsoft® Windows®, Linux®, AIX®, System x®, and System p® servers, and various SAN and storage products.

**Vikas Bajaj** is a Senior Associate IT specialist (storage). He has been working with IBM for the last three years in the area of IBM storage, Brocade, and Cisco. He is responsible for maintaining the storage infrastructure for India Software Lab (ISL), which includes administration of IBM DS8000®, DS6800, DS4700, Brocade Fibre channel switch, Cisco fibre channel switch, and IBM N series NAS boxes. Vikas provides day-to-day support to the clients on IBM storage and also helps design and implement IBM storage solutions for internal clients. In the area of TPC, he has provided training to partner labs and has had articles published on TPC implementation.

**Emile Knebel** is a Senior IT specialist at IBM The Netherlands. He joined IBM twelve years ago at the IBM Business Partner technical marketing support line. After this period, he had eight years of experience in open systems platforms within STG, during which he built

technical pre-sales expertise within Server Consolidation and Enterprise Resource Planning (ERP) projects. After being people manager in the IBM ISC Deal Hub organization, he returned to STG The Netherlands, to become Storage Product Manager for IMT Benelux. Emile held this job for almost two years.

**Glenn Korn** is a member of the World-Wide Technical Support Marketing group for the IBM Systems and Technology Group where he specializes in SAN Storage solutions. Glenn has been working with computer hardware and networks for over 18 years. He has extensive experience in IT support of both hardware and software. He holds a B.S. degree in Industrial Technology and is a Microsoft Certified Systems Engineer (MCSE) and Novell CNE.

**Anna Kutepova** is a Customer Quality Engineer (problem analysis of the installation process for the DS8000 data storage server) on the IBM DSS plant in Vac, Hungary. She is a leader of the Customer Engineer Workshop project for DS8000. She has connection with Budapest University of Technology and Economics and leads students' projects as a consultant from manufacturing.

**Gary Newell** is a senior support specialist in the UK working for the last 10 years on open systems storage, SAN, and virtualization products. He has been with IBM for 10 years and has worked in the UK hardware support center and on EMEA PFE teams during that time. Gary has more than 20 years experience in the IT industry, having worked in European and worldwide support roles for Honeywell, StorageTek, and Sequent before joining IBM.

**Sebastian Szumczyk** is an Accredited IT Architect for IBM Global Technology Services from Warsaw, Poland. He has 12 years experience in the IT industry and has focussed primarily on infrastructure architectures in the last four years. His areas of expertise include Tivoli® Storage and System Management, pSeries®, AIX, virtualization, storage, and high availability solutions. He holds several certifications in the technical field, including the prestigious IBM System p5® Certified Advanced Technical Expert certificate. He holds an engineering degree in Administering Operating Systems and Databases from Warsaw Information Technology under the auspices of the Polish Academy of Sciences.



Figure 1 The Team: Gary, Sebastian, Sangam, Anna, Emile, Glenn, and Vikas

Thanks to the following people for their contributions to this project:

Bertrand Dufrasne  
Mary Lovelace  
Ann Lund  
Alex Osuna  
Jon Tate  
IBM International Technical Support Organization, San Jose Center

Juergen Deicke  
Roger L. Haskin  
John Hoogenboom  
Sven Oehme  
Ronnie Sahlberg  
Andrew Tridgell  
Barry Whyte  
IBM

Thomas Gruber  
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# IBM Information Infrastructure solutions

This book looks at some of the IBM System Storage® products and services that form the base for the Information Infrastructure solutions offered by IBM.

Information Infrastructure is a key element of the Dynamic Infrastructure® strategy, which is designed to help IBM clients create an IT infrastructure designed to operate in today's instrumented, interconnected, and intelligent world: The Smarter Planet™.

IBM offers a strategy for designing and evolving a shared, integrated and highly available IT infrastructure that can address today's challenges and tomorrow's opportunities. Not only can it help ensure high availability and quality of existing services, it can also help to meet customer expectations for real-time, dynamic access to innovative new services.

This will also help contain operational cost and reduce complexity, while enabling businesses to achieve breakthrough productivity gains through workload optimization, virtualization and consolidation, energy stewardship, and flexible delivery choices. The current security, resiliency and compliance demands can also be met as organizations prepare for the new challenges posed by an even more connected and collaborative world.

For complete information about the IBM Information Infrastructure solutions, refer to:

[http://www.ibm.com/systems/information\\_infrastructure/](http://www.ibm.com/systems/information_infrastructure/)

## 1.1 Smarter Planet

The Smarter Planet leadership agenda has been launched by IBM to help build a smarter planet that will help guide the development and deployment of IBM hardware, software, and services.

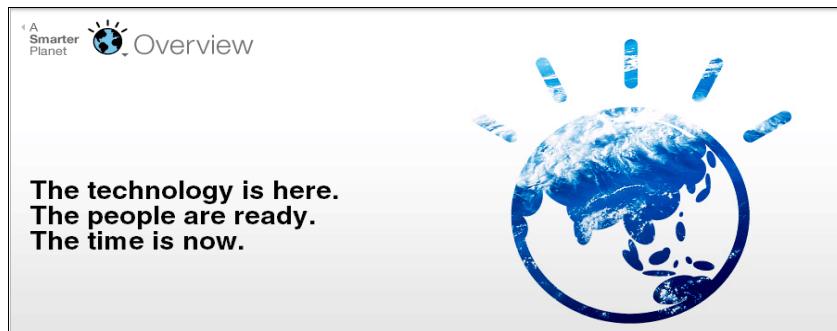


Figure 1-1 Smarter Planet

The smarter planet agenda is born out of the need for change. Our political leaders are not the only ones who have been handed a mandate for change. Leaders of businesses and institutions everywhere have a unique opportunity to transform the way the world works.

We find ourselves at this moment because the crisis in our financial markets has jolted us awake. We are seriously focused now on the nature and dangers of highly complex global systems. And this is not our first such jolt. Indeed, the first decade of the twenty-first century has seen a series of wake-up calls with a single theme: the reality of global integration.

The world is becoming increasingly instrumented, interconnected, and intelligent. The problems of global climate change and energy, global supply chains for food and medicine, new security concerns ranging from identity theft to terrorism—all issues of a hyperconnected world—have surfaced since the start of this decade.

The world continues to get “smaller” and “flatter.” But we see now that being connected is not enough. Fortunately, something else is happening that holds new potential: the planet is becoming smarter.

That is, intelligence is being infused into the way the world works—into the systems, processes, and infrastructures that enable physical goods to be developed, manufactured, bought, and sold, that allow services to be delivered, that facilitate the movement of everything from money and oil to water and electrons, and that help billions of people work and live.

To learn more about the Smarter Planet initiatives, look here:

<http://www.ibm.com/smarterplanet/>

## 1.2 Dynamic Infrastructure

IBM offers a strategy for designing and evolving a shared, integrated and highly available IT infrastructure that can address today's challenges and tomorrow's opportunities (Figure 1-2). Not only can it help ensure high availability and quality of existing services, it can also help meet customer expectations for real-time, dynamic access to innovative new services.



Figure 1-2 Dynamic Infrastructure

It can help contain operational cost and reduce complexity, while enabling businesses to achieve breakthrough productivity gains through workload optimization, virtualization and consolidation, energy stewardship, and flexible delivery choices. And it can help meet current security, resiliency, and compliance demands as organizations prepare for the new challenges posed by an even more connected and collaborative world.

A dynamic infrastructure is designed for today's instrumented and interconnected world, helping clients integrate their growing intelligent business infrastructure with the necessary underlying design of a flexible, secure, and seamlessly managed IT infrastructure.

The key elements of the Dynamic Infrastructure are:

- ▶ Virtualization

Virtualization and consolidation can reduce IT complexity to help your data center become more resilient and secure while reducing costs. The ability to deploy capacity and server images virtually increases speed of deployment roughly by a factor of 30.

- ▶ Business resiliency

Business continuity and resiliency solutions keep your business running in the event of an internal or external risk, planned or unplanned, and allow your IT experts to devote more time to innovation. Less than 50% of companies surveyed have disaster recovery and business continuity strategies in place, according to researchers at UK-based Chartered Management Institute. And among those who have planned for business continuity and resiliency, 75% report that efforts are likely to be "haphazard" and "untested."

- ▶ Security

IBM security solutions deliver the full breadth and depth of capabilities that enable organizations to take a business-driven, holistic approach to security, compliance, and risk management in alignment with an IT governance framework, supporting the secure delivery of services with speed and agility in the dynamic infrastructure.

- ▶ Information infrastructure

IBM's comprehensive approach to information infrastructure addresses compliance, availability, retention, and security requirements while helping businesses get the right information to the right person at the right time. Potential benefits include: a 75% decrease in capital costs, a 600% increase in input capacity, a 300x improvement in throughput, and a 500x improvement in the hardware price/performance ratio.

- ▶ Service management

Service management solutions help you create and manage a more agile, business-oriented and dynamic infrastructure so you can rapidly respond to change and deliver higher quality services at lower cost.

- ▶ Asset management

Hardware, software, and services from IBM help you maximize the performance and lifetime value of assets across your enterprise—production, facilities, transportation and IT—and closely align them with your overall business strategy.

- ▶ Energy efficiency

Energy efficiency solutions can help lower data center energy costs by up to 40% or more through facilities design, power and cooling infrastructure, active energy management, and efficient, scalable IBM systems.

## 1.3 What is the IBM information infrastructure

An information infrastructure (Figure 1-3) is comprised of software, servers, storage, and networks, integrated and optimized to deliver timely, secure, and trusted information throughout the organization and to its customers and partners.



Figure 1-3 IBM information infrastructure

For more information about the IBM information infrastructure, refer to:

[http://www.ibm.com/systems/information\\_infrastructure](http://www.ibm.com/systems/information_infrastructure)

## 1.4 Why use IBM for your information infrastructure

Clients are being overwhelmed by the growth of information (Figure 1-4). The world is now generating approximately 15 petabytes of new information every day. Particularly challenging is the nature of the information being produced. Growth is mostly unstructured content, generated largely by email, with increasing contributions by documents, images, and video, all of which need to be stored. IBM helps clients manage the explosion of information more effectively by mitigating business risks, reducing storage costs, and extracting business value and new intelligence from their information. Clients are generally interested in new ways to optimize performance without increasing complexity, and optimize costs through smarter placement and management of information.



Figure 1-4 Information overload?

### Key facts and figures<sup>1</sup>

The world is becoming more instrumented, interconnected, and intelligent (smarter). For example:

- ▶ 2.5 billion RFID tags sold in 2009.
- ▶ 4 billion camera phones sold through 2009.
- ▶ 900 million GPS devices sold annually by 2013.
- ▶ 76 million smart electric meters in 2009, 200M by 2014.
- ▶ 2 billion people on the web by 2011.
- ▶ 247 billion emails sent daily.
- ▶ Text messages generate 400TB of data per day in the US.
- ▶ MRIs will generate a petabyte of data in 2010.

All these factors are resulting in an explosion of information for clients to manage, and also a huge opportunity to make the world smarter.

To solve these challenges, clients not only need a strategic partner who can help them manage and protect their data from creation to retirement, but they need a partner who knows how to manage the volume and complexity of data, no matter what. IBM is a pioneer in technology solutions, offering a unique vision and a targeted strategy that can help organizations build an information infrastructure that not only supports data growth, but also turns it into valuable insight. IBM is the only vendor that provides such a comprehensive, integrated portfolio of storage and data management solutions that address nearly all of our clients' information management challenges.

<sup>1</sup> Source: The Storage Story, Pulse BP Summit

From inventing the disk drive and relational database to developing leading innovations in encryption, secure key management, and access control, no other vendor has consistently demonstrated the commitment that IBM has to information innovation. IBM invested billions of dollars developing innovative information management solutions and made eight key acquisitions in the last two years to bolster its information infrastructure capabilities.

IBM is the first major vendor to virtualize storage across multiple vendor technologies, and offer full support to third-party platforms such as EMC, Hewlett-Packard, and Oracle/Sun Microsystems. On its own platform, IBM provides superior intelligent data migration between storage tiers, from tape to solid state, helping to cut costs and promote a comprehensive data management solution. Other vendor solutions are proprietary and closed. But IBM is committed to developing open solutions that extend the life and improve the effectiveness of our clients' existing storage infrastructures.

And IBM solutions are supported by world-class expertise and decades of experience developing industry-leading solutions, and working with clients across all industries to successfully implement them.

## 1.5 What we offer

IBM can help you manage rapid information growth more effectively, mitigate business risks, reduce storage costs, and support new, smarter systems by leveraging best practices and key capabilities.

IBM can help you gain more insight into your data, storage resources, and storage system performance. IBM can help clients identify up to 15% of allocated storage for reuse, providing early dividends. With a better understanding of what you have, the right next steps are easier to see. Specifically, IBM can help you:

- ▶ Discover and monitor storage resources by file type and business unit
- ▶ Understand storage utilization rates
- ▶ Understand end-to-end storage system performance
- ▶ Understand storage energy consumption
- ▶ Identify old and duplicate data

IBM can help you solve your toughest information infrastructure challenges. IBM solutions help control costs with solutions that help you grow capacity without complexity, so your staff can manage more capacity efficiently. IBM also helps you optimize storage with tools to move and manage information more easily. IBM can also provide solutions and experts to support public and private storage cloud initiatives, which introduce a new financial and computing model.

IBM offers a full range of disk, tape, and networking hardware, software, and services to support information infrastructures of all sizes. IBM offers technology solutions to address the tough challenges of information growth, flat budgets, and growing service level requirements. Featured solutions include:

- ▶ Storage virtualization
- ▶ Storage consolidation
- ▶ Storage efficiency
- ▶ Archiving
- ▶ Data protection
- ▶ Solid®-state storage optimization

## 1.6 Storage optimization

As business climates improve, clients can shift their attention from cutting costs to seizing opportunities. New, smarter applications and analytics systems can generate volumes of new data and have service level requirements that strain existing infrastructures. IBM storage optimization solutions help clients meet new throughput, scalability, and reliability requirements with innovative technology, proven best practices, and knowledgeable experts.

Storage optimization is of interest to clients responsible for primary data, such as production databases, applications, file systems, and mirrored failover environments that use Tier 1 and Tier 2 disk systems.

Organizations that benefit most from optimizing their storage infrastructure typically need to:

- ▶ Better manage and utilize their infrastructure so they can quickly respond in an ever changing business environment.
- ▶ Lower the cost of operating and maintaining assets to combat escalating asset maintenance and replacement costs.
- ▶ Monitor, manage, and secure information assets across their extended enterprise.
- ▶ Meet customer expectations and increase service capabilities, despite an aging infrastructure and small IT staff.

Some of the key client issues include:

- ▶ Storage utilization
- ▶ Inefficient older assets (consolidation)
- ▶ Storage management automation

IBM Storage Optimization Featured Solutions include:

- ▶ Storage Virtualization (SVC)
- ▶ Storage Management (SERP, TPC)
- ▶ Tier 1 and Tier 2 Disk Storage
- ▶ Solid-state storage optimization: EasyTier
- ▶ Self-optimized, self-managing storage: XIV®
- ▶ Scale-out storage: SONAS
- ▶ Integrated tiered storage for large and mid-range needs: DS8000, DS5000, DS3000

## 1.7 Information archiving and retention

IBM information archiving and retention solutions include the following:

- ▶ Data protection: Information Archive, TSM
- ▶ Data reduction:
  - Storage Resource Management: SERP and TPC
  - Deduplication: ProtecTIER®, TSM
  - Thin Provisioning: SVC, DS8000
  - Long-term retention: Integrated disk + tape solutions, Tape with Tape File System, Enterprise Archive Services, TSM HSM





# Storage solutions for data center applications

Businesses are increasingly dependent on their data center infrastructure to enable continuous availability of their systems, data, and applications. With the emergence of new regulations, security threats and service outages—ranging from deliberate attacks to natural disaster—businesses are increasingly at risk and must implement a proactive plan to mitigate these threats. Well defined continuity and disaster recovery practices for your data center can help reduce downtime and the associated costs.

The IBM information infrastructure is designed to deliver information on demand while at the same time providing security-rich information storage and the resilience to help mitigate business risk.

IBM information infrastructure solutions (Figure 2-1 on page 10):

- ▶ Offer a comprehensive approach that covers all aspects of an information infrastructure.
- ▶ Deliver unified storage and security management software.
- ▶ Include comprehensive disk, tape, and storage networking hardware.
- ▶ Provide integrated business solutions.
- ▶ Build on deep expertise, proven best practices, and successful client engagements.
- ▶ Enable flexibility through standards-based solutions that enable organizations to adapt more easily to change.

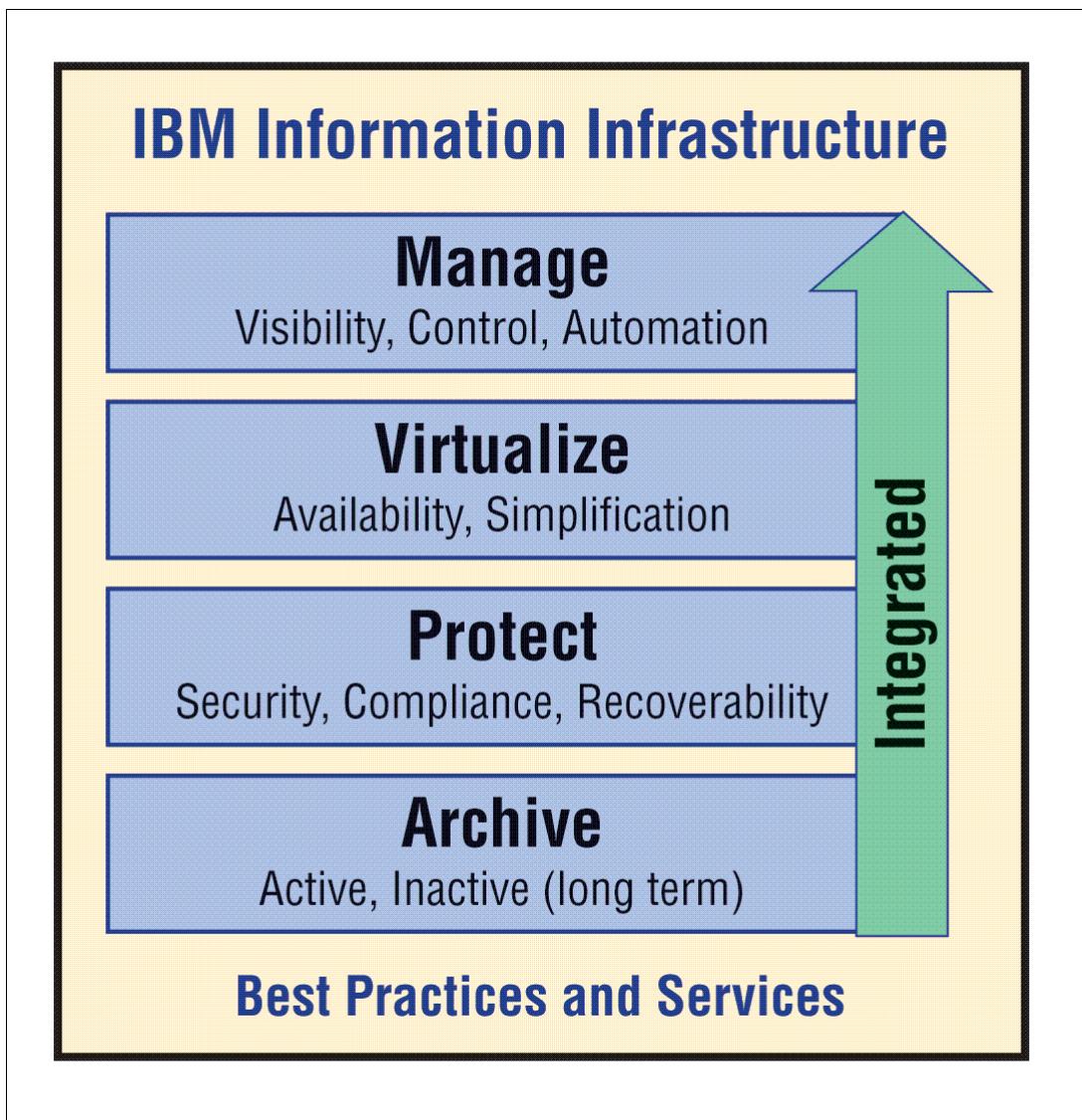


Figure 2-1 IBM information infrastructure

We give an overview of some key IBM solutions.

## 2.1 Archiving

Information is the power of the new IT world, and that is why it is important to have all necessary data available in any situation. Any kind of documents or sources must be stored and archived in case of critical or emergency situations.

Archiving solutions can help address the data growth challenge by moving inactive data off the primary storage to an archiving repository, which can leverage lower cost disk, tape, and optical media. This will help you achieve overall IT optimization gains in performance, storage optimization, backup, and managing storage assets.

IBM unveiled a smarter approach to archiving with a new strategy and leading offerings.

One of the new solutions is IBM Information Archive. Cloud-ready, this next generation information retention solution provides immediate archiving of all business information. Built-in deduplication, policy-driven retention, and automated data migration to tape offers efficiency, longevity, and protection. Its scalable and flexible architecture is simple to use, manage, and expand. IBM Information Archive is a critical part of the IBM Smart Archive Strategy.

Another good example of the IBM Archiving Solution is IBM Grid Medical Archive Solution, a grid-based, secure and flexible solution for health care organizations and hospital networks for archiving of medical images across the campus, multiple sites, or across the country.

Email archive solutions are helping reduce storage costs, improving performance, and addressing retention requirements for email systems.

IBM has SAP Archive options. CommonStore does not store any data or documents. Instead, it manages the data and document archive process defined by the SAP ArciveLink protocol—storing and retrieving archived content to and from the back-end archive management repositories. The back-end archive management system can be one of the following IBM repositories:

- ▶ IBM Content Manager
- ▶ IBM Content Manager OnDemand
- ▶ IBM Tivoli Storage Manager (TSM)

For all IBM Archiving solutions, refer to:

<http://www.ibm.com/systems/storage/news/center/solutions/archiving/index.html>

## 2.2 Storage virtualization

As the need for data storage continues to spiral upward, traditional physical approaches to storage management become increasingly problematic. Physically expanding the storage environment can be costly, time-consuming, and disruptive—especially when it has to be done again and again in response to ever-growing storage demands. Yet manually improving storage utilization to control growth can be challenging. Physical infrastructures can also be inflexible at a time when businesses need to be able to make ever more rapid changes in order to stay competitive.

The alternative is a virtualized approach in which storage virtualization software presents a view of storage resources to servers that is different from the actual physical hardware in use (Figure 2-2 on page 13). This logical view can hide undesirable characteristics of storage while presenting storage in a more convenient manner for applications. For example, storage virtualization may present storage capacity as a consolidated whole, hiding the actual physical boxes that contain the storage.

In this way, storage becomes a logical pool of resources that exists virtually, regardless of where the actual physical storage resources are located in the larger information infrastructure. These software-defined virtual resources are easier and less disruptive to change and manage than hardware-based physical storage devices, since they do not involve moving equipment or making physical connections. As a result, they can respond more flexibly and dynamically to changing business needs. Similarly, the flexibility afforded by virtual resources makes it easier to match storage to business requirements.

Virtualization offers significant business and IT advantages over traditional approaches to storage. Storage virtualization can help organizations to:

- ▶ Reduce data center complexity and improve IT productivity by managing multiple physical resources as fewer virtual resources.
- ▶ Flexibly meet rapidly changing demands by dynamically adjusting storage resources across the information infrastructure.
- ▶ Reduce capital and real estate costs by creating virtual resources instead of adding more physical devices.
- ▶ Improve utilization of storage resources by sharing available capacity and deploying storage on demand only as it is needed.
- ▶ Deploy tiers of different storage types to help optimize storage capability while controlling cost and power and cooling requirements.

Storage virtualization from IBM can help organizations meet the challenges of managing storage as part of a comprehensive infrastructure for managing information. The IBM information infrastructure is designed to deliver information on demand while at the same time providing security-rich information storage and the resilience to help mitigate business risk.

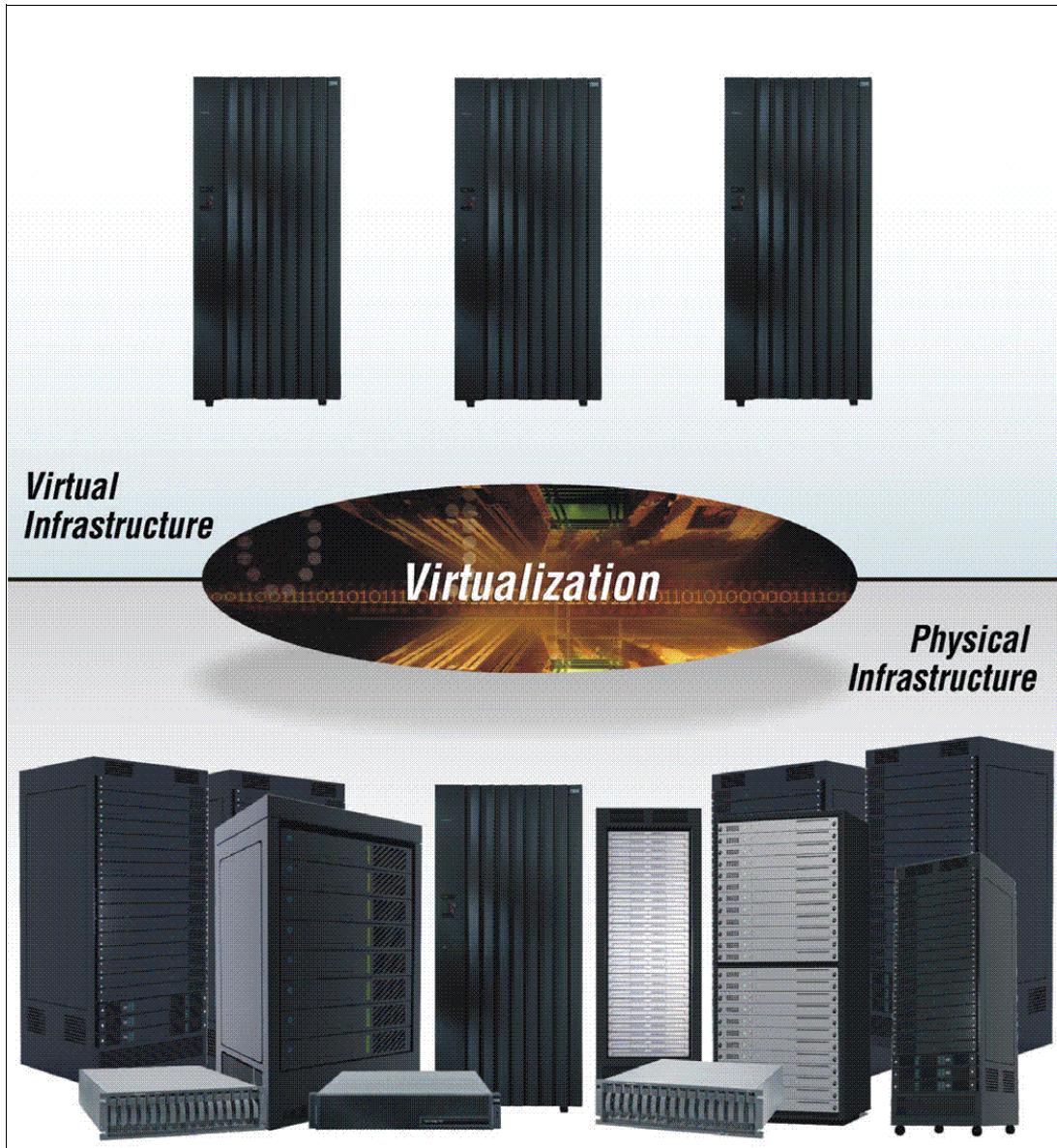


Figure 2-2 Virtualization overview

### File virtualization: IBM Scale-out File Services

In network attached storage (NAS) environments, file virtualization using IBM Scale-out File Services (SoFS) aids in data sharing by presenting a single namespace (directory/folder structure) for files, which remains constant regardless of their physical location. This ability not only helps make it easier to share files among servers, it also facilitates implementation of tiered storage at the file level.

NAS has traditionally been considered unsuitable for large storage demands because of its inability to scale. But new scale-out NAS technology allows greater scalability through the use of virtualization. IBM Scale-out File Services utilizes scaling architectures and technologies borrowed from server environments and applies them to the storage environment. The goal is to offer simplified access to data and the scalability to grow as dictated by the needs of individual users, applications, the IT department, and the broader organization.

## **File system virtualization: IBM System Storage N series Virtual File Manager**

The explosive growth of unstructured data and the associated proliferation of file servers and NAS appliances have resulted in acute management challenges for IT administrators—as well as deteriorating data access for clients (both users and application servers).

IBM System Storage N series Virtual File Manager (VFM®) software is a comprehensive solution for managing unstructured file data. Rather than virtualizing files the way Scale-out File Services does, VFM virtualizes file systems in existing NAS appliances. It is designed to provide simplified and consistent data access, even when the underlying storage infrastructure changes. VFM creates a global namespace that aggregates distributed files located on IBM N series storage systems to present a single logical pool of storage. This helps enable IT organizations to more quickly and easily change, add, migrate, or consolidate storage while avoiding impact to users.

## **Tape storage virtualization: IBM Virtualization Engines TS7700 and TS7500**

The IBM Virtualization Engine TS7700 and IBM Virtualization Engine TS7500 are virtual tape solutions for mainframe and open systems servers, respectively, that are designed to optimize tape processing. Through the implementation of a fully integrated tiered storage hierarchy of disk and tape, the benefits of both technologies can be leveraged to help enhance performance and provide the capacity needed for today's backup and tape processing requirements. Deploying these innovative virtual tape systems can help provide an increased level of operational simplicity and energy efficiency, support a low cost of ownership, and increase reliability to provide significant operational efficiencies. You can find more information in Chapter 6, "IBM system storage tape systems" on page 123.

## **Disk storage virtualization: IBM System Storage SAN Volume Controller**

For organizations using a SAN approach to storage, IBM System Storage SAN Volume Controller combines storage capacity from multiple physical systems into a virtual reservoir of storage that can be managed from a central point. As a result, storage administration is simplified, and organizations can treat storage as a resource to address business requirements without being concerned with its physical implementation.

IBM System Storage SAN Volume Controller (SVC) is specifically designed to help increase storage utilization by providing host applications with more flexible access to capacity, and to improve administrator productivity by providing a common interface for storage management. It also insulates host applications from changes to the physical storage infrastructure, which can improve application availability. Finally, SVC helps enable tiered storage environments in which the type and cost of storage are aligned with the value of the data. When combined with SVC's ability to help improve storage utilization and control growth, tiered storage with SVC also helps reduce energy requirements.

## **Storage infrastructure management: IBM TotalStorage Productivity Center suite**

The IBM TotalStorage® Productivity Center suite of storage infrastructure management tools can help reduce the complexity of managing storage environments by centralizing, simplifying, and automating storage tasks associated with storage systems, storage networks, replication services, and capacity management.

IBM TotalStorage Productivity Center can help manage the capacity utilization of storage systems, file systems, and databases, and automate file system capacity provisioning, perform device configuration and management of multiple devices from a single user

interface, tune and proactively manage the performance of storage devices on the Storage Area Network (SAN), as well as manage, monitor and control the SAN fabric.

All the server and storage components within the IBM Information Infrastructure can be virtualized, with the goal of improving information availability and simplifying information management. The IBM Information Infrastructure enables virtualization of storage assets as well as the storage networks that connect servers and storage. The infrastructure also includes integrated management tools to manage both the virtual and physical aspects of the infrastructure from a single management point.

The value of a virtualized infrastructure is in the increased flexibility created by having pools of system resources on which to draw; in the improved access to information afforded by a shared infrastructure; and the lower total cost of ownership that comes with decreased management costs, increased asset utilization, and the ability to link infrastructure performance to specific business goals.

To learn more about how the IBM Storage Virtualization solutions can help your organization meet your storage challenges, contact your IBM representative or IBM Business Partner, or visit:

<http://www.ibm.com/storage/virtualization>

## 2.3 Backup and restore solutions

Sound data backup and recovery practices are an integral component of most businesses today. Many businesses are pushing the limits of their backup and recovery processes for both infrastructure and personnel. Hitting or shrinking batch windows for backups is critical for many IT managers as they struggle to meet required service and availability levels while managing the exponential growth of data in their enterprises.

IBM can help address your backup and restore requirements with:

- ▶ Reliable backups
- ▶ High application availability and reduced backup windows
- ▶ Continuous operations
- ▶ Rapid and successful data restores from disk or tape
- ▶ Automation and efficiency of management and integration into your environment
- ▶ Protection of data and affordable total cost of ownership

IBM can offer wide range of solution suitable to different needs and requests:

### ***Comprehensive data protection solution***

The IBM DS3000/DS4000/DS5000 series storage offers Microsoft Windows Server-based customers the perfect balance of data protection and recovery when paired with Tivoli Fastback. Companies rely on outdated systems, or in some cases, nothing at all to ensure the protection and continued availability of their data. Their data, and therefore their businesses, are at risk. With the new solution, companies will have faster backup and more reliable recoveries.

For companies with remote offices, the burden of backup and recovery is removed from the non-IT-savvy staff and moved to the central data center where the expertise resides. With Fastback and IBM System Storage, downtime is greatly reduced. Tivoli Fastback is based on continuous, frequent, and scheduled policy-based backups, and when paired with IBM DS3000 series systems, data recovery is quick and easy for both remote workgroups and

central office environments. And for those who need application and server-level protection, Fastback makes recovery of transactions, emails, and servers quick and simple.

### ***IBM System x NAS***

IBM System x Storage Servers and System x NAS products offer a broad range of affordable Windows-based network-attached file server solutions. They combine the proven IBM xSeries® and System x server technology with the Microsoft Windows Storage Server 2003 R2 operating system to provide a superior network-attached storage solution for companies ranging from large enterprises to small businesses. The server's hardware has been preconfigured and the Windows Storage Server 2003 R2 operating system and Tivoli CDP Backup for users is preinstalled, enabling rapid deployment and ease of use.

### ***IBM Tivoli Storage Manager***

As part of the IBM TotalStorage Open Software Family, IBM Tivoli Storage Manager is software that enables you to protect your organization's data from failures and other errors by storing backup, archive, space management, and bare-metal restore data, as well as compliance and disaster recovery data in a hierarchy of offline storage. The Tivoli Storage Manager family of software products is designed to provide centralized, automated data protection that can help reduce the risks associated with data loss while also helping to reduce complexity, manage costs, and address compliance with regulatory data retention requirements.

### ***IBM TotalStorage Integrated Backup for Databases feature***

Data backup and recovery are critical for IBM DB2® database systems that support online transactions, analytical processing, and mission-critical file servers. The IBM TotalStorage Integrated Backup for Databases feature for IBM TotalStorage DS4500, DS4400, and DS4300 systems provides an integrated data protection backup solution for DB2 databases.

### ***Automated Storage Management with IBM eServer xSeries systems***

This enterprise-wide backup and recovery solution is built on IBM Tivoli Storage Manager, IBM xSeries, and TotalStorage systems. It provides a centralized, automated data protection system that helps reduce risks of data loss, improve data availability and storage efficiencies while driving lower total cost of ownership through decreased time and administration costs.

### ***IBM TotalStorage backup solutions for SAP business integration software***

We offer a comprehensive set of IBM TotalStorage solutions that can help simplify the task of running a dynamic SAP environment. These can be identified by our consultants or IBM Business Partners and tailored to your specific SAP environment.

More information about new solutions is here:

[http://www.ibm.com/systems/storage/solutions/business\\_continuity/backup\\_restore/index.html](http://www.ibm.com/systems/storage/solutions/business_continuity/backup_restore/index.html)

## **2.4 Email archive solutions**

With business increasingly conducted around the clock and in multiple locations, corporate email traffic grows heavier every year. It causes many employees to spend time searching for particular messages or attached documents. In turn, IT administrators face constant demands for more disk space and associated overhead for backing up email servers.

In response, some companies set arbitrary storage limits or ask users to store content locally. However, such limits or local storage can result in the loss of valuable information, excessive file duplication, and challenges to meeting compliance requirements.

Without archiving, the volume of emails and attachments on your email server can become unmanageable. And if storage limits are not enforced, your company's storage costs can escalate. In addition, with an ever-expanding email server, you face extended service intervals for backup, restore and recovery; increased replication time; and greater efforts for system administration, maintenance, and system upgrades or consolidations.

IBM offers email archive solutions that can help reduce the size of email systems, reduce management and improve performance. They can help you:

- ▶ Improve productivity by reducing the need for user management of email
- ▶ Address compliance requirements for email
- ▶ Improve performance of email systems
- ▶ Reduce email storage costs

This also helps to provide virtually unlimited mailbox space to users; helping lower system backup, restore and recovery times, and associated maintenance costs and efforts.

IBM and ISV email archive solutions are designed to provide comprehensive solutions for managing email. These systems are designed to move emails and attachments, according to policies, to a secure archive where they can easily be recovered if needed. This process helps reduce the need for end-user management of email, improve the performance of email systems and reduce the need for high-performance email storage. In combination with the IBM Information Archive (more about this solution in further chapter), these solutions can also help you address compliance requirements.

Key offers from IBM:

#### ***IBM Information Archive: The Next Generation Information Retention Solution***

As you address your information retention needs—whether keeping valuable content for long periods of time, meeting industry retention regulations, or addressing corporate governance—you need an archiving solution that is secure, scalable, but also cost-effective. IBM Information Archive, the next generation information retention solution is designed as an archiving repository for all types of content (structured or unstructured) to help organizations of any size address complete information retention needs—business, legal, or regulatory.

#### ***IBM DB2 CommonStore for Exchange Server and IBM DB2 CommonStore for Lotus Domino***

IBM DB2 CommonStore for Exchange Server and IBM DB2 CommonStore for Lotus® Domino® are designed to manage email archiving and retrieval. They can help trim the size of your email system to reduce storage costs, improve email system performance, and provide virtually unlimited mailbox space for each user.

#### ***IBM email archiving preload solution***

Solution for small and midsize companies to address the challenges of growing email systems, including improving responsiveness for users, retaining email for compliance, governance, and legal discovery purposes.

For more information about the email archive solutions, refer to:

[http://www.ibm.com/systems/storage/solutions/ilm/email\\_archive/index.html](http://www.ibm.com/systems/storage/solutions/ilm/email_archive/index.html)

## 2.5 Data encryption solution

Data is one of the most highly valued resources in a competitive business environment. Protecting that data, controlling access to it, and verifying its authenticity while maintaining its availability are priorities in our security-conscious world. Increasing regulatory requirements are also helping to drive the need for the adequate security of data. Encryption is a powerful and widely used technology that helps protect data from loss and inadvertent or deliberate compromise.

### ***Protecting information with IBM self-encrypting storage solutions***

IBM System Storage solutions can help organizations enforce security controls by encrypting stored data. Encryption is critical because data center storage is inherently mobile: Tapes get archived, disk drives routinely get replaced, and enterprises become understandably concerned about the sensitive data that resides in their storage systems. The idea of storage encryption is to protect the data stored in these systems so that if a tape cartridge or disk is lost or stolen, the information stored there is useless to anyone who accesses it—unreadable due to encryption.

IBM offers a portfolio of information security solutions based on its innovative self-encrypting disk and tape drives. These drives are designed to encrypt data automatically as it enters the drive to be stored, and then automatically decrypt it as it moves out of the drive. The embedded encryption engine helps to ensure that there is virtually no performance degradation compared to non-encrypting drives. This drive-level encryption approach reduces the risk that information could be compromised when storage media is physically removed from the storage systems for archiving.

IBM introduced the industry's first self-encrypting enterprise tape drive, the IBM System Storage TS1120, in 2006, followed by the next-generation IBM System Storage TS1130 and Linear Tape Open (LTO) self-encrypting drives, which can address a wide range of enterprise and entry-level tape environments. In February of 2009, IBM introduced full disk encrypting drives in its flagship IBM System Storage DS8000R and soon followed that with the announcement of full disk encrypting drives in its mid-range disk platform, the IBM System Storage DS5000. Adding self-encrypting disk solutions to the highly successful self-encrypting tape solutions offers clients a consistent approach to securing data at rest, enabling organizations to adequately address their data security concerns. Using these IBM self-encrypting drives to encrypt data at the storage end point provides the ability to store data in an encrypted form with minimal operational complexity and minimal impact on performance. Encrypting at the storage end point can help organizations to:

- ▶ Minimize the need for host-based encryption, which can drain host performance.
- ▶ Minimize the need to use specialized encryption appliances that can add to infrastructure complexity.
- ▶ Accommodate data compression of tape storage, so that fewer tape cartridges are needed.
- ▶ Reduce the risk that batch processing windows will be affected by placing no significant impact on the tape drives' native performance.

Self-encrypting drives are rapidly becoming the preferred model for securing data stored on tape cartridges and disk drives. For example, the National Security Agency recently qualified self-encrypting disk drives for protecting information on computers deployed by U.S. government agencies and contractors for national security purposes.

When you talk about securing your information infrastructure, it is difficult not to mention the mainframe. For years, the IBM mainframe has been satisfying the most demanding clients with the highest levels of performance, availability, and security. Originally designed to be

shared by thousands of users, the mainframe has security built into nearly every level of the system—from the processor level to the operating system to the application level. This design helps protect it from malware, viruses, and threats from both within and outside the organization.

By providing the ability to enforce, monitor and manage security, IBM System z® is the logical central management point for enterprise-wide security. For user identification and authentication, access control and auditing, distributed directory services, networking security and security administration, the mainframe is designed to provide integrity, process isolation, and cryptographic capabilities to help keep information secure. On top of this solid hardware foundation, System z operating systems offer a variety of customizable security elements within the Security Server and Communication Server components.

And, of course, along with the inherent security built into the mainframe, there are additional security management offerings from IBM Tivoli software, such as identity and access management solutions, and the IBM Tivoli zSecure suite, which can provide advanced security to help protect the information infrastructure.

### ***Successful key management strategies***

Just as each tape drive has an embedded encryption engine, each disk drive also has an embedded encryption engine, and it, too, uses the IBM encryption key management software to manage the keys associated with the solution. This simplified and proven key management system is being used in some of the largest banks in the world. As with the encrypting tape solution, the encrypting disk solution is designed to be transparent to the operating system, applications, databases, system administrators and users—making deployment much simpler than with specialized encryption appliances.

IBM currently addresses key management in its self-encrypting tape storage solutions with the standards-based IBM Tivoli Key Lifecycle Manager (TKLM) and its predecessor, Encryption Key Manager (EKM). TKLM is designed to help manage the growing volume of encryption keys across the enterprise with simplified deployment, configuration and administration over their life cycles.

More information about IBM encryption solutions can be found in tape and disk storage solutions and at:

[http://www.ibm.com/systems/storage/solutions/data\\_encryption/index.html](http://www.ibm.com/systems/storage/solutions/data_encryption/index.html)

## **2.6 Storage infrastructure management**

As storage environments grow exponentially, they present more complex management challenges. From capacity management to human error, configuration options to unpredictable performance—all of these can contribute to storage management difficulties.

Controlling the complexity of information infrastructures is critical for maintaining high availability at a reasonable cost. With the proper tools in place, your IT staff can spend more time performing analysis, provisioning, and other more valuable tasks.

IBM storage infrastructure management software can deliver several benefits:

- ▶ Help reduce the management complexity of your storage environments by centralizing, simplifying, and automating storage tasks associated with storage hardware, replication services, data protection services, capacity management, and security compliance reporting.

- ▶ Improve service levels by notifying administrators of problems faster, and managing more of the environment from fewer consoles.
- ▶ Control operating expenses by helping storage administrators manage more information with less effort.

IBM offers many solutions for a wide range of business requirements:

- ▶ IBM Tivoli Storage Productivity Center  
Centralize, simplify, and automate storage tasks associated with storage systems, storage networks, replication services, and capacity management.
- ▶ IBM Tivoli Storage Manager FastBack  
Get applications and users back up and running within minutes following any data loss, while performing full data recovery in the background. TSM FastBack now includes Tivoli Common Reporting (TCR) enablement.
- ▶ IBM Tivoli Storage Manager  
Automate data backup, restore and archive functions. Centralize storage management operations. Includes Tivoli Common Reporting (TCR) enablement.
- ▶ IBM Proventia® Management SiteProtector  
Control, monitor, analyze and report on your enterprise security posture through a single, centralized console.
- ▶ IBM Tivoli Security Information and Event Manager  
Centralized log management, event correlation, policy compliance dashboard and reporting to improve visibility into your security posture.

For more information, go to:

[http://www.ibm.com/systems/information\\_infrastructure/leadership/storage\\_management.html](http://www.ibm.com/systems/information_infrastructure/leadership/storage_management.html)

## 2.7 Storage solutions for business applications

New IBM information infrastructure solutions are designed to help businesses gain a competitive advantage through the optimization of information-related business trends.

IBM gives clients excellent opportunities to choose complete solutions that will fit their business needs perfectly and will not take much time trying many different single point products. Complete storage solutions include the hardware, software, and services that enable improved information management. Concrete solutions can be of interest to IT departments and to line of business managers outside of the IT departments.

We now present some examples of IBM System Storage offerings.

### 2.7.1 IBM content management solutions

Most companies operate with strict content management requirements to help control content and automate content-related processes. As unstructured content grows exponentially (for example emails, signed documents, audio files, Web content, and so on), you need content management to capture, store, manage, integrate, and deliver all forms of content across your enterprise. You need the right information at the right time to make the right decisions.

Manage, integrate and deliver critical information on demand:

- ▶ Provides a comprehensive, scalable and security-rich content management solution
- ▶ Enables users to work with electronic information practically anytime, anywhere
- ▶ Extends information across diverse business solutions and processes
- ▶ Scales horizontally and vertically, from Microsoft Windows platforms through mainframes
- ▶ Integrates with IBM FileNet® Business Process Manager software via event-enabled content

IBM Content Manager Enterprise Edition manages all types of content for multiple platforms, databases, and applications. Solutions built on IBM Content Manager deliver documents and information to users in context, streamline work processing, and improve productivity with automated processes. IBM Content Manager Enterprise Edition offers the following services:

- ▶ Acts as the core repository of a portfolio of products that helps manage, share, integrate and deliver critical business information on demand, for multiple platforms, databases, and applications.
- ▶ Provides a comprehensive, scalable, and secure content management platform for solutions such as production imaging, compliance management, records management, document management, Lotus Notes® and Microsoft Exchange email management; archiving, digital media, web content management; and case management.
- ▶ Manages the life cycle of all content, including images, electronic documents, XML, audio and video, so that users can work with all types of information anytime, anywhere.
- ▶ Offers a powerful and expressive XML-ready data model, Java™, C++ and Web Services programming interfaces, and an integrated hierarchical storage manager that supports hundreds of storage devices and media types.
- ▶ Scales horizontally and vertically, from Microsoft Windows through mainframes, with enterprise features such as replication to store and manage objects in multiple locations, and application-transparent content caching.
- ▶ Content Manager Starter Pack provides full content management functions at an introductory price. It helps you address key business needs at an attractive price point while allowing trade-up licensing.
- ▶ V8.4.2 for Agile ECM provides further enhancements with FileNet Business Process Manager.
- ▶ Operating systems supported: Windows Server, AIX Power, Linux (x86 and z), and Sun Solaris SPARC.

Content management systems store critical catalog information in database tables that require fast access. They also store large amounts of infrequently accessed images and records.

To learn more about IBM Content Manager software, contact your IBM marketing representative or an IBM Business Partner, or visit:

<http://www.ibm.com/software/ecm>

## 2.7.2 IBM application and database archive solutions

Many businesses respond to database overload by expanding their storage and processing infrastructure to accommodate larger databases. This includes incremental high-performance online storage, and even offline tape devices. But as budgets shrink, IT executives are challenged to justify continued investments. Reclaiming current resources becomes critical for managing costs and reducing infrastructure complexity.

At the same time, access to critical information can be restricted to authorized personnel in order to maintain the integrity of the information. IBM enterprise database archiving solutions can also help speed application performance by automatically migrating unused historical data to the appropriate storage device, based on defined business policies.

Databases are excellent candidates for tiered storage. Heavily used table spaces are ideal for fast disk, while transaction logs and flash copies may get the best price performance from a SATA disk. Database users are often heavy users of tape, disk mirroring, and flash copies. Typically, the replicated disk copy is backed up to tape daily, and transaction logs are backed up to tape more frequently. IBM offers a wide variety of all types of business tape and disk storage systems. For more information, refer to “Related publications” on page 255.

### 2.7.3 Data warehouse solution

A data warehouse is an organization’s data with a corporate-wide scope for use in decision support and informational applications. Therefore, a data warehouse is designed to serve all possible decision support processes for an organization.

Data warehouses are optimized to perform complex queries more quickly. They maintain multiple copies of data in extract and translation tables, as well as in the data rows. Data warehouse tables are often heavily indexed, effectively creating more copies of the data. When data warehouses get too large or too busy, smaller data marts are generated that contain subsets of the data. For more details, go to:

<http://www.ibm.com/software/data/infosphere/warehouse/>

### 2.7.4 Medical imaging and storage

Improve the quality of care and patient safety, and control the growth of costs with medical imaging and storage solutions for health care. These solutions can help you centralize, distribute, archive and manage medical images, while improving workflow.

Images typically need to be searched, transferred, and annotated. Images also need to be protected from tampering and secured from public viewing. Some medical images have long retention periods. Companies and physicians face penalties if they lose some types of medical images. Applications that manage large numbers of medical images are called picture archive communication systems, or PACS.

With the pressures of increasing costs, labor shortages, reduced payments for procedures, and the need to improve quality of care, today’s health care organizations are challenged to do more with less, while improving patient safety. In this fast-paced environment, medical imaging and storage virtualization solutions such as Grid Medical Archiving Solution (GMAS) facilitate digital image storage, access and workflow, and enable remote diagnosis and consultation across the health care enterprise and beyond. Enhanced integration of digital imaging with both internal and external clinical data helps IBM provide comprehensive, security-rich and cost-effective imaging and storage solutions. In addition, as data needs to continue to outpace the longevity of storage media, IBM can help you leverage your existing infrastructure to develop a long-term strategy for data archival and storage.

IBM and IBM Business Partners have helped many hospitals transform their operations with innovative medical imaging solutions, while protecting long-term storage investments.

Medical imaging and storage solutions from IBM are affordable, flexible, secure, scalable, tested, and proven—and they leverage IBM’s leading servers, storage systems, software, services, and more. The solutions can be implemented in phases, so you can roll out by

department, building, or entire campus - and remote sites - as the needs arises and funding becomes available.

With IBM and IBM Business Partner medical imaging and storage solutions, you can:

- ▶ Easily archive, retrieve, and review long-term and historical patient images and information
- ▶ Improve clinical outcomes by providing faster and more precise information to medical professionals, both on site and off
- ▶ Streamline workflow and improve staff productivity
- ▶ Consult with colleagues in another city, or country, in realtime
- ▶ Maintain patient privacy and system security
- ▶ Ensure that you are protected from planned *and* unplanned downtime with reliable backup and high availability
- ▶ Develop a long-term strategy that leverages existing infrastructure and seamlessly integrates with existing PACS
- ▶ Contain costs by reducing long-term storage expense

You can find more information here:

[http://www.ibm.com/businesscenter/smb/us/en/healthcarepacs/nav\\_id/healthcareintro](http://www.ibm.com/businesscenter/smb/us/en/healthcarepacs/nav_id/healthcareintro)

## 2.7.5 Optim capabilities for PeopleSoft Enterprise

PeopleSoft Enterprise applications manage every aspect of your business, from customer service and support to financial reporting. Maintaining historical transaction data for compliance purposes is an absolute necessity. However, when historical data is kept in the same environment as current transactions, service levels can decline.

Optim™ is a single, scalable solution that allows management of PeopleSoft Enterprise data at the business object level; apply business policies to segregate inactive transaction data from current activity and safely move it to a secure archive; consistently achieve performance targets by establishing distinct service levels for both current and historical data quickly respond to inquiries or legal requests with audit-ready snapshots of historical data, perfectly preserved at each point in time.

With Optim, align continuous control of your PeopleSoft data with business objectives to optimize performance, control costs and mitigate risks:

- ▶ Apply test data management best practices to deploy PeopleSoft enhancements.
- ▶ Align application performance with business processes to meet service levels and reduce storage requirements, and cut costs by creating “right-sized” test environments.
- ▶ Mask data consistently and accurately to comply with privacy policies and regulations, and techniques that preserve application integrity.
- ▶ Lower costs with shorter testing cycles, improved test coverage and enhanced accuracy.
- ▶ Support compliance with privacy regulations and corporate governance standards and protect privacy by de-identifying confidential data across non-production environments.
- ▶ Substitute valid fictionalized values for confidential data and generate accurate results.
- ▶ Leverage prepackaged routines to mask payment card numbers, identifiers and email addresses.

- ▶ Segregate inactive PeopleSoft application data at the business object level from current activity and safely move it to a secure archive.
- ▶ Respond to audit and discovery requests with query or self-help access to standalone archives.
- ▶ Protect your investment with integrated archiving across the Oracle family of applications.

For more information, go to:

<http://www.ibm.com/software/data/data-management/optim/peoplesoft/>

## 2.7.6 Solutions for SAP

SAP customers need their systems to run efficiently and cost effectively. Software upgrades, implanting new modules, and other changes can place a significant load on IT resources, potentially driving costs up and compromising performance. Drawing on a history of storage innovation and a relationship with SAP that has lasted more than three decades, IBM has worked closely with SAP to provide a set of IBM TotalStorage solutions that are designed to help simplify the task of running a dynamic SAP environment. Based on open standards, IBM TotalStorage products and services for mySAP are designed to integrate easily with many other IT systems, helping to leverage past and future IT investments.

Our global SAP implementation capabilities offer IBM's full breadth of services, including consulting, infrastructure and applications, in-depth support, and operational and management processes.

Through our close alliance with SAP, IBM is uniquely qualified to be your solution provider from the most simple to the most complex SAP deployment. IBM:

- ▶ Was SAP's first Global Alliance Partner when the formal program was established in 1989.
- ▶ Is the only SAP partner that holds all three certifications—global services, technology, and hosting.
- ▶ Has an established network of SAP Competence Centers including the IBM SAP International Competence Center (ISICC), the SAP IBM Collaboration Technology Support Center (CTSC), the Global SAP Center of Excellence (GCoE), and SOA development centers in India.
- ▶ Has won more awards around the world than any other SAP implementation partner.

Requirements for an effective SAP enterprise storage infrastructure include disk and tape system platforms; software tools for storage infrastructure management, point-in-time copy, archiving, and content management; backup and recovery; virtualization and other functions. IBM System Storage platform, software and service components provide the solutions for an effective SAP enterprise storage information infrastructure.

### ***IBM TotalStorage solutions for SAP customers***

Many of today's global businesses depend on SAP to help provide enterprise-wide visibility and control over essential operational processes. They use enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), and Business Intelligence applications from SAP to help streamline operations, collaborate with suppliers, and understand clients' needs.

### ***Information lifecycle management retention for SAP***

Information is critical to businesses and for legal compliance—the ability to keep the right kind of information, at the right place for the right reason, with the ability to retrieve it when you need it. IBM understands this.

As the quantity of information grows for an SAP client, it becomes increasingly costly and complex to store and manage and retrieve it in a timely manner. Information Lifecycle Management (ILM) is a process for managing information through its lifecycle, from conception until disposal, in a manner that optimizes storage and access at the lowest cost. IBM's unique experience with the broad range of ILM technologies, and its broad portfolio of offerings and solutions—including offerings in TotalStorage, TotalStorage Open Software, and DB2 Content Management—will provide businesses with the best solutions to manage their information throughout its lifecycle.

### ***Infrastructure simplification for SAP***

For SAP clients, the infrastructure is vital to their users' ability to access the needed applications and data to run their business, and to plan for migration, new applications, new users, or new divisions.

Infrastructure simplification is a process by which organizations contain expenses, enable business growth, and reduce operational risk by optimizing IT resources. Simplified infrastructures hold the promise of improved system optimization and TCO, higher personnel productivity, and greater application availability through infrastructure resiliency. IBM TotalStorage products are designed to help SAP clients obtain these benefits through consolidation, virtualization, and automated management. Once simplified, the infrastructure can be better managed for lower cost and with fewer errors. For SAP customers, having a simplified and resilient infrastructure means less resources and time for managing, monitoring, and updating the infrastructure and more time for running SAP applications and the business.

There are three ways to accomplish this:

- ▶ Consolidation - IBM TotalStorage products can help consolidate the storage environment to be more resilient.
- ▶ Virtualization - Virtualization of physical resources is an essential part of a simplified storage environment.
- ▶ Automated Management - Understanding the environment is essential; IBM's automated management software can help.

For more information about SAP and IBM Solution, go to:

<http://www.ibm.com/systems/storage/solutions/sap/continuity/solutions.html>  
<http://www.ibm.com/solutions/sap/us/en/landing/N352407B40650D67.html>

## **2.7.7 Oracle's Siebel CRM and IBM**

The IBM and Oracle alliance unites the recognized market leader in CRM with the largest Oracle integrator and is implemented worldwide. Together, we offer companies new opportunities to utilize CRM. Oracle's Siebel Customer Relationship Management applications help provide insight to the right person at the right time, leading to faster, better-informed decisions. With solutions tailored to the specific needs of more than 20 industries, Siebel CRM provides predictive analysis capabilities that deliver real-time intelligence, greater flexibility through support of both J2EE and .NET, and a lower total cost of ownership.

We can help your business with:

- ▶ Comprehensive CRM software solution - Siebel CRM provides a solution that includes all of the business processes and associated systems needed by a client, including billing and delivery.
- ▶ Lower total cost of ownership - Siebel CRM software is easier to install and less expensive to maintain.
- ▶ Sales solutions - Provide a single repository for customer and supply chain information, including enhanced applications for sales force automation, sales order entry, mobile sales and product configuration, enabling companies to respond quickly and accurately to customer inquiries.
- ▶ Superior service - Siebel CRM service solutions ensure higher levels of customer satisfaction by providing visibility into customer billing and order information.

For more information, go to:

<http://www.ibm.com/solutions/oracle/us/en/index/siebel.html>



# IBM System Storage Disk Systems

The three goals of the Dynamic Infrastructure are:

- ▶ Improve service
- ▶ Reduce costs
- ▶ Manage risk

IBM offers a wide range of products and services that can help you to achieve these goals. That is why Information Infrastructure (being one of the six pillars of Dynamic Infrastructure) is often seen as the foundation of a Dynamic Infrastructure.

Information Infrastructure is all about Storage Products. It guides us in the way we build or acquire our products and the way we transform them into solutions for you, our client.

The definition of Information Infrastructure is simple: To reach a resilient infrastructure for securely storing information and mitigating information risks.

In our way to do so, Information Infrastructure has four basic capabilities we want to be resident in our products: they have to be able to support:

- ▶ Information compliancy
- ▶ Information availability
- ▶ Information retention
- ▶ Information security

When talking about disk products (the topic of this chapter), we see examples of these capabilities in many spectrums of the IBM System Storage portfolio. For example:

- ▶ Active/Active controllers
- ▶ Encrypted disks
- ▶ Multiple Host connect support
- ▶ Data protection software

## 3.1 IBM System Storage product portfolio

In this chapter, we explore the IBM System Storage hardware, software, packaged solutions, and offer some resources that will help you find more information about the mentioned products.

### Disk storage

The IBM System Storage family includes a variety of disk storage products ranging from direct-attached disk drives to complete enterprise storage systems. In this section, we look at the product offerings in the disk storage arena.

The IBM System Storage disk products portfolio covers the needs of a wide spectrum of possible implementations, from entry level to large enterprise.

The IBM System Storage DS® family comprises the high performance of the IBM System Storage DS6000/DS8000 series and XIV enterprise servers with the IBM System Storage DS5000 series of mid-range systems, and with the DS3000 series low-priced entry systems.

The entire family of N series unified storage systems, features a comprehensive line-up from top-to-bottom of hardware and software designed to address a variety of possible deployment environments.

### Disk storage cross reference by workload size

It is often a mistake to associate entry-level, midrange, and enterprise-class storage products with small, medium, and large size businesses, respectively. For example, did you know that 30 percent of DS8000s are used by small and medium businesses? Did you know that 70 percent of SAN Volume Controllers are used by small and medium businesses? Conversely, did you know that nearly every large enterprise uses entry-level and midrange storage products in addition to enterprise-class devices?

For example, some large enterprises have branch offices or remote areas where smaller storage systems are more appropriate. Measurements often used to classify business size, such as the number of employees or sales revenue, do not always correlate with the amount of information those businesses store. For this reason, product recommendations based on workloads often make more sense, though they still should be considered only as general guidelines. In this section, you will find a list of disk storage products organized by workload size (entry, midsize, and enterprise) to help you find the best solution for your client.

### Disk storage for entry-level workloads

Here is a list of disk storage products designed for businesses with entry-level workloads, described in this chapter:

- ▶ DS3200 Express®
- ▶ DS3300 Express
- ▶ DS3400 Express
- ▶ EXP3000 Expansion Enclosure

### Disk storage for midsize workloads

Here is a list of disk storage products designed for midsize workloads, described in this chapter:

- ▶ DS4700 Express
- ▶ EXP810 Expansion Enclosure
- ▶ DS5020
- ▶ DS5100/5300

- ▶ EXP520 and EXP5000 Expansion Enclosure
- ▶ EXP5060 High Density drawer
- ▶ Model DCS9900 HPC

### Disk storage for enterprise workloads

Here is a list of disk storage products designed for large enterprise workloads, described in this chapter:

- ▶ DS6800
- ▶ DS8100
- ▶ DS8300
- ▶ DS8700
- ▶ XIV Storage System

### Network-attached disk storage for all workloads

IBM N series unified storage products provide a wide range of network attachment capabilities to a broad range of host systems, and offer solutions from entry-level performance to enterprise-level performance models. Here is a list of NAS storage products designed for entry to large enterprise workloads, described in this chapter.

- ▶ N3300
- ▶ N3600
- ▶ N6040
- ▶ N6060
- ▶ N6070
- ▶ N7700
- ▶ N7900
- ▶ EXN1000 Expansion unit
- ▶ EXN3000 Expansion unit
- ▶ EXN4000 Expansion unit

## 3.2 IBM System Storage DS3000 series

Designed to deliver high availability, reliability, and scalability at a breakthrough price, the IBM System Storage DS3000 family of storage systems provides an exceptional solution for workgroup storage applications such as email, file, print, and web servers, as well as collaborative databases and remote boot for diskless servers. In this section, we take a look at the DS3000 series. Figure 3-1 shows a front view of the DS3000 storage subsystem.

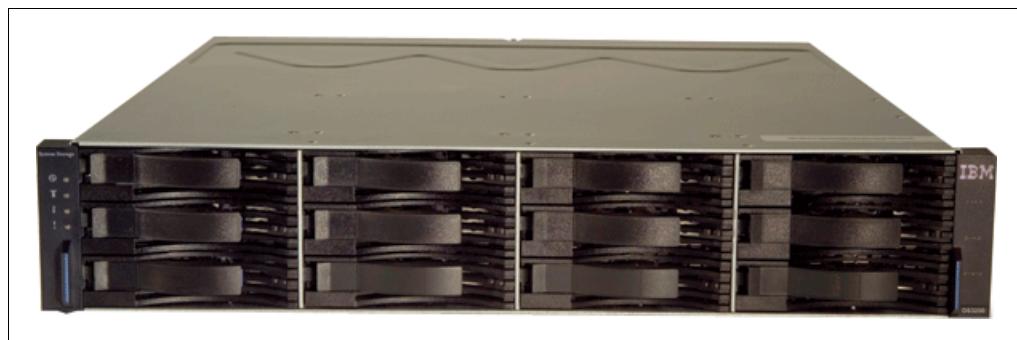


Figure 3-1 DS3000 series - front view

The main difference between the various models of the DS3000 series is the way they are connected to the host. Model DS3200 is designed to use SAS host connectivity. Model

DS3300 has iSCSI to connect over an existing Ethernet infrastructure, whereas the DS3400 is capable of using Fibre Channel connectors, as shown in Figure 3-2.

All models can make use of the EXP3000 disk expansion cabinet, which allows them to grow in steps to a maximum of 48 disks. Disk types are intermixed within the controller and in the expansion cabinets.

With a wide range of advanced functions such as Partitioning, FlashCopy®, and VolumeCopy, this entry-level disk solution is highly suitable for small to midsize workloads.

Furthermore, the DS3000 series is easy to deploy and manage via the DS3000 Storage Manager.

Figure 3-2 shows host cabling possibilities for the DS3000 series.

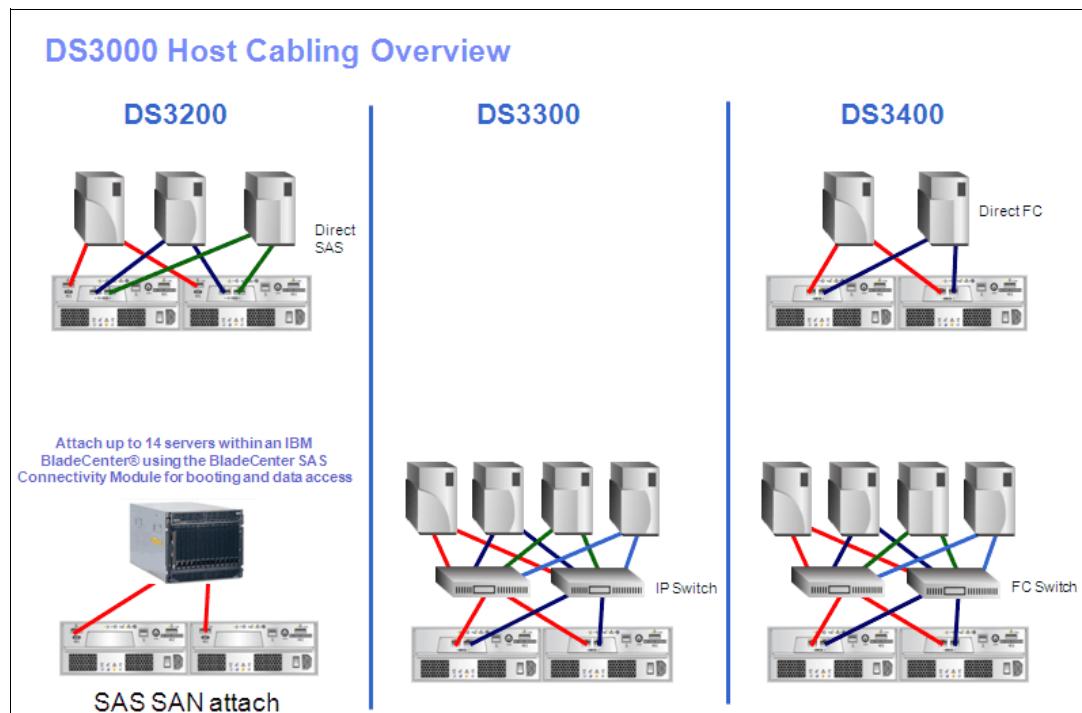


Figure 3-2 Host cabling DS3000 series overview

### 3.2.1 IBM System Storage model DS3200 Express

The IBM System Storage model DS3200 combines next-generation SAS technology with a time-proven architecture for external storage and an intuitive management interface to create a robust, flexible, and scalable storage system ideally suited for small and medium businesses (SMBs) and remote offices. By moving storage outside the server and consolidating storage across several servers, businesses can increase the capacity, management efficiency, and availability of their data solution.

The IBM System Storage DS3000 Storage Manager software is designed to provide a friendly user interface from setup to administration. This intuitive software builds on generations of IBM software development to provide trusted and reliable data management. Its task-based user interface helps to significantly reduce the complexity of installation, configuration, and management. With this approach, even non-storage savvy administrators can quickly set up and deploy their storage solution with minimal effort.

With SAS host-interface technology, up to three servers can be directly attached to a single DS3200 storage system redundantly ensuring high availability and simplicity. The DS3200 also supports up to 14 servers within an IBM BladeCenter using the BladeCenter SAS Connectivity Module for data access and boot support.

Tiered storage is the assignment of different categories of data to different types of disk drives in order to reduce total storage cost. A key attribute of the DS3000 series of disk systems is the integration of SAS and SATA technologies within a single enclosure. This simplifies purchasing and storage deployment with nearline applications using inexpensive SATA disk drives and highly utilized applications deploying SAS disk drives.

### Some quick DS3200 facts

- ▶ Two U rack-mountable enclosures with 12 easily accessible drive bays
- ▶ One or three 3 Gbps SAS host ports per controller
- ▶ Support for dual-ported, and hot-swappable SAS (15k rpm) and SATA (7.2k rpm) disks
- ▶ Scalability of up to 12 TB internal physical storage capacity using 1-TB hot-swappable SAS disks
- ▶ Expandability of up to 48 TB physical storage capacity with attachment of three EXP3000 expansion units
- ▶ RAID 0, 1, 3, 5, 6, and 10 support
- ▶ LED indicators
- ▶ Min. 512 MB RAID cache memory
- ▶ Max. 2 GB system memory, battery backup
- ▶ Built-in reliability features with dual-redundant power supplies standard

Figure 3-3 shows the rear view of the DS3200.

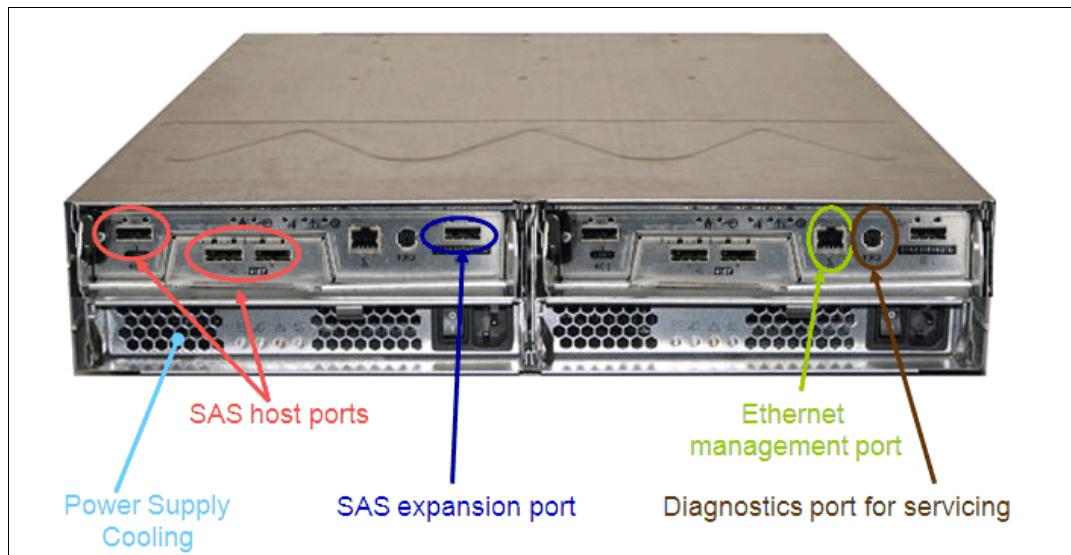


Figure 3-3 DS3200 (1726-22x) storage subsystem rear view

## Specifications

Table 3-1 shows the DS3200 specifications.

*Table 3-1 IBM System Storage DS3200 specifications*

Model	1726-21x Single controller 1726-22x Dual controller 1726-22T Dual controller Telco,
RAID controller	Dual active
Cache per controller	512 MB battery-backed cache with 1 GB upgrade option
Host interface	One or three host ports per controller, Serial Attached SCSI (SAS) 3 Gbps
Drive interface	Serial Attached SCSI (SAS)
Supported drives	3 Gbps SAS: 73 GB, 146 GB, 300 GB, and 450 GB SAS drives at 15,000 rpm speeds 3 Gbps SATA: 500 GB, 1.0 TB SATA drives at 7,200 rpm speed
RAID	RAID-0, -1, -3, -5, -6, -10
Storage partitions	4, 8, 16, 32
Maximum drives supported	48 drives (utilizing three EXP3000 Expansion Units)
Fans and power supplies	Dual-redundant, hot-swappable
Rack support	19-inch, industry-standard rack
Warranty	Three-year limited warranty on parts and labor

For the latest specification information, including the DS3200 Interoperability Matrix, check:

<http://www.ibm.com/systems/storage/disk/ds3000/ds3200>

### 3.2.2 IBM System Storage model DS3300 Express

The IBM System Storage model DS3300 is designed to simply and cost-effectively meet the availability and consolidation needs for a wide range of users—from the entry level SMB to an enterprise organization's remote sites or departments. The DS3300 provides organizations an affordable, reliable, and scalable storage solution that takes advantage of their current IP infrastructure equipment and in-house expertise. And as iSCSI is a routable transport with virtually no distance limitations, the DS3300 can extend its scope well beyond the corporate data center to remote locations as well.

The IBM System Storage DS3000 Storage Manager software is designed to provide a friendly user interface from setup to administration. This intuitive software builds on generations of IBM software development to provide trusted and reliable data management. Its task-based user interface helps to significantly reduce the complexity of installation, configuration, and management. With this approach, even non-storage savvy administrators can quickly set up and deploy their storage solution with minimal effort.

#### Some quick DS3300 facts

- ▶ Two 1-Gbps iSCSI host connections per controller
- ▶ One 3-Gbps SAS drive interface for capacity expansion per controller
- ▶ Affordable, reliable, and well-understood IP SAN storage

- ▶ Easy to deploy and manage with the DS3000 Storage Manager - Ideal for inexperienced and/or part-time administrators
- ▶ Combination of 12 SAS or SATA 3.5" disk drives per enclosure
- ▶ Expandable by attaching up to three EXP3000s, a total of 21.6 TB of storage capacity with 450 GB SAS disk drives or up to 48.0 TB with 1.0 TB SATA disk drives
- ▶ Affordable for the SMB, entry-level, and enterprise remote site and department budgets
- ▶ High availability features - Dual-active RAID controllers, redundant hot-swappable components, online automated I/O path failover, and unlimited global hot spares
- ▶ Shared-storage benefits - Consolidation, single management, and increased efficiencies within the IT infrastructure
- ▶ Solution for IBM System x, IBM BladeCenter®, and select third party servers
- ▶ Telco model supports -48 V dc power supplies
- ▶ NEBS and ETSI compliance for AC and DC models

Figure 3-4 shows the rear view of the DS3300

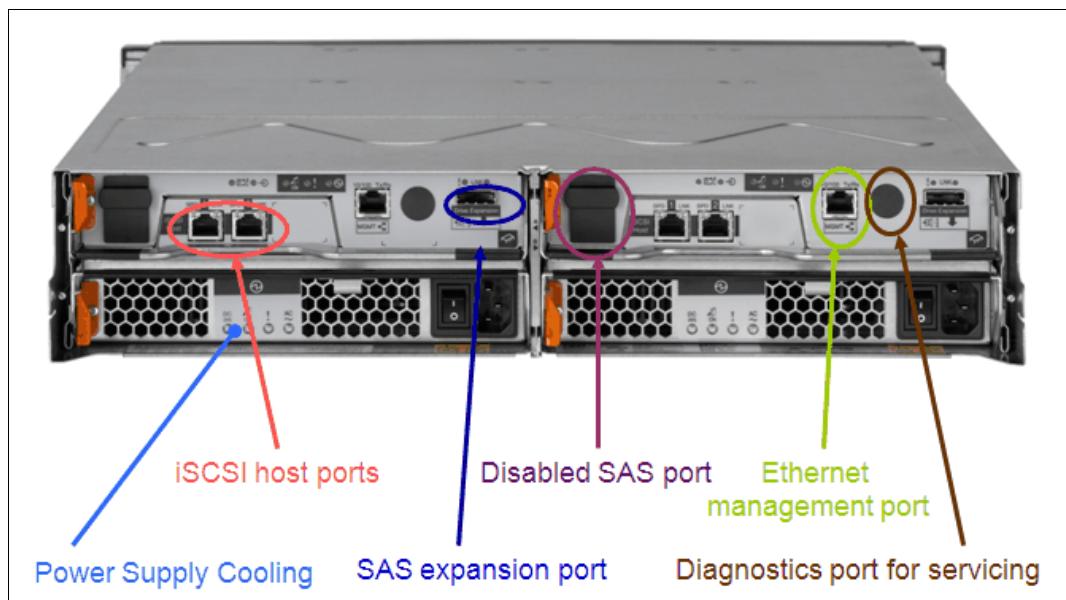


Figure 3-4 DS3300 (1726-32x) storage subsystem rear view

## Specifications

Table 3-2 shows the DS3300 specifications.

Table 3-2 IBM System Storage DS3300 specifications

Model	1726-31x Single controller 1726-32x Dual controller 1726-32T Dual controller Telco,
RAID controller	Dual active
Cache per controller	512 MB battery-backed cache with 1 GB upgrade option
Host interface	Two host ports per controller, 1 Gbps iSCSI
Drive interface	Serial Attached SCSI (SAS)

Supported drives	3 Gbps SAS: 73 GB, 146 GB, 300 GB, and 450 GB SAS drives at 15,000 rpm speeds 3 Gbps SATA: 500 GB, 750 GB and 1.0 TB SATA drives at 7,200 rpm speed
RAID	RAID-0, -1, -3, -5, -6, -10
Storage partitions	4, 8, 16, 32
Maximum drives supported	48 drives (utilizing three EXP3000 Expansion Units)
Fans and power supplies	Dual-redundant, hot-swappable
Rack support	19-inch, industry-standard rack
Warranty	Three-year limited warranty on parts and labor

For the latest specification information, including the DS3300 Interoperability Matrix, check:

<http://www.ibm.com/systems/storage/disk/ds3000/ds3300>

### 3.2.3 IBM System Storage model DS3400 Express

The IBM System Storage model DS3400 allows a business to consolidate and share data within a direct-attach or FC SAN solution. The DS3400 adds front-end 4 Gbps FC technology to IBM time-proven architecture for enterprise-class storage. With FC host connectivity and SAS back-end technology, the DS3400 is designed to improve productivity through data consolidation, availability, performance, and scalability for a wide range of organizations.

The IBM System Storage DS3000 Storage Manager software is designed to provide a friendly user interface from setup to administration. This intuitive software builds on generations of IBM software development to provide trusted and reliable data management. Its task-based user interface helps to significantly reduce the complexity of installation, configuration, and management. With this approach, even non-storage savvy administrators can quickly set up and deploy their storage solution with minimal effort.

#### Here are some quick DS3400 facts:

- ▶ 4 Gbps Fibre Channel (FC) interface technology
- ▶ One 3 Gbps SAS drive interface for capacity expansion per controller
- ▶ Direct-attach storage (DAS) or SAN solution - Start with a DAS configuration and seamlessly transition to an FC SAN when ready
- ▶ Easy to deploy and manage with the DS3000 Storage Manager - Ideal for inexperienced and or part-time administrators
- ▶ Combination of 12 SAS or SATA 3.5" disk drives per enclosure
- ▶ Expandable by attaching up to three EXP3000s, a total of 21.6 TB of storage capacity with 450 GB SAS disk drives or up to 48.0 TB with 1.0 TB SATA disk drives
- ▶ Affordable for the SMB, entry-level, and enterprise remote site and department budgets
- ▶ High availability features - Dual-active RAID controllers, redundant hot-swappable components, online automated I/O path failover, and unlimited global hot spares
- ▶ Shared-storage benefits - Consolidation, single management, and increased efficiencies within the IT infrastructure
- ▶ Solution for IBM System x, IBM BladeCenter, and select third party servers

- ▶ Telco model supports -48 V dc power supplies
- ▶ NEBS and ETSI compliance for AC and DC models

Figure 3-5 shows the rear view of the DS3400.

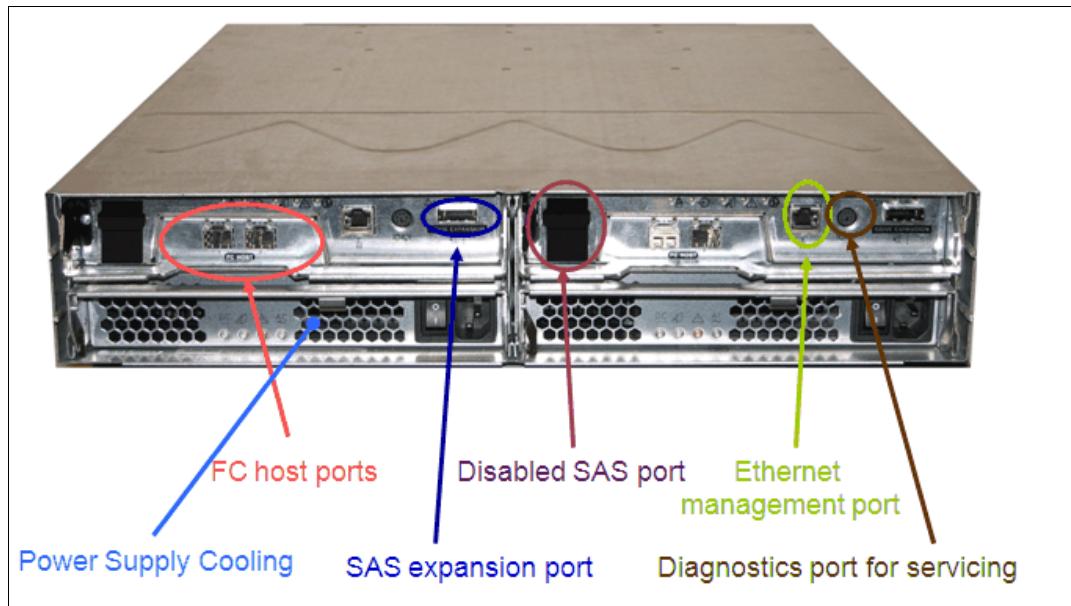


Figure 3-5 DS3400 storage subsystem model 1726-42x rear view

## Specifications

Table 3-3 shows the DS3400 specifications.

Table 3-3 IBM System Storage DS3400 specifications

Model	1726-41x Single controller 1726-42x Dual controller 1726-42T Dual controller Telco,
RAID controller	Dual active
Cache per controller	512 MB battery-backed cache with 1 GB upgrade option
Host interface	Fibre Channel (FC) 4 Gbps auto-sensing 1 Gbps/2 Gbps
Drive interface	Serial Attached SCSI (SAS)
Supported drives	3 Gbps SAS: 73 GB, 146 GB, 300 GB, and 450 GB SAS drives at 15,000 rpm speeds 3 Gbps SATA: 500 GB, 750 GB and 1.0 TB SATA drives at 7,200 rpm speed
RAID	RAID-0, -1, -3, -5, -6, -10
Storage partitions	4, 8, 16, 32
Maximum drives supported	48 drives (utilizing three EXP3000 Expansion Units)
Fans and power supplies	Dual-redundant, hot-swappable
Rack support	19-inch, industry-standard rack
Warranty	Three-year limited warranty on parts and labor

### 3.2.4 IBM System Storage EXP3000 Expansion Enclosure

The IBM System Storage EXP3000 Expansion Enclosure is a high-density 2U, 19-inch rack mount driven closure designed for supporting up to a total of twelve 3.5-inch SAS and/or SATA disk drives. Robust and flexible, the EXP3000 Expansion Enclosure is offered as an expansion enclosure behind the DS3000 series of storage systems including the DS3200, DS3300, and DS3400. The EXP3000 can also be utilized as a direct-attach solution for IBM System x servers with support of MegaRAID or ServeRAID host bus adapters.

Multiple EXP3000s can be connected to expand capacity and help address storage needs for today and tomorrow. The addition of solid state drives (supported with EXP3000 when attached to MegaRAID and ServeRAID only) presents an opportunity to simplify local storage infrastructure to help maintain overall maintenance and cooling cost, while considering remote storage solutions for end-to-end data availability as part of a System x ecosystem.

Solid state drives are an appropriate solution for local OS booting, high performance input/output applications, and some local storage space. Increasingly, solid state storage may be a practical component in balancing data center costs, reliability, and manageability.

#### Some quick EXP3000 facts

- ▶ 3 Gbps SAS disk drive expansion technology
- ▶ Support for up to 5.4 TB (with 450 GB SAS disk drives) or up to 12 TB (with 1.0 TB SATA disk drives) in a single enclosure
- ▶ SAS or SATA disk drive intermix supported with select IBM System x, IBM System p, and IBM BladeCenter servers using the DS3000 series of storage systems, MegaRAID, or ServeRAID host bus adapters
- ▶ 50 GB SATA Solid State Disk drive supported in EXP3000 expansion units that are directly attached to System x servers via the ServeRAID MR10M SAS/SATA controller adapter installed in the System x server
- ▶ Three EXP3000s can be attached to a DS3000 storage system to expand up to 21.6 TB of physical storage capacity when utilizing 450 GB SAS disk drives or 48.0 TB of physical storage capacity when utilizing 1 TB SATA disk drives
- ▶ Telco model supports -48 V DC power supplies
- ▶ NEBS and ETSI compliance for AC and DC models

Figure 3-6 shows the EXP3000 front view.

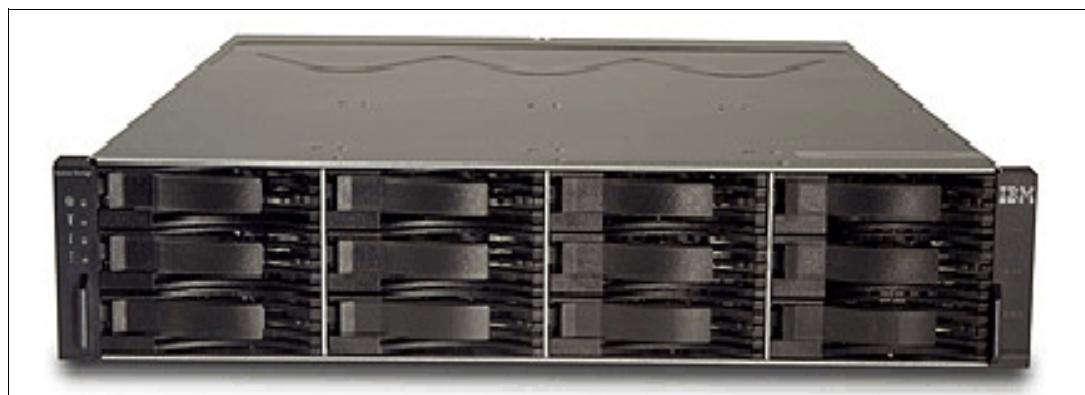


Figure 3-6 EXP3000 front view

## **Specifications:**

Table 3-4 shows the EXP3000 specifications.

*Table 3-4 IBM System Storage EXP3000 specifications*

Model	1727-01X—IBM System Storage EXP3000 1727-02T—IBM System Storage EXP3000 with DC power supplies
Environmental Services Module	Single ESM with dual ESM upgrade SAS interface: Mini-SAS connectors
Drives supported	SAS 15,000 rpm capacities: 73 GB, 146 GB, 300 GB, 450 GB SATA 7,200 rpm capacities: 500 GB, 750 GB, 1.0 TB Solid State Disk: 50 GB SATA (System x direct attach only via the ServeRAID MR10M SAS/SATA controller adapter)
Fans and power supplies	Two hot-swappable 530 watt (115 – 230 V AC) power supplies
Rack support	19-inch, industry-standard rack

### **DS3000 series warranty, maintenance, and service**

The standard warranty that is included with the purchase of a DS3000 series is a limited three years parts and labor.

For the latest specification information, including the EXP3000 dimensions, check:

<http://www.ibm.com/systems/storage/disk/exp3000>

For more information about the IBM System Storage entry-level disk systems, consult the following documents and websites:

<http://www.ibm.com/systems/storage/disk/entry/index.html>

## **3.3 DS4000 series**

In this section, we take a closer look at the DS4000® series, targeted for midsize workloads.

As we are in a product marketing transition phase between current DS4000 series towards a new DS5000 series, DS4000 products are still available today. We provide an overview of the DS4700 Express model which is the only available model from the very successful DS4000 series.

The IBM System Storage DS4000 series consists of midrange rack-mountable storage devices that can be used in multiple operating environments (Microsoft Windows, Netware, Linux, and UNIX®). The standard warranty that is included with the purchase of the DS4000 series is three years parts and labor.

### **3.3.1 IBM System Storage model DS4700 Express**

The IBM System Storage model DS4700 Express offers high-performance 4 Gbps-capable Fibre Channel connections, up to 112 TB of physical storage capacity with 112 1-TB SATA disk drives, and powerful system management, data management, and data protection features. The DS4700 Express is designed to expand from workgroup to enterprise-wide capability with the attachment of six DS4000 EXP810 disk enclosures. The DS4700 Express

DC Models are NEBS-3 compliant storage systems designed to be powered from a -48 volt DC Telco industry-standard power source.

The IBM DS4000 series has a history of flexibility that helps manage growth. The DS4700 Express builds on that history with drive options that help manage complexity. And the increased data protection of the DS4700 helps manage risk.

There are two ways to measure the performance of a SAN device: Megabytes per second (MBps) and input/output per second (IOPS). The DS4700 Express 4 Gbps SAN solution is designed to provide up to 1550 MBps throughput (assuming a 4 Gbps-capable system) with up to 120,000 IOPS. A 2 Gbps storage array can require up to twice as many host ports as a 4 Gbps array to deliver the throughput of four 4 Gbps ports. The DS4700 Express can help you free up or eliminate the need for additional host ports in the SAN for each array.

### **Some quick DS47000 Express facts**

- ▶ End-to-end 4 Gbps-capable Fibre Channel interface technology to help optimize performance
- ▶ Up to 1550 MBps bandwidth for high throughput applications
- ▶ Intermix of Fibre Channel and SATA hard disk drives supported in the EXP810 storage expansion unit
- ▶ Includes IBM System Storage DS Storage Manager to help centrally manage the DS4000, DS5000, and DS3000 series
- ▶ Eight total host channels with dual controllers for increased connectivity
- ▶ Support for up to 112 disk drive modules with the attachment of six DS4000 EXP810 Expansion Units
- ▶ NEBS-3 compliant designed to be powered from a -48 V DC Telco industry-standard power source
- ▶ Eight total host channels with dual controllers for increased connectivity
- ▶ Support for up to 112 disk drive modules with the attachment of six DS4000 EXP810 Expansion Units

Figure 3-7 on page 39 shows the DS4700 with 16 hard disk drives installed.

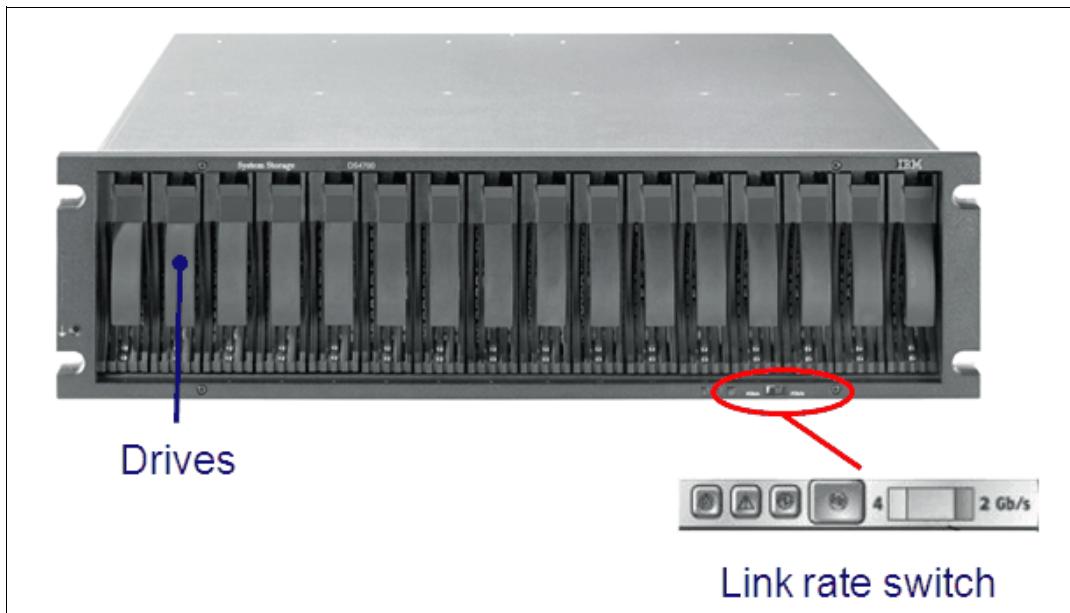


Figure 3-7 IBM System Storage model DS4700 Express front view

## Specifications

Table 3-5 shows the DS4700 Express model specifications.

Table 3-5 IBM System Storage model DS4700 Express specifications

Model	1814-72H	1814-70H
RAID controller	Dual active 4 GB RAID controllers	Dual active 4 GB RAID controllers
Capacity of base enclosure	16 HDD	16 HDD
Controller cache	Total of 4 GB, battery-backed	Total of 2 GB, battery-backed
Host interface	FC-AL	FC-AL
Connectivity	Eight host side and four drive side ports	Four host side and four drive side ports
Drive interface	FC-AL	FC-AL
Supported drives	4 Gbps FC: 15K rpm, 600GB/300GB/146GB/73GB (E-DDM) 4 Gbps SATA: 7.2K rpm 1TB SATA II <sup>a</sup> /750GB SATA II / 500GB SATA (E-DDM)	4 Gbps FC: 15K rpm, 600GB/300GB/146GB/73GB (E-DDM) 4 Gbps SATA: 7.2K rpm 1TB SATA II <sup>a</sup> /750GB SATA II / 500GB (E-DDM)
RAID levels	0, 1, 3, 5, 6 and 10	0, 1, 3, 5, 6 and 10
Storage partitioning	Up to 128	Up to 128
Maximum drives supported	Up to 112 FC or SATA drives	Up to 112 FC or SATA drives
Fans and power supplies	Dual redundant, hot-swappable	Dual redundant, hot-swappable
Rack support	Industry standard 19" rack - 3U	Industry standard 19" rack - 3U

a. requires firmware 6.23.05

For the latest specification information, check:

<http://www.ibm.com/servers/storage/disk/ds4000/ds4700>

### 3.3.2 EXP810 Storage Expansion Unit

The DS4000 EXP810 Storage Expansion Unit is the disk drive enclosure for the DS4000 series of products, although it can be connected to the DS5000 family of products for migration purposes only.

This expansion unit is packaged in a 3U rack-mountable enclosure, and supports up to 16 FC disk drives or E-DMM SATA drives. It contains 16 drive bays, dual-switched 4 Gbps ESMs, and dual power supplies and cooling components. Fully populated with 450 GB FC disk drive modules, this enclosure offers up to 7.2 TB of raw storage capacity or up to 16 TB when populated with the 1000 GB E-DDM SATA drives. Through the proper firmware level, this expansion unit is able to host both FC and SATA Drives. Intermix of FC and SATA drives is supported within this expansion enclosure. The EXP810 allows continuous, reliable service, using hot-swap technology for easy replacement without shutting down the system, and support redundant, dual-loop configurations.

Figure 3-8 shows the front view of the EXP810 Expansion unit.



Figure 3-8 EXP810 Disk Expansion unit

### Specifications

Table 3-6 shows the EXP810 specifications.

Table 3-6 IBM System Storage EXP810 Expansion Unit

Model	1812-81A/81S
Number of drives supported	Up to 16 FC drives
Fans and power supplies	Dual redundant, hot-swappable
Dimensions	(with bezel) 12.95 cm H x 48.26 cm W x 57.15 cm D (5.1 in x 19 in x 22.5 in)
Weight	40 kg (88 lb)

For the latest specification information, and Interoperability Matrix, check:

<http://www.ibm.com/systems/storage/disk/ds4000/exp810>

## 3.4 IBM System Storage DS5000 series

The recently announced IBM System Storage DS5000 series storage systems are designed to meet today's and tomorrow's demanding open-systems requirements while establishing a new standard for lifecycle longevity. Building on many decades of design expertise, the DS5000 series' seventh-generation architecture delivers industry-leading performance, real reliability, multidimensional scalability, and unprecedented investment protection.

The DS5000 series is equally adept at supporting transactional applications such as databases and OLTP, throughput-intensive applications such as HPC and rich media, and concurrent workloads for consolidation and virtualization. With its relentless performance and superior reliability and availability, the DS5000 series storage system can support the most demanding service level agreements (SLAs).

### 3.4.1 IBM System Storage model DS5020

The IBM System Storage model DS5020 is the newest in the DS5000 series and is designed to help address midrange or departmental storage requirements. Equally adept at IOPS and MB/s, the DS5020 is able to support applications with wide-ranging performance requirements, well suited for data warehousing, consolidation and virtualization environments that have diverse workloads and application requirements. It is designed to concurrently support transactional-applications, such as databases and OLTP, and throughput-intensive applications, such as HPC and rich media at entry price level.

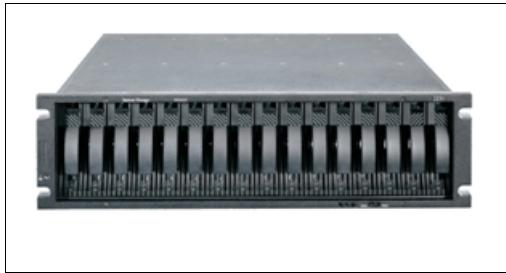
The DS5020's design avoids over-configuration for an affordable entry-point, while offering seamless "pay-as-you-grow" scalability as requirements change. Its efficient storage utilization lowers raw capacity requirement, and support for intermixing high-performance and high-capacity drives enables enclosure-based tiered storage. These unique capabilities reduce the number of drives needed to meet performance and/or capacity demands: lower acquisition and operational expenditures. Support of Full Disk Encrypted drives against almost no performance loss will secure your data at rest environments.

#### Some quick DS5020 facts

- ▶ Up to 112 TB physical storage capacity.
- ▶ DS5020 comes with 2 GB cache memory (1 GB per internal RAID controller).
- ▶ 4 GB cache memory (2 GB per RAID controller) feature is available as an initial plant order feature. There are no cache memory upgrades available as field (MES) features for the DS5020.
- ▶ Accommodates up to 16 disk drives installed within the DS5020 enclosure.
- ▶ Attachment support for up to six EXP520 expansion enclosures.
- ▶ Attachment support for EXP810 with the Attach EXP810 to DS5020 Activation feature is to be used for migration purposes only.
- ▶ Supports intermix of SATA drives, FC drives, and encryption-capable FC drives (FDE) within the DS5020 and EXP520 enclosures.
- ▶ Provides SAN-attached 8 Gbps Fibre Channel (FC) host connectivity, as well as optional 1 GbE iSCSI host connectivity.
- ▶ All DS5020s have four 8 Gbps FC ports (two per controller).
- ▶ Additionally, you may order initially one of the following:
  - 2-Dual 8Gbps Host Interface Cards (HIC)
  - 2-Dual 1Gbps ISCSI HIC

- ▶ Drive options
  - FC disks without encryption:
    - 146.8 GB/15K 4 Gbps FC DDM
    - 300 GB/15K 4 Gbps FC DDM
    - 450 GB/15K 4 Gbps FC DDM
    - 600 GB/15k 4 Gbps FC DDM
  - FC disk with encryption:
    - 146.8 GB/15K 4 Gbps FC encryption-capable DDM
    - 300 GB/15K 4 Gbps FC encryption-capable DDM
    - 450 GB/15K 4 Gbps FC DDM encryption-capable DDM
    - 600 GB/15k 4 Gbps FC DDM encryption-capable DDM
  - SATA disks:
    - 750 GB/7.2K SATA DDM
    - 1000 GB/7.2K SATA DDM
- ▶ The DS5020 Supports RAID 0, 1, 3, 5, 6, and 10.
- ▶ At the time of writing one model is available: 1814-20A

Figure 3-9 shows the front view of the model DS5020.



*Figure 3-9 IBM System Storage model DS5020*

## Specifications

Table 3-7 shows the DS5020 specifications.

*Table 3-7 IBM System Storage model DS5020 specifications*

<b>Model</b>	<b>1814-20A</b>
RAID controller	Dual active
Cache	2 GB battery-backed or 4 GB battery-backed initial option (No MES)
Host interface	Four 8 Gb/s FC or eight 8 Gb/s FC; or four 4 Gb/s FC and four 1 Gb iSCSI
Drive interface	4 drive ports: Fibre Channel (FC) Switched and FC Arbitrated Loop (FC-AL) standard, auto-sensing 2 Gbps/4 Gbps
Supported drives	Supports 4 Gbps FC/FDE: 15k 600 GB, 450 GB, 300 GB, 146.8 GB, and E-DDM Supports 4 Gbps SATA: 7.2K 750 GB and 1 TB E-DDM disk drives
RAID	Levels 0, 1, 3, 5, 6 and 10
Storage partitions	4, 8, 16, 64 or 128 storage partitions
Maximum drives supported	112 FC or 112 SATA drives (using 6 EXP520 Expansion Units)

Fans and power supplies	Dual redundant, hot-swappable
Rack support	19-inch, industry-standard rack - 4U
Warranty	3-years, 5 x 9

The DS5020 controller and EXP520 expansion unit have the following warranty service:

- ▶ 9 hours per day, Monday through Friday (excluding holidays)
- ▶ Next-business-day response
- ▶ IBM On-site Repair

For the latest specification information, and Interoperability Matrix, check:

<http://www.ibm.com/systems/storage/disk/ds5020>

### 3.4.2 IBM System Storage model DS5100/5300

The first models of the IBM System Storage DS5000 series that have been released offer increased performance compared to the family's DS4000 predecessors. It offers "Pay-as-you-grow" scalability up to 448 drives for both the DS5100 and the DS5300, thus enabling the most demanding capacity requirements by utilizing the EXP5000 expansion enclosure. With the introduction of the DS5060 Expansion drawer we can also deliver up to 480 TB of physical storage housed in one single rack.

The DS5000 series is equally adept at supporting transactional applications such as databases and OLTP, throughput-intensive applications such as HPC and rich media, and concurrent workloads for consolidation and virtualization. With its relentless performance and superior reliability and availability, the DS5000 series storage system can support the most demanding service level agreements (SLAs). And when requirements change, you can add or replace host interfaces, grow capacity, add cache and reconfigure the system on the fly—ensuring that it will keep pace with your growing company.

Additionally, the DS5100 offers further value in flexibility, scalability, and investment protection by providing the ability to upgrade to a full DS5300.

Figure 3-10 shows the front view for the DS5000 storage subsystem.



Figure 3-10 DS5000 front view

#### Some quick DS5100/DS5300 facts

Models DS5100 (1818-51A) and DS5300 (1818-53A)

- ▶ Compact 4U rack-mountable enclosure.

- ▶ Utilizes new seventh generation dedicated ZIP ASIC engines on RAID controllers.
- ▶ Features Intel® Xeon 2.8 GHz processor.
- ▶ Dual, redundant controllers.
- ▶ PCI Express x8 bus technology.
- ▶ Attach up to eight EXP5060 Enclosures.
- ▶ IBM i Host Kit feature.
- ▶ Dedicated cache for data (base model has 8 GB cache) with enhanced diagnostics. The architecture is designed to support a 64 GB cache.
- ▶ Dedicated processor memory of 2 GB per controller.
- ▶ Hot-swappable lithium-ion battery for backup and de-staging data from cache.
- ▶ New flash memory to store data from cache during power outage.
- ▶ Two dedicated PCI Express buses for cache mirroring.
- ▶ Redundant, hot-swappable power supplies and fans.
- ▶ Hot-swappable interconnect module acts as midplane.
- ▶ Supports RAID 0, 1, 3, 5, 6, and 10 (RAID 1+0).
- ▶ Supports RAID 1 and 10 dedicated mirrored drive pair configurations.
- ▶ Ability to create a RAID 10 or 0 group on all available drives to maximize performance for a LUN.
- ▶ Flexible host interface modules can be added, changed, or mixed as the infrastructure changes. The quad-4 Gbps Fibre Channel (FC) Host Interface Cards (HIC) can be replaced now with quad-8 Gbps FC HIC or a dual-1 Gbps iSCSI Host Interface Card. Field replacements (MES) are available.
- ▶ Supports an unlimited number of Global Hot Spare drives with the ability to enable/disable the copy back function (important for SATA drives).
- ▶ Host-side connections support
  - Fibre Channel Switched Fabric
  - Arbitrated Loop, and Fibre Channel Direct Connections
  - Ethernet Direct Connection, and Ethernet Switched Network (with iSCSI HIC)
- ▶ Supports sixteen 4 Gbps drive-side connections for both controllers. This allows a total of eight dual-redundant drive channel pairs to be implemented to support expansion enclosure additions.
- ▶ Redundant drive-side connections are designed to avoid any single-point of failure and maintain high availability.
- ▶ Supports up to 28 EXP5000 (or a mix of EXP5000 and EXP810 for migration purposes) for a total of 448 disks. This will allow you to install up to 448 TB of raw capacity with 1TB SATA disks or 268 TB of raw capacity with FC drives.
- ▶ Supports a maximum of 20 solid state drives (SSDs) in EXP5000.
- ▶ Fully supports Fibre Channel/SATA/SSD intermix (premium feature) by allowing the simultaneous usage of SATA, Fibre Channel, and SSD behind one DS5000 controller, allowing user flexibility and increased storage capacity utilization. It is also possible to mix disks of different size and technology inside one enclosure.
- ▶ Supports up to 512 host storage partitions that isolate LUNs for different servers or groups of servers.
- ▶ Supports up to 2048 logical volumes.

- ▶ Supports up to 2048 host logins.
- ▶ Supports 4096 command queue depth (maximum drive queue depth is 16).
- ▶ Supports logical volumes greater than 2 TB (when required and supported by the operating system).
- ▶ Supports shortwave Fibre Channel 4 and 8 Gbps host attachment.
- ▶ Supports 1 Gbps copper iSCSI host attachment.
- ▶ Multiple heterogeneous server and operating system support (host kits required).
- ▶ Powerful On Demand functions: Dynamic Volume Expansion, Dynamic Capacity Expansion, and Dynamic RAID Level Migration. Dynamic Segment Size allows users to modify storage configurations on-the-fly without incurring any downtime.
- ▶ Remote Support Manager notifies IBM if there is an issue.
- ▶ New dual 10/100/1000 Ethernet for out-of-band management to separate out-of-band management from service diagnostics for each controller.
- ▶ FlashCopy (premium feature) for up to 16 copies per base volume. Two FlashCopies per default (without premium feature).
- ▶ VolumeCopy (premium feature).
- ▶ Remote Volume Mirroring: Metro Mirror, Global Mirror, and Global Copy (premium features) for up to 128 pairs.
- ▶ Standard DB-9 serial connection for service purposes.

## Specifications

Table 3-8 shows the DS5000 specifications.

*Table 3-8 IBM System Storage DS5000 specifications*

Model	1818-51A and 1818-53A
RAID controller	Dual active
Cache	Starts with 8 GB battery-backed Max. 64 GB battery-backed per controller
Host interface	8 or 16 host ports: Fibre Channel (FC) Switched and FC Arbitrated Loop (FC-AL) standard, auto-sensing 4 GBps or 8GBps
Drive interface	16x 4Gbps drive ports: Fibre Channel (FC) Switched and FC Arbitrated Loop (FC-AL) standard
Supported drives	146 GB, 300 GB, 450 GB, 600 GB 15,000 rpm (Fibre Channel) 146 GB, 300 GB, 450 GB, 600 GB 15,000 rpm (Fibre Channel) FDE also full 16 encryption capable disk packs and FC disk packs available 750 GB, 1 TB SATAII 7,200 rpm 73 GB Solid State Disk (SSD)
RAID	Levels 0, 1, 3, 5, 6, and 10
Storage partitions	8, 16, 32, 64, 128, 256, and 512 storage partitions, choice required Upgrades in steps available: 8–16, 16–64 and so on
Maximum drives supported	All models: 448 FC/FDE/SATA drives (using 28 EXP5000 Expansion Units) Maximum of 480 SATA drives (using 8 EXP5060 High Density Drawers) Maximum of 20 solid state disks per model
Fans and power supplies	Dual redundant, hot-swappable

Rack support	19-inch, industry-standard rack - 4U
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For the latest specification information, including Interoperability Matrix, check:

<http://www.ibm.com/systems/storage/disk/ds5000>

### 3.4.3 IBM System Storage model EXP520 and EXP5000

The EXP520 and EXP5000 drive enclosures are more than just-a-bunch-of-disks. They are designed to optimize performance, availability, and serviceability. Redundant 4 Gbps FC drive loops ensure complete accessibility to all drives in the event of a loop or cable failure; having redundant power supplies, cooling fans and ESMs, while all primary components are hot-swappable CRUs and can be easily accessed and removed or replaced.

The EXP5000 (1818-D1A) and EXP520 (1814-52A) storage expansion unit is packaged in a 3U rack-mountable, high-capacity 16-drive bay enclosure containing dual switched 4 Gbps ESMs, dual power supplies, and redundant cooling. EXP5000s connect to DS5100 and DS5300 controllers through high-speed 4 Gbps FC disk expansion ports and have a physical storage capacity of up to 16 TB per enclosure, using 1000 GB SATA DDMs (disk drive modules) and up to 9.6 TB per enclosure, using 600 GB FC DDMs. It is also possible to mix SATA and FC drives in the same enclosure. The EXP520 uses the same disk types and sizes but only connects to DS5020 storage controllers.

The EXP5000 Expansion Unit (1818-D1A) and EXP520 (1814-52A) base model includes a 3U, rack-mount 16-bay disk enclosure, two SW SFP transceivers, dual power supplies, redundant cooling, rack mounting rails, soft copy documentation, and two rack PDU power cords.

#### Some quick EXP520/EXP5000 facts

Disks supported:

- ▶ 600 GB, 450 GB, 300 GB, 146 GB FC 4 Gbps, 15000 rpm (FDE and non-FDE)
- ▶ 1000 GB SATAII and 750 GB SATAII 4 Gbps 7200 rpm
- ▶ 76 GB, FC, solid state drive (only in EXP5000)

Figure 3-11 shows the EXP520 expansion unit front view.

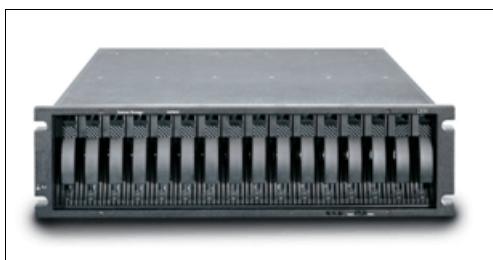


Figure 3-11 Model EXP520

For the latest specification information on the expansion units, check:

<http://www.ibm.com/systems/storage/disk/>

For the latest specification information, check:

<http://www.ibm.com/systems/storage/disk/ds5000/specifications.html>

### 3.4.4 IBM model EXP5060 High-Density disk drive enclosure

The System Storage DS5000 series now has an EXP5060 High-Density disk enclosure. The disk enclosure offers 60 disk drives in a 4U unit, allowing a great reduction of footprint. Next to its lower infrastructure costs, with its high-density format and number of disks, it will deliver beneficial performance for HPC capacity-intensive application environments, and with its efficient power supplies and variable speed cooling fans it is a real energy saver.

DS5000 series (DS5100 and DS5300 controllers) supports attachment of up to eight EXP5060 enclosures. A configuration composed of a DS5100 or DS5300 controller attached to eight EXP5060 disk enclosures provides up to 480 TB of physical storage, all of which can be housed in a single IBM 2101 Model 200 Storage Solutions rack system.

Customers who will benefit most are the ones who:

- ▶ Have traditional HPC or GPC environments
- ▶ Have growing capacity needs
- ▶ Want to reduce power consumption
- ▶ Want to maximize density to reduce footprint in the data center

The EXP5060 comes in a 4U rack-mount enclosure and accommodates up to sixty 1000 GB 7.2K SATA DDMs. Up to eight EXP5060 disk enclosures are attachable to a DS5100 or DS5300 controller, providing up to 480 TB of physical storage.

Figure 3-12 shows the model EXP5060 drawer view.



Figure 3-12 Model EXP 5060 drawer

## 3.5 IBM System Storage Model DCS9900

The IBM System Storage model DCS9900 Storage System is designed for applications with high-performance streaming data requirements served by Deep Computing systems, IBM System p High Performance Computing (HPC) systems, System x 1350™ Linux Cluster systems and Broadcast Video applications.

Applications such as those in HPC, rich media, life sciences and government research require high-performance, reliable access to streaming data and extreme capacity and density to simplify management and reduce cost. Examples of such applications include weather forecasting, seismic processing, reservoir modeling, high definition (HD) creation and distribution, proteomics, structural analysis, fluid dynamics and gene sequencing. With its parallel storage solution architecture, DCS9900 is specifically designed to address those needs.

DCS9900 brings many advantages, such as:

- ▶ Performance: Industry leading streaming I/O performance (up to 5.7 GB/s)
- ▶ Density/scalability: 1200 TB in two racks
- ▶ Energy efficiency: Fewer Controller/Powersupplies/Fans and sleep mode enabled
- ▶ Availability and reliability: Hardware-based RAID 6 (8+2) with no performance penalty, parity computed on every read—no SATA silent corruption errors and all data remains visible to all clients even in the case of a disk, enclosure or controller failure, parallel architecture at every level.

**Note:** All orders for the DCS9900 Storage System, which includes the DCS9900 Controller Model CP2, DCS9900 Storage Expansion Units, and features, must first be approved via the mandatory I-listed RPQ 8S0870. Ask your IBM representative how to order the I-listed RPQ.

### Some quick DCS9900 facts

Here are the features of DCS9900 Controller Model CP2.

- ▶ The DCS9900 Controller Model CP2 (1269-CP2) comes in a 4U rack-mount enclosure containing dual controllers with 5 GB cache (2.5 GB cache per controller) and eight 8 Gbps Fibre Channel host ports. The DCS9900 controller attaches to DCS9900 3S1 SAS/SATA Storage Expansion Units using 3 Gbps SAS v1.0 disk expansion ports. The DCS9900 Model CP2 controller can support up to 1200 disks, yielding up to 1200 TB physical storage capacity, 64,000 LUNs, and up to 4096 direct host logins per DCS9900 system.
- ▶ Infiniband host connectivity delivers a high speed host connectivity option for attachment of host systems to the DCS9900 Storage System; it complements Fibre Channel host connectivity and offers host cables in several convenient lengths.
- ▶ Improved temperature reporting, fault handling and ability to shut down all drives with one command.
- ▶ The DCS9900 controller is designed to support managed Quality of Service to provide uninterrupted data delivery, as well as source all of its performance from multiple target LUNs or a single target "PowerLUN" reducing the need for host-based striping software.
- ▶ The DCS9900 controller incorporates enterprise-class data protection with on-the-fly parity checking on all read I/Os, as well as hardware-enabled RAID 6, which protects data in the event of double disk failure in the same redundancy group, without adversely affecting data availability or system performance.

- ▶ Additionally, the DCS9900 includes block level virtualization, to virtualize storage deployment and system management, through LUN aliasing, WWN masking and filtering, or port zoning.
- ▶ The DCS9900 Controller Model CP2 attaches to DCS9900 Storage Expansion Units to form the following supported, orderable configurations:
  - One DCS9900 Model CP2 Controller attached to five DCS9900 3S1 SAS/SATA Storage Expansion Units
    - Range from 150 to 300 disk drives (in increments of 10 disk drives)
    - Scales from 21.9 to 300 TB physical storage capacity
  - One DCS9900 Model CP2 Controller attached to 10 DCS9900 3S1 SAS/SATA Storage Expansion Units
    - Range from 150 to 600 disk drives (in increments of 10 disk drives)
    - Scales from 21.9 to 600 TB physical storage capacity
  - One DCS9900 Model CP2 Controller attached to 20 DCS9900 3S1 SAS/SATA Storage Expansion Units
    - Range from 600 to 1200 disk drives (in increments of 10 disk drives)
    - Scales from 87.6 to 1200 TB physical storage capacity
- ▶ Each DCS9900 Storage System must be ordered with the minimum number of disk drives, and then can be incremented an additional ten drives at a time, applied to the overall DCS9900 system configuration.

Figure 3-13 shows the DCS9900 front view.



Figure 3-13 IBM System storage model DCS9900

### Specifications:

Table 3-9 shows the DCS9900 specifications.

Table 3-9 IBM System Storage model DCS9900 specifications

Model	1269-CP2 and 1269-3S1
RAID controller	Dual active
Cache	Dual controller with 5GB of RAID protected cache (2.5 GB cache per controller)
Host interface	Eight FC8 or IB 4X DDR host ports (4 ports per controller)

Drive interface	Twenty SAS 4-lane (3Gbp/s) connections (10 per controller)
Supported drives	450 GB 15.000 rpm SAS and 1000 GB 7.200 rpm SATA
RAID	Hardware enabled RAID 6, which protects data in the event of double disk failure in the same redundancy group
Maximum # of supported LUNs	1024 LUNs, 512 concurrent logins (IB) and 1024 concurrent logins (FC) per DCS9900 couplet
Maximum drives supported	Maximum of 1200 SAS/SATA drives in 2 racks
Fans and power supplies	Two redundant power supplies Three redundant blowers with temp sensors, ensuring safe write-through and shutdown
Rack support	19-inch, industry-standard rack - 4U

For the latest specification information, check:

<http://www.ibm.com/systems/storage/disk/dcs/dcs9900/index.html>

## 3.6 IBM System Storage model DS6800

The DS6000™ offers true high performance enterprise-class functionality with modular design and an attractive entry-level pricing for medium and large businesses. The DS6000 series helps simplify data management and enables easy scalability, which allows accommodation of continuing exponential data growth. As part of the IBM System Storage DS family, the DS6800 is designed to provide medium and large businesses with a low-cost, enterprise-class storage solution to help simplify data management and provide comprehensive data protection and recovery capabilities and easy scalability for both mainframe and open system storage needs. By leveraging proven software functions of the Enterprise Storage Server®, the DS6000 series brings proven enterprise class technology to a modular package.

The DS6800 is designed to provide enterprise-class reliability, availability, and serviceability by orchestrating its operations dynamically to improve performance, identify problems before they occur, and take preemptive, corrective action without administrative intervention. The DS6000 series includes multi-pathing software designed to provide enhanced data availability through automatic path failover and improved performance through dynamic I/O load balancing across multiple paths.

### Some quick DS6800 facts

- ▶ Designed to deliver enterprise-class storage functionality for distributed and mainframe servers in a modular, space saving, power-efficient, scalable package.
- ▶ Provides low total cost of ownership by offering tiered pricing on software and a 24x7 IBM on-site repair warranty that covers both hardware and software.
- ▶ Designed to offer a highly available, robust storage solution for medium and large enterprises.
- ▶ Supports advanced copy services, which are interoperable with IBM System Storage DS8000 series and IBM TotalStorage Enterprise Storage Server.
- ▶ Designed to provide over 1600 MBps performance for high throughput applications.
- ▶ Includes eight host ports supporting Fibre Channel and IBM FICON® connectivity.

- ▶ Includes IBM DS6000 Storage Manager software that supports a web-based intuitive interface and Express Configuration Wizards for simplified system configuration and management.

Figure 3-14 shows the front view of the DS6800.



*Figure 3-14 IBM system storage model DS6800*

### **Specifications:**

Here are some DS6800 specifications:

- ▶ Model 1750-522
- ▶ Two RAID controller cards
- ▶ PowerPC® 750GX 1 GHz processors and one PowerPC 750FX processor on each RAID controller card
- ▶ Dual active controllers to provide continuous operations and back up the other controller in case of controller maintenance or an unplanned outage of a controller
- ▶ 4 GB of cache memory (2 GB in each controller card)
- ▶ Battery backed mirrored cache
- ▶ Two battery backup units (one per controller card)
- ▶ Two AC/DC power supplies with imbedded enclosure cooling units
- ▶ Eight Fibre Channel host ports that can be configured as pairs of FCP or FICON host ports. The host ports auto-negotiate to either 2 Gbps or 1 Gbps link speeds
- ▶ Two Fibre Channel switches for disk drive connectivity
- ▶ Eight 2 Gbps device ports (for additional DS6000 expansion enclosures)
- ▶ Attachment to up to seven DS6000 Model 1750-EX1 expansion enclosures
- ▶ Choice of 2 Gbps Fibre Channel disk drives, including:
  - 73 GB 15k RPM
  - 146 GB 15k RPM
  - 146 GB 10k RPM
  - 300 GB 10k RPM
  - 450 GB 15k RPM
- ▶ 3U in height and mountable in a standard 19-inch rack

#### **3.6.1 DS6000 Model 1750-EX1 expansion unit**

DS6800 can expand with the expansion enclosure model 1750-EX1 (Figure 3-15 on page 53). Up to seven expansion drawers build up to the maximum configuration of 128 DDMs, which is comprised of eight drawers x 16 DDMs.

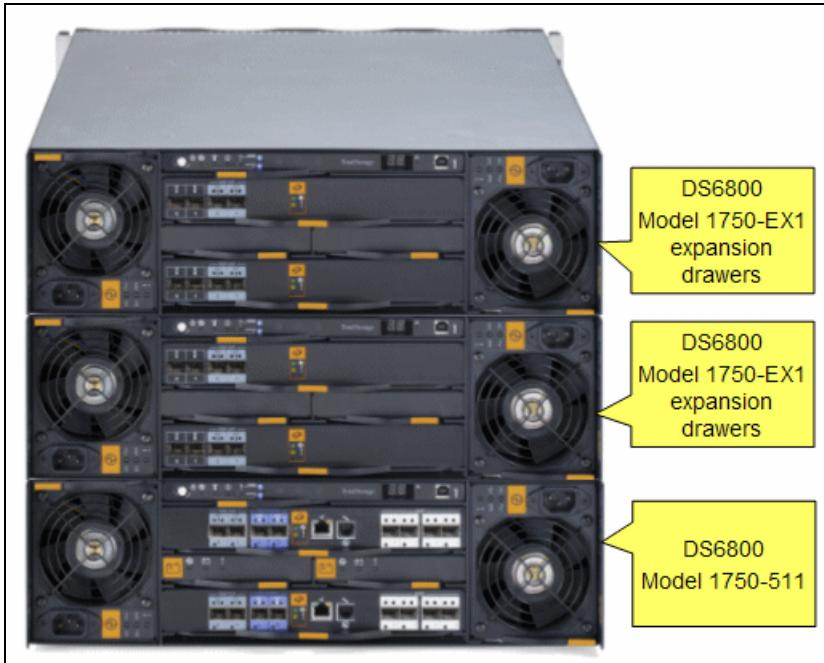


Figure 3-15 DS6000 with two expansion enclosures

Each expansion enclosure contains the following features:

- ▶ Two expansion controller cards, each with:
  - Two 2-Gbps inbound ports
  - Two 2-Gbps outbound ports
  - One Fibre Channel switch
- ▶ A disk enclosure which holds up to 16 Fibre Channel DDMs.
- ▶ Two AC/DC power supplies with embedded enclosure cooling units.
- ▶ Supports attachment to DS6800 Model 1750-511.
- ▶ The DS6800 Model 1750-EX1 can also be mounted in a standard 19-inch rack.

### DS6000 series warranty, maintenance, and service

Current models of the IBM System Storage DS6000 series (1750-522 and 1750-EX2) include IBM installation and a one year, 24x7, IBM on site, same-day-response warranty on both hardware and software. Additional services for maintenance, configuration, data migration, and other storage management needs are available to help organizations optimize their storage infrastructure and choose the length of service and support that is right for their needs.

For the latest specification information, check:

<http://www.ibm.com/systems/storage/disk/ds6000/index.html>

## 3.7 IBM System Storage DS8000 series

The IBM System Storage DS8000 Turbo series is designed to support the most demanding business applications with its exceptional performance and superior data throughput. It comprises three models:

- ▶ Model DS8100
- ▶ Model DS8300
- ▶ Model DS8700

The IBM System Storage model DS8100 and the IBM System Storage model DS8300 use the IBM POWER5™ server processor technology; the IBM System Storage model DS8700 uses the IBM POWER6® processor technology that is integrated with the IBM Virtualization Engine technology. All DS8000 series models consist of a storage unit and one or two management consoles, two being the recommended configuration.

Combined with exceptional performance, its world-class resiliency features and five-nines<sup>1</sup> availability make it an ideal storage platform for supporting today's round-the-clock, global business environment. Moreover, with its tremendous scalability, flexible tiered storage options, broad server support, and support for advanced IBM de-duplication technology, the DS8000 Turbo can help simplify the storage environment by consolidating multiple storage systems onto a single DS8000 system. The DS8000 can help lower total cost of ownership and reduce the complexity of managing storage environments.

Physical capacity can range from a few terabytes (TB) to over 1 petabyte (PB) on a single system, providing scalability on which to grow and consolidate data from multiple storage systems. Consolidating disk platforms in this way can help you address your performance and capacity requirements more effectively, while simplifying your storage environments and reducing costs related to data center floor space, energy, and cooling. Add to that the tremendous capacity optimization and performance benefits when combining the DS8000 series and the world-class data de-duplication technology of the IBM SystemStorage TS7650g ProtectTIER De-duplication Gateway, and you have got an enterprise disk system that scales like no other.

What is more, the IBM System Storage SAN Volume Controller can extend the DS8000's powerful capabilities to offer additional advanced functions, such as thin provisioning, heterogeneous storage virtualization, and online data migration.

### **DS8000 Turbo highlights: Models DS8100 and DS8300**

- ▶ Support continuous operations for cross-platform, mission critical workloads with leading performance, flexibility, high availability, security, and cost effectiveness.
- ▶ Manage growth and reduce operational complexity through consolidation with high-performance solid-state drives, high capacity Serial ATA (SATA) drives, support for advanced IBM de-duplication technology, flexible system logical partitions (LPARs), and advanced management capabilities.
- ▶ Protect sensitive information from internal and external threats with innovative self-encrypting (FDE) disk drives.
- ▶ Realize greater efficiencies for IBM server environments through unique support for innovative IBM server platforms, such as High Performance FICON for System z, z/OS® Metro/Global Mirror, Incremental Resync, Extended Address Volumes, HyperPAV, Extended Distance FICON, and Cooperative Caching.
- ▶ Exceptional acquisition costs and total cost of ownership with enterprise choice warranties of one, two, three, or four years on both hardware and advanced functions.
- ▶ Additional enhancements to improve overall business continuity, management, and security capabilities.

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<sup>1</sup> Five-nines is a term used to denote that a piece of equipment is functioning with 99.999 percent reliability.

Figure 3-16 shows the front view of DS8000.



Figure 3-16 IBM system storage model DS8000

### Models DS8100 (931) DS8300 (932) specifications:

Table 3-10 shows the specifications of the DS8100 and DS8300.

Table 3-10 DS8100 (931) DS8300 (932) specifications

Feature	DS8100 (931)	DS8300 (932)
Shared SMP processor configuration	POWER5+ dual 2-way	POWER5+ dual 4-way
Other major processors	PowerPC, ASICs	PowerPC, ASICs
Processor memory for cache and NVS (min/max)	16 GB/128 GB	32 GB/256 GB
Virtualization Engine (LPAR) capability	Not available	Optional
Host adapter interfaces	4-port 4 Gbps Fibre Channel/FICON	4-port 4 Gbps Fibre Channel/FICON
Host adapters (min/max)	2/16	2/32
Host ports (min/max)	4/64	4/128
Drive interface	FC-AL	FC-AL
Number of disk drives (min/max)	16/384	16/1024
Device adapters	Up to 8 4-port FC-AL	Up to 16 4-port FC-AL
Maximum physical storage capacity	384 TB	1024 TB

Feature	DS8100 (931)	DS8300 (932)
Disk sizes	73 GB solid-state drives 146 GB solid-state drives 146 GB (15,000 rpm) FC 300 GB (15,000 rpm) FC 450 GB (15,000 rpm) FC 1 TB (7,200 rpm) SATA	73 GB solid-state drives 146 GB solid-state drives 146 GB (15,000 rpm) FC 300 GB (15,000 rpm) FC 450 GB (15,000 rpm) FC 1 TB (7,200 rpm) SATA
RAID levels	5, 6, and 10	5, 6, and 10

### 3.7.1 IBM System Storage model DS8700

The IBM System Storage DS8700 is designed to support the most demanding business applications with its exceptional all-around performance and data throughput. It is the next step of DS8000, which includes all functions from previous family members. This, combined with its world-class business resiliency and encryption features, provides a unique combination of high availability, performance, and security. Its tremendous scalability, broad server support, and virtualization capabilities can help simplify the storage environment by consolidating multiple storage systems onto a single DS8700.

The IBM System Storage DS8000 series encompasses the flagship disk enterprise storage products in the IBM System Storage portfolio. The DS8700 represents the latest in this series designed for a high-performance, high-capacity, and resilient series of disk storage systems.

The IBM System Storage DS8700 provides new functional capabilities, allowing you to choose the combination of price and efficiency that is right for your application needs. New capabilities include:

- ▶ IBM POWER6 processor technology- The DS8700 features the IBM POWER6 server technology to help support high performance. Compared to the POWER5+ processor in previous models, the POWER6 processor can enable better than a 50% performance improvement in I/O operations per second in transaction processing workload environments. Additionally, sequential workloads can receive as much as 150% bandwidth improvement. The DS8700 offers either a dual 2-way processor complex or a dual 4-way processor complex.
- ▶ PCI-e IO enclosures- To improve IOPS (I/O Operations Per Second) and sequential read/write throughput, the new IO enclosures are directly connected to the servers via point-to-point PCI-e cables. IO enclosures no longer share common “loops”, they connect directly to each internal server via separate cables and link cards.
- ▶ Four-port device adapters- Device adapter processor hardware has been upgraded to twice as fast processors for more IOPS performance to enable better utilization of SSD drives.
- ▶ Non-disruptive upgrade path for the DS8700 Model 941 and additional Model 94E expansion frames allows processor, cache, and storage enhancement to be performed concurrently without disrupting applications.
- ▶ Enhancements to disk encryption key management that can help address PCI-DSS (Payment Card Industry Data Security Standard) requirements:
  - Encryption deadlock recovery key - Supports the ability for IBM to restore access to a DS8700 when the encryption key for the storage is unavailable due to an encryption deadlock scenario.
  - Dual platform key server support - DS8000 requires an isolated key server in encryption configurations. The isolated key server currently defined is an IBM System x

server. Dual platform key server support allows two different server platforms to host the key manager with either platform operating in either *clear key* or *secure key* mode.

- ▶ Value-based pricing/licensing - Operating Environment License is now priced based on the performance, capacity, speed, and other characteristics that provide value in client environments.

In addition to these new functions, the DS8700 inherits most of the features of its predecessors.

### 3.7.2 The DS8000 design keys

Here are some key architectural basics of DS8000 and improvements of DS8700. From an architectural point of view, the DS8700 has not changed much with respect to the fundamental architecture of the predecessor DS8100 and DS8300 models. This ensures that the DS8700 can leverage a very stable and well-proven operating environment, offering the optimum in availability. The hardware is optimized to provide higher performance, connectivity, and reliability.

#### Green Data Center

Faced with increasingly urgent warnings about the consequences of the projected rise in both energy demands and greenhouse gas emissions, governments and businesses alike are now focusing more attention than ever on the need to improve energy efficiency. Corporate data centers are well known as significant power users.

IBM is launching the Green Data Center environment in a very responsible *green* way, which is catching the attention of many companies. IBM products can provide huge increases in processing, with dramatically less power consumption and lower carbon output. The DS8700 is one of these products and is reflected with a green colored stripe on the front covers of the machine (base frame).

For more information about creating a green data center, call your IBM representative or visit:

<http://www.ibm.com/cio>

#### IBM POWER processor technology

The DS8000 series exploits the IBM POWER5 technology, which is the foundation of the storage system LPARs. The DS8000 uses 64-bit POWER5 microprocessors in dual 2-way or dual 4-way processor complexes, with up to 256 GB of cache.

The DS8700 exploits the IBM POWER6 technology. The SMP system features 2-way or 4-way, copper-based, SOI-based POWER6 microprocessors running at 4.7 GHz.

Compared to the POWER5+ processor in previous models, the POWER6 processor can enable better than a 50% performance improvement in I/O operations per second in transaction processing workload environments. Additionally, sequential workloads can receive as much as 150% bandwidth improvement. The DS8700 offers either a dual 2-way or a dual 4-way processor complex.

#### Internal fabric

The DS8000 comes with a high bandwidth, fault tolerant internal interconnection, called RIO-G (Remote I/O), which is also used in System p. The interconnection can operate at speeds up to 1 GHz and offers a 2 Gbps sustained bandwidth per link, with exceptional performance and reliability.

DS8700 uses direct point-to-point high speed PCIe connections to the I/O enclosures to communicate with the device and host adapters. Each single PCIe connection operates at a speed of 2 GB/s in each direction. There are up to 16 PCIe connections from the processor complexes to the I/O enclosures.

### **Switched Fibre Channel Arbitrated Loop (FC-AL)**

The DS8000 uses switched FC-AL for its disk interconnection. This offers a point-to-point connection to each drive and device adapter, so that there are four paths available from the controllers to each disk drive.

### **Fibre Channel disk drives**

The DS8000 offers a selection of industry standard Fibre Channel disk drives, including 146 GB (15K rpm), 300 GB (15K rpm), and 450 GB (15K rpm). The 450 GB 15K rpm Fibre Channel disk drive provides capacity, allowing a single system to scale up to 460 TB of Fibre Channel capacity. The DS8000 series also now allows you to install 146 GB 15K rpm, 300 GB 15K rpm, and 450 GB 15K rpm Full Disk Encryption drive sets.

### **Serial ATA drives**

With the 1 TB (7200 rpm) Serial ATA (SATA) drives, the DS8000 capacity scales up to 1 PB (1024 TB = 1 petabyte = 1 PB). These SATA drives offer a cost-effective option for lower priority data.

### **Solid State Drives**

With the Solid State Drives (SSD), which are available in 73 GB and 146 GB, the DS8000 offers new opportunities for ultra-high performance applications. The SSD drives are the best choice for I/O intensive workload. They provide up to 100 times the throughput and 10 times lower response time than 15K rpm spinning disks. Additionally, they also consume much less power.

For more information about SSDs, refer to *DS8000: Introducing Solid State Drives*, REDP-4522.

### **Host adapters**

The DS8000 series offers host connectivity with 4-port Fibre Channel/FICON Host Adapters. The DS8000 currently supports 4 Gbps Fibre Channel/FICON host adapters.

The 4 Gbps Fibre Channel/FICON Host Adapters are offered in longwave and shortwave, auto-negotiate to either 4 Gbps, 2 Gbps, or 1 Gbps link speeds. Each port on the adapter can be individually configured to operate with Fibre Channel Protocol (FCP) (also used for mirroring) or FICON.

A DS8700 with the dual 4-way feature can support up to a maximum of 32 host adapters, which provide up to 128 Fibre Channel/FICON ports. Note that ESCON adapters are no longer supported.

### **DS8000 series warranty, maintenance, and service**

The IBM System Storage DS8000 series offers leading Enterprise Choice warranties with one, two, three, or four years with IBM installation and 24x7 IBM onsite, same-day-response on both hardware and advanced function software. Additional services for maintenance, configuration, data migration, and other storage management needs are available to help you optimize your storage infrastructure and choose the length of service and support that is right for your needs.

For the latest specification information about the DS8000 family, check:

<http://www.ibm.com/systems/uk/storage/disk/ds8000/index.html>

## 3.8 IBM System Storage model XIV (Storage System)

The IBM XIV Storage System is a fully scalable enterprise storage system that is based on a grid of standard, off-the-shelf hardware components. It has been designed with an easy-to-use and intuitive GUI that allows administrators to become productive in a very short time.

The XIV Storage System architecture is designed to deliver performance, scalability, and ease of management while harvesting the high capacity and cost benefits of Serial Advanced Technology Attachment (SATA) drives. The system employs off-the-shelf products as opposed to traditional offerings that use proprietary designs, thus requiring more expensive components. This in combination with its revolutionary self-monitoring, self-optimizing and auto-recovery features makes the XIV Storage System a TCO saving complex.

### Key properties of a ground-breaking solution

- ▶ Superior architecture boasting massive parallelism and sophisticated distributed algorithms that yield superior power and value
- ▶ Superior performance through maximized utilization of all disks, true distributed cache implementation coupled with more effective cache bandwidth, and practically zero overhead incurred by snapshots
- ▶ Superior reliability through distributed architecture, redundant components, self-monitoring and auto-recovery processes; ability to sustain failure of a complete disk module and three more disks with minimal performance degradation
- ▶ Market leading auto-restoration of system redundancy in case of disk failure (less than 30 minutes for 1TB drives, compared to several hours for the closest competitor)
- ▶ Superior administration and zero management overhead: no need to ever tune the system in order to attain high-end performance, even after adding or removing disks; no need to make compromises when utilizing snapshots; non-restricted creation and management of unlimited snapshots with practically zero overhead.

### Some quick XIV Storage System highlights

- ▶ A revolutionary high-end disk storage architecture designed to eliminate the complexity of administration and management of tiered storage and information lifecycle management
- ▶ Near-instantaneous and highly space-efficient snapshots provide point-in-time copies of data that consumes storage capacity only per changes while maintaining high performance
- ▶ System virtualization that greatly simplifies IT operations and optimizes performance through automatic distribution of data across system resources, avoiding hot spots without manual tuning
- ▶ High reliability achieved through unique self-healing functionality, which can enable the system to rebuild a 1 TB disk drive within 30 minutes or less, with almost no performance impact
- ▶ Optimized, consistent performance derived from the system's massive parallelism, disk utilization, and unique caching algorithms
- ▶ Amazingly intuitive user interface and system virtualization, greatly simplifying storage configuration and management

- ▶ Built-in thin provisioning that can help reduce direct and indirect costs by allowing users to install capacity only for data actually written, and gradually grow it over time with minimal management effort
- ▶ Customer-centric, low point of entry (27 TB usable) with incremental scaling (in 6 TB increments) to full rack capacity (79 TB usable), enabling organizations to start small based on current needs and flexibly add capacity while in production and with no need to reconfigure.

Figure 3-17 shows the XIV front view.



*Figure 3-17 IBM system storage model XIV*

## Specifications

- ▶ Number of disks 72 (entry) /180 (full model)
- ▶ Number of FC ports 8 (entry) /24 (full model), 4 Gbps, 2 Gbps, or 1 Gbps
- ▶ Number of iSCSI ports 0 (entry) /6 (full model)
- ▶ Raw capacity 72 (entry) /180 (full model) TB
- ▶ Usable capacity 27 (entry) /79 TB<sup>2</sup> (full model)
- ▶ Internal switching capacity 64 Gbps (entry) /168 Gbps (full model)
- ▶ Memory 48 entry /120 GB (full model)
- ▶ Cache to disk bandwidth 240 Gbps
- ▶ CPUs (quad-core) 6 (entry) /15 (full model)

For the latest specification information, check:

<http://www.ibm.com/systems/uk/storage/disk/xiv/index.html>

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<sup>2</sup> After taking into account capacity used by mirroring (redundancy), spares, and metadata

## 3.9 IBM System Storage SAN Volume Controller

The IBM System Storage SAN Volume Controller (SVC) is a storage virtualization system that enables a single point of control for storage resources to help support improved business application availability and greater resource utilization. The objective is to manage storage resources in your IT infrastructure and to make sure they are used to the advantage of your business—and do it quickly, efficiently, and in real time, while avoiding administrative cost. SAN Volume Controller is designed to pool storage volumes from IBM and non-IBM storage systems into a reservoir of capacity for centralized management. It is designed to hide the boundaries among disk systems, which helps you to focus on managing storage as a resource to meet business requirements and not as a set of boxes. SAN Volume Controller helps you to set business process goals based on all the storage resources at your disposal rather than allowing the storage resources to limit what your business can accomplish.

Figure 3-18 shows a flexible infrastructure with SAN Volume Controller.

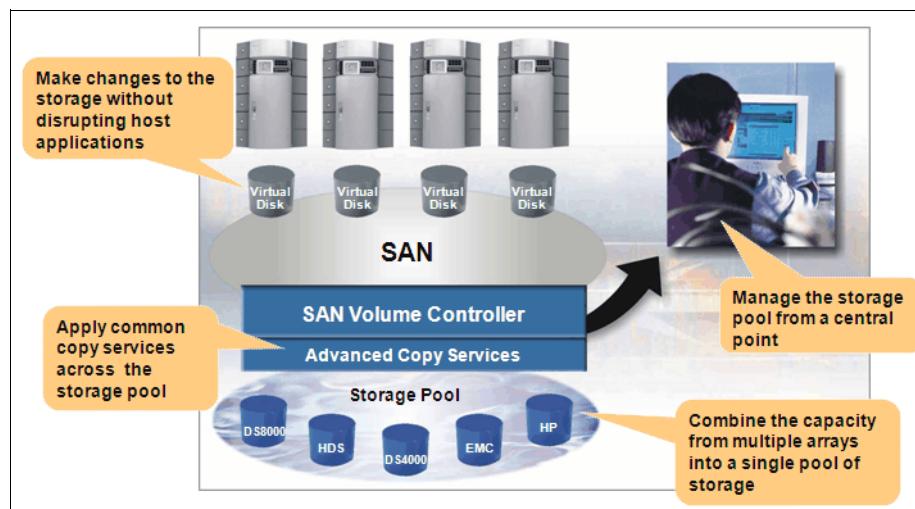


Figure 3-18 SVC within Heterogeneous Storage Infrastructure environment

### Some quick SAN Volume Controller facts

- ▶ Combines storage capacity from multiple disk systems into a reservoir of capacity that can be managed more efficiently.
- ▶ Helps increase storage utilization by providing host applications with more flexible access to capacity.
- ▶ Helps improve storage administrator productivity by enabling management of heterogeneous storage systems using a common interface.
- ▶ Supports improved application availability by insulating host applications from changes to the physical storage infrastructure.
- ▶ Enables a tiered storage environment in which the cost of storage can be better matched to the value of data.
- ▶ Supports advanced copy services from higher- to lower-cost devices and across storage systems from multiple vendors.
- ▶ Is even more affordable for midsize businesses.

For the latest specification information, check:

<http://www.ibm.com/systems/storage/software/virtualization/svc>

## 3.10 IBM SVC Entry Edition

IBM System Storage SAN Volume Controller Entry Edition (SVC EE) is a storage virtualization system that is designed to deliver enterprise-class capabilities in a package optimized for midsize businesses. SVC EE is based on the IBM SAN Volume Controller offering but delivered in a more affordable package. Storage virtualization with SVC EE helps hide much of the complexity of storage environments both from servers and also from administrators. Servers and administrators are presented with a single type of storage system with a single management interface and common network-based replication functions, regardless of the type of physical storage being used. Storage virtualization with SVC EE helps you focus on using storage as a resource to support your business needs and not as boxes that must be managed.

SVC EE is limited to a maximum of 60 disks within the storage environment.

SAN Volume Controller Entry Edition software is delivered preinstalled on SVC Storage Engines, so it is quickly ready for implementation once the engines are attached to your storage area network (SAN). SVC Storage Engines are based on proven IBM System x server technology and are always deployed in redundant pairs in order to deliver very high availability. SVC Entry Edition is designed to take control of existing storage, retaining all your existing information. This ability helps speed and simplify implementation while helping to minimize the need for additional storage. Once SVC EE is implemented, you can make changes to the configuration quickly and easily as needed.

### Some quick SVC EE facts

- ▶ Offers enterprise-class storage virtualization in a more affordable package for midsize businesses.
- ▶ Helps reduce costs and improve data center energy efficiency.
- ▶ Simplifies the IT infrastructure and administration.
- ▶ Complements server virtualization and increases the value of server virtualization strategies,
- ▶ Eases and speeds storage provisioning.
- ▶ Delivers consistent replication functions regardless of the type of storage being managed.
- ▶ Has software pre-installed on storage engines for rapid deployment.
- ▶ Supports a wide range of operating system environments including Microsoft Windows, UNIX, Linux, and VMware.

For the latest specification information, check:

<http://www.ibm.com/systems/storage/software/virtualization/svc/ee/index.html>

## 3.11 IBM System Storage N series

IBM N series unified storage products provide a wide range of network attachment capabilities to a broad range of host systems, and offer solutions from entry-level performance to enterprise-level performance models. The IBM N series systems allow both SAN and NAS storage to be consolidated to a single modular platform. This series provides a range of reliable, scalable storage solutions for a variety of storage requirements. These capabilities are achieved by using network access protocols such as Network File System (NFS), Common Internet File System (CIFS), HTTP, Fibre Channel over Ethernet (FCoE) and iSCSI, as well as storage area network technologies such as Fibre Channel (FC). Disk

expandability is reached by making use of external expansion cabinets (EXN 1000, EXN3000 and EXN4000) for Fibre Channel, SAS, or SATA disks. Utilizing built-in Redundant Array of Inexpensive Disks (RAID) technologies, all data is well protected with options to enhance protection through mirroring, replication, snapshots, and backup. The N series systems are also characterized by simple management interfaces that make installation, administration, and troubleshooting straightforward.

#### ***Advantages of using this type of flexible storage solution***

- ▶ Tune the storage environment to a specific application while maintaining flexibility to increase, decrease, or change access methods with minimal disruption, and keeping its availability.
- ▶ React easily and quickly to changing storage requirements. If additional storage is required, you can expand it quickly and non-disruptively. When existing storage exists but is deployed incorrectly, you have the capability to reallocate available storage from one application to another quickly and simply.
- ▶ Maintain availability and productivity during upgrades. If outages are necessary, keep them to the shortest time possible.
- ▶ Create effortless backup and recovery solutions that operate commonly across all data access methods.
- ▶ Simplify your infrastructure with file and block-level services in a single system.
- ▶ Change the deployment of storage resources non-disruptively, easily, and quickly. Online storage resource redeployment is possible.
- ▶ Easily and quickly implement the upgrade process. Non-disruptive upgrade is possible.
- ▶ Strong data protection solutions and support for online backup and recovery.

#### **3.11.1 IBM N series storage systems functionality**

The IBM System Storage N series storage systems offer multiprotocol connectivity using internal storage or storage provided by expansion units (Figure 3-19 on page 64). The IBM System Storage N series systems are designed to provide integrated block-level and file-level data access, allowing concurrent operation in IP SAN (iSCSI), FC SAN, NFS, and CIFS environments. Other storage vendors may require the operation of multiple systems to provide this functionality, thus making the N series a perfect storage consolidation system. IBM System Storage N series systems are designed to avoid costly downtime, both planned and unplanned, and improve your access to mission-critical data.

Figure 3-19 on page 64 shows the ability to connect multiple data access methods.

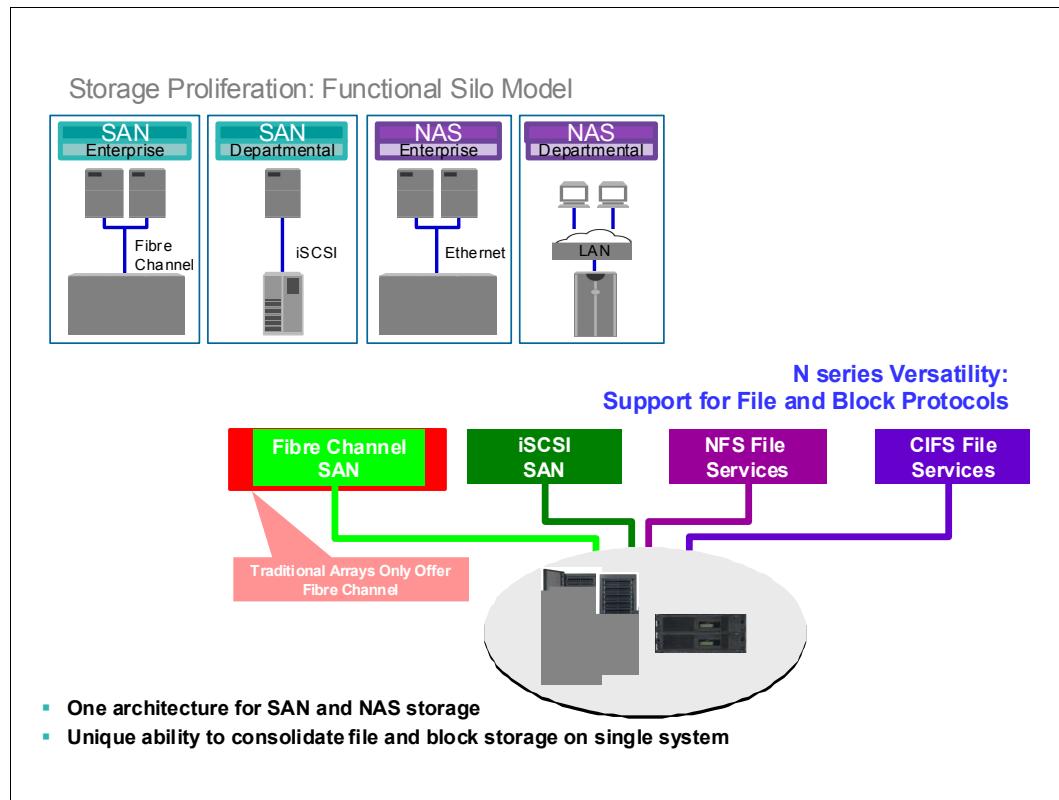


Figure 3-19 IBM System Storage N series A models

The N series is a specialized, *thin server* storage system with a customized operating system, similar to a stripped-down UNIX kernel, hereafter referred to as Data ONTAP®.

With this customized operating system, many of the server operating system functions that you are familiar with are not resident. Data ONTAP improves performance and reduces costs by eliminating unnecessary functions that do not pertain to a storage system.

The N series comes with preconfigured software and hardware, and with no monitor or keyboard for user access. This is commonly called a *headless* system. A storage administrator accesses the systems and manages the disk resources from a remote console using a web browser or command line.

One of the typical characteristics of an N series storage systems product is its ability to be installed rapidly, using minimal time and effort to configure the system. N series is integrated seamlessly into the network, making it especially attractive when limited resources of time and skills are of consideration in the decision process.

## **Drive flexibility**

IBM System Storage N series products are designed to provide network-attached storage for environments where clients have a need to utilize their storage investment in a multifaceted environment. IBM System Storage N series storage systems provide you with a tremendous amount of versatility by allowing this solution to be populated with both Fibre Channel disk drives and SATA disk drives. An N series populated with Fibre Channel disk drives may be suitable for mission-critical high-performance data transaction environments, whereas an N series populated with SATA disk drives may be attractive to clients who wish to use the platform for disk-to-disk backup scenarios, disaster recovery scenarios, archive data, or data such as home directories, which do not have the demands of high-performance transactional environments.

### **3.11.2 N3000 Express series (Modular Disk Storage Systems)**

IBM System Storage N3000 Express series Modular Disk Storage Systems are designed to provide primary and secondary storage for midsize workloads. Consolidating all of their fragmented application-based storage and unstructured data into one unified, easily managed, and expandable platform can help IT generalists increase their effectiveness. N3000 Express systems offer integrated block-level and file-level data access, intelligent management software, and data protection capabilities—such as higher-end N series systems—in a cost-effective package. IBM N3000 Express series innovations include internal controller support for Serial Attached SCSI (SAS) or SATA drives, expandable I/O connectivity, and on board remote management.

The IBM N3000 Express is compatible with the entire family of N series unified storage systems, which feature a comprehensive line-up from top-to-bottom of hardware and software designed to address a variety of possible deployment environments.

The N3300 Express squeezes 12 TBs of internal raw capacity into a 2U enclosure and optional external expansion that can increase total system raw capacity to 68 TB. The N3600 Express scales up to 20 TB of internal raw capacity and can scale up to 104 TB by supporting up to 104 disk drives. Whether for primary or secondary storage use, the N3000 Express systems are intended to provide outstanding deployment versatility and connectivity to help satisfy your data protection and recovery needs.

#### **Some quick N3000 facts**

- ▶ High availability - Takes advantage of proven features including a high-performing and scalable operating system, data management software, and redundancy features designed to support disk-based backup, with file or application-level recovery with Snapshot™ and SnapRestore® software features.
- ▶ Simple replication and disaster recovery - Designed to provide an easy-to-deploy mirroring solution that is highly tolerant of WAN interruptions.
- ▶ Management simplicity - Self-diagnosing systems designed to enable on-the-fly provisioning.
- ▶ Versatile - Single, integrated architecture designed to support concurrent block I/O and file serving over Ethernet and Fibre Channel SAN infrastructures.

Figure 3-20 on page 66 shows the front view of an N3600.



Figure 3-20 IBM system storage model N3600

## Specifications

Figure 3-21 shows the specifications for all models of N3300 and N3600.

	N3300	N3300	N3600	N3600
<b>Machine Type Model</b>	<b>2859-A10</b>	<b>2859-A20</b>	<b>2862-A10</b>	<b>2862-A20</b>
<b>Controller configuration</b>	Single	Dual (active/active)	Single	Dual (active/active)
<b>Processors Speed and Type</b>	Intel® 2.2 GHz Mobile Celeron®			
<b>Number of Processors</b>	1	2	2	4
<b>Random Access Memory</b>	1 GB	2 GB	2 GB	4 GB
<b>Nonvolatile memory</b>	128 MB	256 MB	256 MB	512 MB
<b>Integrated I/O Ports</b>				
<b>Fibre Channel Ports (Speed)</b>	2(4 Gbps)	4(4 Gbps)	2(4 Gbps)	4(4 Gbps)
<b>Ethernet Ports (Speed)</b>	2(1 Gbps)	4(1 Gbps)	2(1 Gbps)	4(1 Gbps)
<b>Storage Scalability</b>				
<b>Maximum Number of Fibre Channel Loops</b>	1	1	2	2
<b>Maximum Raw Capacity (Note 3)</b>	68 TB	68 TB	104 TB	104 TB
<b>Maximum Number of Internal Drives</b>	12	12	20	20
<b>Maximum Number of Expansion Drives</b>	56	56	84	84
<b>Maximum Number of Disk Drives</b>	68	68	104	104
<b>Maximum Volume Size</b>	16 TB	16 TB	16 TB	16 TB
<b>Maximum Number of Volumes/LUNs</b>	1024	1024	1024	1024
<b>Maximum Number of Storage Enclosures</b>	4	4	6	6

Figure 3-21 N3300 and N3600 specifications

For the latest specification information and interoperability matrix, check:

<http://www.ibm.com/systems/storage/network/n3000/appliance/index.html>

### 3.11.3 IBM System Storage N6000 series

The IBM N6000 series systems offer a versatile storage platform for handling the large amounts of diverse data moving through your business. N6000 series systems help a

business consolidate these varied data sets onto a unified storage platform supporting simultaneous block and file services for business and technical applications. With IBM N6000 series, you can unlock the full potential of your growing virtualized server environment by enabling virtual machine mobility and offloading the work of data protection. The N6000 systems enable you to connect your heterogeneous server environment (including Windows, UNIX, and Linux servers) and clients to one storage system by using standard storage protocols and interfaces.

IBM N6000 series systems can help you spend less time on backup and recovery so you can focus your energy and creativity on growing your business. Our full range of enterprise class, high availability, and disaster-recovery products provide affordable software for data protection to help safeguard your business-critical applications' data. IBM N series Snapshot technology helps reduce backup times to minutes; SnapRestore software enables recovery of point-in-time data, also in minutes. IBM N series SnapManager® software quickly returns applications to the same point in time as recovered data. All of this is built on the solid foundation of our low-overhead, dual parity RAID-DP—the IBM N series implementation of high performance RAID 6 for better data protection and capacity utilization than RAID 5 and RAID 1+0.

Figure 3-22 shows the front view of the N6000.

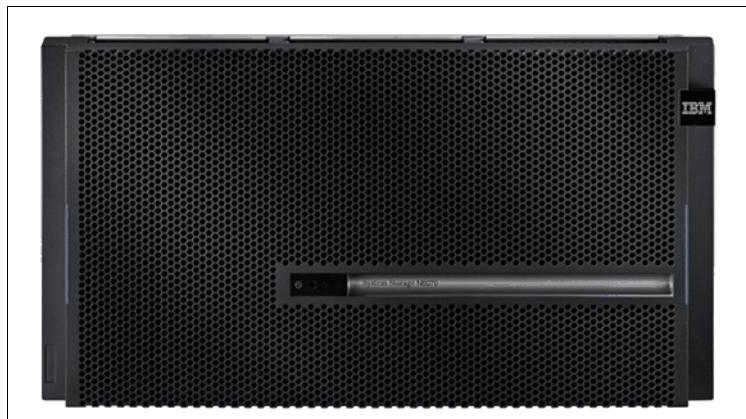


Figure 3-22 IBM system storage model N6000

### Some quick N6000 facts

- ▶ Meet diverse and changing needs - Consolidate diverse data sets onto a unified storage platform that provides simultaneous block and file services for business and technical applications.
- ▶ Perform when your applications need it most - Outstanding file-based and transaction-based performance with high bandwidth, 64-bit architecture, and the latest I/O technologies.
- ▶ Respond to growth - Thin provisioning helps eliminate stranded storage. Preserve investments in staff expertise and capital equipment with data-in-place upgrades to more powerful N series systems while running the same OS and using the same management tools.
- ▶ Maximize your resources- Highly efficient storage utilization makes it possible to dramatically reduce your consumption of raw storage, power, cooling, and space.
- ▶ Improve your business efficiency - Clients with different storage subsystems in their SAN environments can now take advantage of the N6000 series Gateway capabilities to help improve business efficiency and reduce data management complexity.

## Specifications

Figure 3-23 shows the specifications for the N6040 and N6060 models.

	<b>N6040</b>	<b>N6040</b>	<b>N6060</b>	<b>N6060</b>
<b>Machine Type Model</b>	<b>2858-A10</b>	<b>2858-A20</b>	<b>2858-A12</b>	<b>2858-A22</b>
<b>Gateway Machine Type Model</b>	2858-A10 (w/FC 9551)	2858-A20 (w/FC 9551)	2858-A12 (w/FC 9551)	2858-A22 (w/FC 9551)
<b>Controller Configuration</b>	Single	Dual (active/active)	Single	Dual (active/active)
<b>Processors Speed and Type</b>	2.4 GHz AMD Dual-core 64-bit Opteron			
<b>Number of Processors</b>	1	2	2	4
<b>Random Access Memory</b>	4 GB	8 GB	8 GB	16GB
<b>Nonvolatile Memory</b>	512 MB	1 GB	2 GB	4 GB
<b>Integrated I/O Ports</b>				
<b>Fibre Channel Ports (Speed)</b>	4 (4-Gbps)	8 (4-Gbps)	4 (4-Gbps)	8 (4-Gbps)
<b>Ethernet Ports (Speed)</b>	2 (1-Gbps)	4 (1-Gbps)	2 (1-Gbps)	4 (1-Gbps)
<b>Storage Scalability</b>				
<b>Maximum Number of Fibre Channel Loops</b>	10	10	10	10
<b>Maximum Raw Capacity</b>	420 TB	420 TB	672 TB	672 TB
<b>Maximum Number of Disk Drives</b>	420	420	672	672
<b>Maximum Volume Size</b>	16 TB	16 TB	16 TB	16 TB
<b>Maximum Number of Volumes/LUNs</b>	2048	2048	2048	2048
<b>Maximum Number of Storage Enclosures</b>	30	30	48	48

Figure 3-23 N6040 and N 6060 specifications

Figure 3-24 on page 69 shows the specifications for the N6070 models.

	N6070	N6070
<b>Machine Type Model</b>	<b>2858-A11</b>	<b>2858-A21</b>
<b>Gateway Machine Type Model</b>	2858-A11	2858-A21
<b>Controller Configuration</b>	(w/FC 9551) Single	(w/FC 9551) Dual (active/active)
<b>Processors Speed and Type</b>	2.4 GHz AMD Dual-core 64-bit Opteron	
<b>Number of Processors</b>	2	4
<b>Random Access Memory</b>	16 GB	32 GB
<b>Nonvolatile Memory</b>	2 GB	4 GB
<b>Integrated I/O Ports</b>		
<b>Fibre Channel Ports (Speed)</b>	4 (4-Gbps)	8 (4-Gbps)
<b>Ethernet Ports (Speed)</b>	4 (1-Gbps)	4 (1-Gbps)
<b>Storage Scalability</b>		
<b>Maximum Number of Fibre Channel Loops</b>	10	10
<b>Maximum Raw Capacity</b>	840 TB	840 TB
<b>Maximum Number of Disk Drives</b>	840	840
<b>Maximum Volume Size</b>	16 TB	16 TB
<b>Maximum Number of Volumes/LUNs</b>	2048	2048
<b>Maximum Number of Storage Enclosures</b>	60	60

Figure 3-24 N6070 specifications

For the latest specification information and interoperability matrix, check:

<http://www.ibm.com/systems/storage/network/n6000/appliance/index.html>

### 3.11.4 IBM System Storage N7000 series

The IBM System Storage N7000 series systems are intended to help IT organizations tackle the challenge of effective data management using virtualization technology and a unified storage architecture. The N7000 series is designed to deliver high-end enterprise storage and data management value with midrange affordability. Built-in enterprise serviceability and manageability features help support your efforts to increase reliability, simplify and unify storage infrastructure and maintenance, and deliver exceptional economy.

The N7000 series, like all N series systems, provides powerful virtualization and thin-provisioning capabilities intended to maximize storage utilization and staff productivity while minimizing the use of power, cooling, and floor space. Staff productivity can be enhanced by an integrated suite of application-aware manageability software that can provide policy-based automation to otherwise manual tasks. The IBM N7000 series is designed to provide remarkable versatility by unifying FC SAN, iSCSI SAN, NAS, primary, nearline, and regulatory compliance data retention and archival storage in an integrated architecture.

The combination of versatility and simplicity of N series systems is intended to help IT professionals respond quickly to changing business needs. The N7000 series combines the benefits of a unified storage architecture suite of application-aware software with massive

scalability, which is intended to provide an ideal platform for large-scale data center applications and storage consolidations. In addition, the N7000 series ordered through a Gateway feature can help you optimize the use of your existing storage equipment, and improve efficiency and return on investment while continuing to support different access methods for different business solutions throughout the enterprise.

### Some quick N7000 facts

- ▶ Scalable - Designed for nondisruptive expansion to more than 1.1 petabytes (1.1 PB or 1100 TB) storage capacity.
- ▶ Versatile - Integrated architecture designed to support concurrent block I/O and file serving over Ethernet and Fibre Channel SAN infrastructures.
- ▶ Efficient consolidation - Intended to provide storage for multiple applications in a system with FlexShare™ to ensure that critical workloads get priority service.
- ▶ Application availability - N7000 systems with Data ONTAP enable application-level recovery in minutes, not hours, upon failure or user error.
- ▶ Performance - Delivers high, consistent performance for mission-critical applications.

Figure 3-25 shows the front view of the N7000.



Figure 3-25 IBM system storage model N7000

### Specifications

Figure 3-26 on page 71 shows the specifications for the N7700 and N7900 models.

	<b>N7700</b>	<b>N7900</b>
<b>Machine type model</b>	2866-A21	2867-A21
<b>Gateway Machine Type Model</b>	2866-A21 (w/ FC 9551)	2867-A21 (w/ FC 9551)
<b>Controller Configuration</b>	Dual (active/active)	Dual (active/active)
<b>Processors Speed and Type</b>	2.6 GHz AMD™ Opteron™	2.6 GHz AMD Dual Core Opteron
<b>Number of Processors</b>	4	8
<b>Random Access Memory</b>	32 GB	64 GB
<b>Nonvolatile Memory</b>	1 GB	4 GB
<b>Integrated I/O Ports</b>		
<b>Fibre Channel Ports/Speed</b>	16 (4-Gbps)	16 (4-Gbps)
<b>Ethernet Ports/Speed</b>	12 (1-Gbps)	12 (1-Gbps)
<b>Storage Scalability</b>		
<b>Maximum Number of Fibre Channel Loops</b>	10	14
<b>Maximum Raw Capacity</b>	840 TB	1176 TB
<b>Maximum Number of Disk Drives</b>	840	1176
<b>Maximum Volume Size</b>	16 TB	16 TB
<b>Maximum Number of Volumes/LUNs</b>	2048	2048
<b>Maximum Number of Storage Enclosures</b>	60	84
<b>Disk Expansion Units Supported</b>	EXN4000 - 4-Gbps Fibre Channel Disk Storage Expansion Unit: 4-Gbps Fibre Channel: 300 GB, 15,000 rpm; 450 GB, 15,000 rpm 2-Gbps Fibre Channel: 300 GB, 15,000 rpm; 450 GB, 15,000 rpm EXN3000 - SAS Disk Storage Expansion Unit: SAS: 300 GB, 15,000 rpm; 450 GB, 15,000 rpm SATA: 500 GB, 7,200 rpm; 1 TB EXN1000 - SATA Disk Storage Expansion: SATA: 500 GB, 7,200 rpm; 1 TB	

Figure 3-26 specifications for the IBM System Storage N7700 and N7900 models

For the latest specification information and interoperability matrix, check:

<http://www.ibm.com/systems/storage/network/n7000/appliance/>

### 3.11.5 IBM System Storage N series Gateways

The IBM System Storage N series Gateway product line is a network-based unified storage solution designed to provide Internet Protocol (IP) and Fibre Channel (FC) protocol access to SAN-attached heterogeneous storage arrays. The N6000 and N7000 series ordered with a Gateway feature can help you make the most of the dynamic provisioning capabilities of Data ONTAP software across your existing Fibre Channel SAN infrastructure to support an expanded set of business applications. The IBM N series Gateway is based on the Data ONTAP micro-kernel operating system, which is designed to unify block and file storage networking paradigms under a common architecture. The N series Gateway is designed to provide a comprehensive suite of advanced data management capabilities to help you consolidate, protect, and recover mission-critical data for enterprise applications and users.

The IBM N series Gateway is designed to deliver the performance and capacity to meet access requirements for enterprises of all sizes. N series Gateway systems are intended to deliver industry-leading performance, offer terabytes of managed capacity, and be configured for simultaneous active/active access with secure failover across two independent systems in a cluster. The N6000 and N7000 series Gateway product lines support the attachment to both N series EXN1000 and EXN4000 disk storage expansion units, as well as a broad range of IBM, EMC, Hitachi, Fujitsu, 3PAR, and HP storage subsystems, including the IBM Enterprise Storage Server (ESS) series, IBM System Storage DS8000, and DS4000 series. Clients with these storage subsystems in their SAN environments can now take advantage of the N series Gateway capabilities to help improve business efficiency and reduce data management complexity.

Figure 3-27 shows a tiered heterogeneous storage environment with N series.

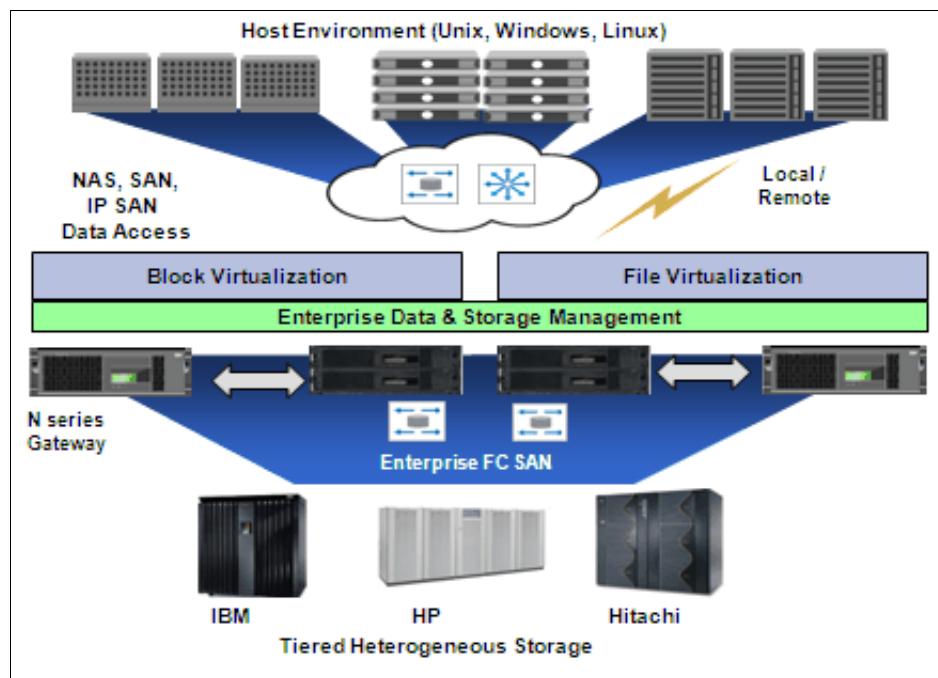


Figure 3-27 Tiered heterogeneous storage environment with N series

### Some quick N series gateway facts

- ▶ Heterogeneous unified storage environment - Designed to provide unified storage access for multiprotocol, multivendor storage environments.
- ▶ Versatile - Single, integrated architecture designed to support concurrent block I/O and file serving over Ethernet and Fibre Channel SAN infrastructures.
- ▶ Storage consolidation - Designed to enable organizations to consolidate UNIX, Linux, Windows, and Web workloads with existing SAN storage, thereby helping to increase storage utilization.
- ▶ Builds on existing SAN infrastructure - Designed to integrate into existing SAN storage environments, helping to optimize investment protection and ROI.
- ▶ Data management - Designed to provide advanced data management solutions that maximize availability and help to reduce operational costs significantly.
- ▶ Comprehensive software suite - Designed to provide robust system management, copy services, virtualization technologies, and disaster recovery and backup capabilities across all SAN resources.

Figure 3-28 shows the front view of the N6000 series gateway.



Figure 3-28 N6000 front view

### Specifications of the N6000 series gateway models

Figure 3-29 shows the specifications for the N6000 gateway models N6040 and N6060.

	N6040	N6040	N6060	N6060
Machine type model	2858-A10	2858-A20	2858-A12	2858-A22
Gateway Machine Type Model	2858-A10 (w/ FC 9551)	2858-A20 (w/ FC 9551)	2858-A12 (w/ FC 9551)	2858-A22 (w/ FC 9551)
Controller Configuration	Single	Dual (active/active)	Single	Dual (active/active)
Processors Speed and Type	2.4 GHz AMD Dual-core 64-bit Opteron			
Number of Processors	1	2	2	4
Random Access Memory	4 GB	8 GB	8 GB	16 GB
Nonvolatile Memory	512 MB	1 GB	2 GB	4 GB
<b>Integrated I/O Ports</b>				
Fibre Channel Ports (Speed)	4 (4-Gbps)	8 (4-Gbps)	4 (4-Gbps)	8 (4-Gbps)
Ethernet Ports (Speed)	2 (1-Gbps)	4 (1-Gbps)	2 (1-Gbps)	4 (1-Gbps)
<b>Storage Scalability</b>				
Maximum Number of Fibre Channel Loops	10	10	10	10
Maximum Raw Capacity	420 TB	420 TB	672 TB	672 TB
Maximum Number of Disk Drives	420	420	672	672
Maximum Volume Size	16 TB	16 TB	16 TB	16 TB
Maximum Number of Volumes/LUNs	2048	2048	2048	2048
Maximum Number of Storage Enclosures	30	30	48	48

Figure 3-29 IBM System Storage N6000 series gateway models

### Specifications of the N7000 series gateway models

Figure 3-30 on page 74 shows the specifications for the N7000 gateway models N7700 and

N7900.

	<b>N7700</b>	<b>N7900</b>
<b>Machine type model</b>	2866-A21	2867-A21
<b>Gateway Machine Type Model</b>	2866-A21 (w/ FC 9551)	2867-A21 (w/ FC 9551)
<b>Controller Configuration</b>	Dual (active/active)	Dual (active/active)
<b>Processors Speed and Type</b>	2.6 GHz AMD™ Opteron™	2.6 GHz AMD Dual Core Opteron
<b>Number of Processors</b>	4	8
<b>Random Access Memory</b>	32 GB	64 GB
<b>Nonvolatile Memory</b>	1 GB	4 GB
<b>Integrated I/O Ports</b>		
<b>Fibre Channel Ports/Speed</b>	16 (4-Gbps)	16 (4-Gbps)
<b>Ethernet Ports/Speed</b>	12 (1-Gbps)	12 (1-Gbps)
<b>Storage Scalability</b>		
<b>Maximum Number of Fibre Channel Loops</b>	10	14
<b>Maximum Raw Capacity</b>	840 TB	1176 TB
<b>Maximum Number of Disk Drives</b>	840	1176
<b>Maximum Volume Size</b>	16 TB	16 TB
<b>Maximum Number of Volumes/LUNs</b>	2048	2048
<b>Maximum Number of Storage Enclosures</b>	60	84
<b>Disk Expansion Units Supported</b>	EXN4000 - Fibre Channel Disk Storage Expansion Unit EXN3000 - SAS Disk Storage Expansion Unit EXN1000 - SATA Disk Storage Expansion	

Figure 3-30 IBM System Storage N7000 series gateway models

For the latest specification information, check:

<http://www.ibm.com/systems/storage/network/gateway/>

### 3.11.6 IBM System Storage N series software

The IBM System Storage N series also provides a selection of features and functions delivered through software offerings that are designed to provide a comprehensive set of robust management and operational tools as well as high availability features, disaster recovery, and data copy services that help the system administration provide a high level of support for environments requiring IP-attached storage solutions.

Table 3-11 shows an overview of the many different N series software standard and additional offerings:

Table 3-11 Standard software features at no costs

<b>Data ONTAP</b>	Operating system software that optimizes data serving and allows multiple protocol data access.
<b>FTP</b>	File Transfer Protocol (FTP), a standard Internet protocol, is a simple way to exchange files between computers on the Internet.

<b>Telnet</b>	The Telnet protocol provides a general, bidirectional communications facility. It provides user-oriented command-line login sessions between hosts.
<b>Snapshot</b>	This enables online backups, providing near instantaneous access to previous versions of data without requiring complete, separate copies.
<b>FlexVol®</b>	FlexVol creates multiple flexible volumes on a large pool of disks; dynamic, nondisruptive (thin) storage provisioning; and space and time efficiency. These flexible volumes can span multiple physical volumes without regard to size.
<b>FlexShare</b>	FlexShare gives administrators the ability to leverage existing infrastructure and increase processing utilization without sacrificing the performance of critical business needs. With the use of FlexShare, administrators can confidently consolidate different applications and data sets on a single storage system. FlexShare gives administrators the control to prioritize applications based on how critical they are to the business.
<b>Disk sanitization</b>	Disk sanitization is the process of physically obliterating data by overwriting disks with specified byte patterns or random data in a manner that prevents recovery of current data by any known recovery methods. This feature enables you to carry out disk sanitization by using three successive byte overwrite patterns per cycle. By default, six cycles are performed.
<b>FilerView®</b>	This is a web-based administration tool that allows IT administrators to fully manage N series storage systems from remote locations. It provides simple and intuitive web-based single-appliance administration.
<b>SnapMover®</b>	This migrates data among N series clusters with no impact on data availability and no disruption to users.
<b>AutoSupport</b>	AutoSupport is a sophisticated, event-driven logging agent featured in the Data ONTAP operating software and inside each N series system. It continuously monitors the health of your system and issues alerts if a problem is detected. These alerts can also be in the form of email.
<b>SecureAdmin™</b>	SecureAdmin is a Data ONTAP module that enables authenticated, command-based administrative sessions between an administrative user and Data ONTAP over an intranet or the Internet.
<b>Domain Name System (DNS)</b>	The N series supports using a host naming file or a specified DNS server and domain.
<b>Network Information Service (NIS)</b>	The N series provides NIS client support and can participate in NIS domain authentication.
<b>Integrated automatic Redundant Array of Independent Disks (RAID) manager</b>	The IBM System Storage N series and Data ONTAP provide integrated RAID management with RAID-Double Parity (default) and RAID 4.
<b>iSCSI Host Attach Kit for AIX, Windows, Linux</b>	A host support kit includes support software and documentation for connecting a supported host to an iSCSI network. The support software includes programs that display information about storage and programs to collect information needed by customer support to diagnose problems.
<b>Systems Manager</b>	The basic idea behind the System Manager (SM) is to provide comprehensive management and capability of one or more arrays by way of a simple, easy-to-use, intuitive GUI.

<b>SyncMirror®</b>	SyncMirror is the synchronous mirror of a volume. It maintains a strict physical separation between the two copies of your mirrored data. In case of an error in one copy, the data is still accessible without any manual intervention.
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Table 3-12 shows the optional software features offerings.

*Table 3-12 Optional Software features*

<b>Common Internet File System (CIFS)</b>	This provides file system access for Microsoft Windows environments.
<b>NFS</b>	This provides file system access for UNIX and Linux environments.
<b>Hypertext Transfer Protocol (HTTP)</b>	Hypertext Transfer Protocol allows a user to transfer displayable web pages and related files.
<b>FlexCache™ for NFS</b>	This provides efficient caching of files and volumes in a local N series storage system when the source volume resides in a remote location N series storage system, thus avoiding inefficient use of bandwidth resources.
<b>FlexClone®</b>	This is designed to provide instant replication of data volumes and sets without requiring additional storage space at the time of creation.
<b>FlexScale</b>	This is used exclusively to improve performance by managing the additional cache provided by Performance Accelerator Modules. These modules can be added as an option to an N series storage system.
<b>Multistore</b>	This permits an enterprise to consolidate a large number of Windows, Linux, or UNIX file servers onto a single storage system. Many virtual N series storage systems on one physical appliance ease migration and multi-domain failover scenarios.
<b>SnapLock®</b>	This provides non-erasable and non-rewritable data protection that helps enable compliance with government and industry records retention regulations. Snaplock is not available starting in DATA ONTAP 7.3.0. It is available in Data ONTAP 7.3.1.
<b>SnapMirror®</b>	This is remote mirroring software that provides automatic block-level incremental file system replication between sites. It is available in synchronous, asynchronous, and semi-synchronous modes of operation.
<b>SnapRestore</b>	This allows rapid restoration of the file system to an earlier point in time, typically within a few seconds.
<b>SnapVault®</b>	This provides disk-based backup for N series systems by periodically backing up a Snapshot copy to another system
<b>SnapDrive®</b>	SnapDrive enables Windows and UNIX applications to access storage resources on N series storage systems, which are presented to the Windows 2000 or later operation system as locally attached disks. For UNIX it allows you to create storage on N series storage systems in the form of logical unit numbers (LUNs), file systems, logical volumes, or disk groups.

<b>SnapManager</b>	Host software for managing Snapshots for backup and restore operations. There are different versions of SnapManager that integrate easily with critical applications, in particular: <ul style="list-style-type: none"> <li>▶ SnapManager for MS Exchange</li> <li>▶ SnapManager for SQLServer</li> <li>▶ SnapManager for MS SharePoint</li> <li>▶ SnapManager for Oracle</li> <li>▶ SnapManager for SAP</li> <li>▶ SnapManager for Virtual Infrastructures, which automates and simplifies backup and recovery of primary storage used by VMware Virtual Infrastructure</li> </ul>
<b>SnapValidator®</b>	For Oracle deployments, SnapValidator can be used to provide an additional layer of integrity checking between the application and N series storage. SnapValidator allows Oracle to create checksums on data transmitted to N series storage for writes to disk and include the checksum as part of the transmission.
<b>Single Mailbox Recovery for Exchange (SMBR)</b>	SMBR is a software option from SnapManager that is designed to take near-instantaneous online backups of Exchange databases, verify that the backups are consistent, and rapidly recover Exchange within levels (storage group, database, folder, single mailbox, or single message). The potential results are improved service to internal clients, reduced infrastructure expenses, and significant time savings for Exchange administrators.
<b>Operations Manager SRM</b>	The File Storage Resource Manager (FSRM) feature of Operations Manager provides monitoring and management of storage resources, including applications, files, file systems, and networks.
<b>Operations Manager Core</b>	Operations Manager provides remote, centralized management of IBM System Storage N series data storage infrastructure, including global enterprise, storage network, and so on.
<b>MetroCluster</b>	MetroCluster software provides an enterprise solution for high availability over wide-area networks between two clustered nodes of a single N series storage system.
<b>NearStore® option</b>	This provides enhanced performance in a disk-based, secondary storage device used for enterprise applications.
<b>Advanced Single Instance Storage (ASIS)</b>	This is designed to significantly improve physical storage efficiency and network efficiency by enabling the sharing of duplicate data blocks. ASIS provides a data-deduplication solution native to N series.
<b>Virtual File Manager (VFM)</b>	IBM System Storage N series Virtual File Manager (VFM) software is a comprehensive solution for managing unstructured file data. It is designed to provide data management functionality for server and storage consolidation, migration, remote office data management, and disaster recovery features while avoiding disruption to users. It provides all of this functionality through automated policy-based data management leveraging a global namespace.
<b>Cluster fail over (CFO)</b>	This ensures high data availability for business-critical requirements by eliminating a single point of failure. It must be ordered for A2X clustered configurations or upgrades from A1X to A2X. Its active/active pairing delivers even more <i>nines to the right of the decimal point</i> .

## 3.12 More Information

For more information about all the products discussed in this chapter, refer to the following books:

- ▶ *Implementing the IBM System Storage SAN Volume Controller V5.1*, SG24-6423
- ▶ *IBM Midrange System Storage Implementation and Best Practices Guide*, SG24-6363
- ▶ *IBM System Storage DS4000 and Storage Manager V10.30*, SG24-7010
- ▶ *IBM System Storage DS3000: Introduction and Implementation Guide*, SG24-7065
- ▶ *IBM Midrange System Storage Hardware Guide*, SG24-7676
- ▶ *IBM System Storage DS8000: Architecture and Implementation*, SG24-6786
- ▶ *IBM System Storage DS8700: Architecture and Implementation*, SG24-8786
- ▶ *IBM XIV Storage System: Architecture, Implementation, and Usage*, SG24-7659
- ▶ *IBM System Storage DS8000 Series: IBM FlashCopy SE*, REDP-4368
- ▶ *IBM DS8000 and z/OS Basic HyperSwap*, REDP-4441
- ▶ *IBM System Storage DS8700 Disk Encryption Implementation and Usage Guidelines*, REDP-4500
- ▶ *IBM System Storage DS8000: Remote Pair FlashCopy (Preserve Mirror)*, REDP-4504
- ▶ *IBM System Storage DS8000: LDAP Authentication*, REDP-4505
- ▶ *DS8000: Introducing Solid State Drives*, REDP-4522
- ▶ *DS8000 Thin Provisioning*, REDP-4554
- ▶ *IBM System Storage N series*, SG24-7129



# IBM Scale Out Network Attached Storage

The IBM Scale Out Network Attached Storage (SONAS) is a highly scalable system designed to provide a clustered NAS system with a single name space for CIFS, NFS, and FTP services. The system consists of 2 to 30 Interface nodes (2851-SI1), 1 to 30 storage pods consisting of the Storage node (2851-SS1), Storage controller (2851-DR1) and attached disks, and one to two Management nodes (2851-SM1). The maximum configuration provides up to 14.4 PB of storage capacity in a single clustered, highly-redundant system.

The storage used in the SONAS system can be high performance 15K RPM SAS hard disk drives or high capacity 7.2K RPM SATA hard disk drives, allowing users to tune the configuration to suit their needs.

There are three rack configurations (2851-RXA, -RXB, and -RXC) that need to be populated with the systems and switches needed to configure according to the needs of the environment.

## 4.1 SONAS overview

SONAS is designed to address the new storage challenges posed by the continuing explosion of data. Leveraging mature technology from IBM's High Performance Computing experience, and based upon the IBM General Parallel File System (GPFS™), SONAS is an easy-to-install, turnkey, modular, scale out NAS solution that provides the performance, clustered scalability, high availability and functionality that are essential to meeting strategic Petabyte Age and cloud storage requirements.

The high-density, high-performance SONAS can help organizations consolidate and manage data affordably, reduce crowded floor space, and reduce management expense associated with administering an excessive number of disparate storage systems. With its advanced architecture, SONAS virtualizes and consolidates multiple files into a single, enterprise-wide file system, which can translate into reduced total cost of ownership, reduced capital expenditure, and enhanced operational efficiency.

SONAS provides a global namespace that enables your storage infrastructure to scale to extreme amounts of data, from terabytes to petabytes. Within the solution, centralized management, provisioning, control, and automated information life-cycle management (ILM) are integrated as standard features to provide the foundation for a truly cloud storage-enabled solution.

SONAS provides extreme scale out capability, a globally clustered NAS file system built upon IBM GPFS. The global namespace is maintained across the entire global cluster of multiple storage pods and multiple interface nodes. All interface nodes and all storage nodes share equally in the cluster to balance workloads dynamically and provide parallel performance to all users and storage, while also assuring high availability and automated failover.

SONAS will eventually support a full complement of standards-based network protocols, including Common Internet File System (CIFS), Network File System (NFS), Secure Copy Protocol (SCP), Hypertext Transfer Protocol (HTTP), and File Transfer Protocol (FTP).

## 4.2 How SONAS works

IBM Scale Out Network Attached Storage (SONAS) is a Scale Out NAS offering designed to manage vast repositories of information in enterprise environments requiring very large capacities, high levels of performance, and high availability. The system supports multiple petabytes of storage and up to a billion files in a single file system and supports up to 256 file systems per system. Data access to the system from client computers is provided using industry standard network file protocols NFS v2/v3, CIFS, and FTP (including z/OS NFS client support).

In addition, the system supports traditional NAS features and functions, including:

- ▶ Snapshots
- ▶ Quotas (user, group, and fileset level)
- ▶ Integration with user directory servers such as Microsoft Active Directory (AD) and Lightweight Directory Access Protocol (LDAP)
- ▶ Command line interface (CLI) and browser-based graphical user interface (GUI)
- ▶ Call home and remote support capabilities

In addition to these traditional features, the system supports advanced features, including integrated Tivoli Storage Manager (TSM) backup client.

The advanced architecture of SONAS virtualizes and consolidates the file space into a single, enterprise-wide file system, as shown in Figure 4-1.

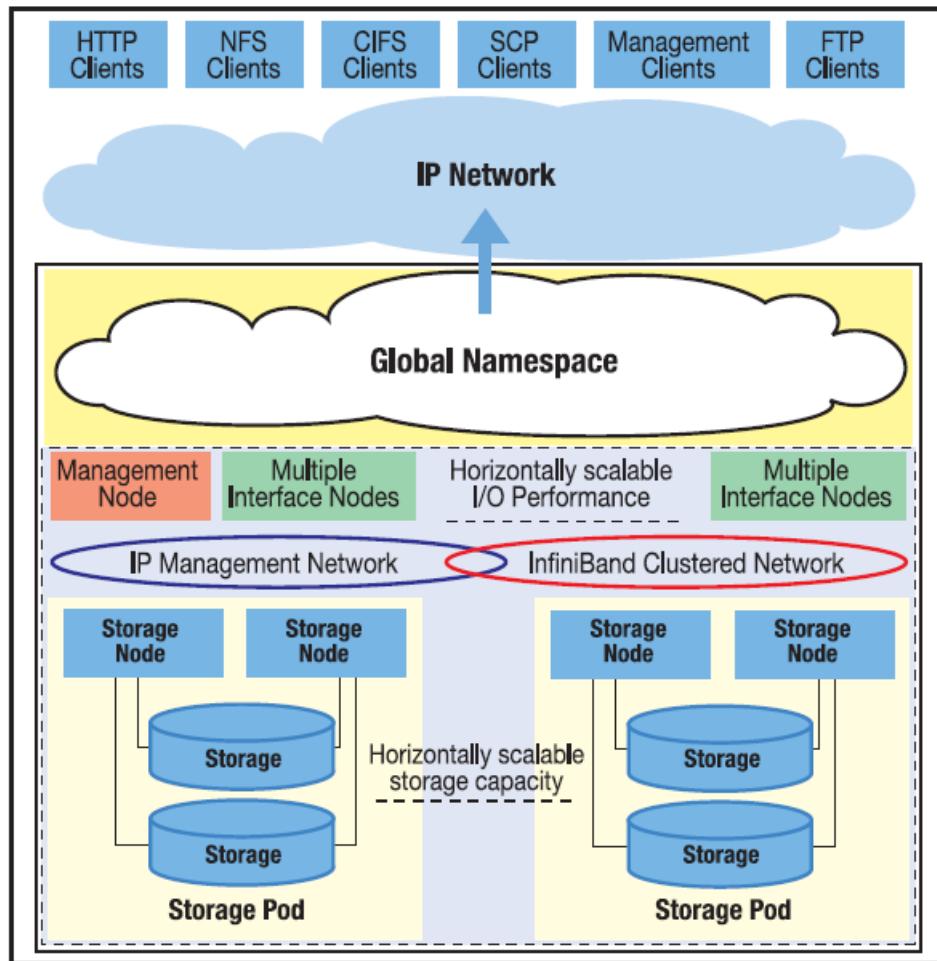


Figure 4-1 SONAS architecture

The SONAS system consists of:

- ▶ Management node
- ▶ Interface nodes
- ▶ Storage nodes
- ▶ Storage controllers
- ▶ Disk storage expansion units
- ▶ Ethernet and InfiniBand switches and racks

The Management node provides a central point for the system administrator to configure, monitor, and manage the system. The management node supports both a browser-based graphical user interface (GUI) and a command line interface (CLI). It also provides a System Health Center for monitoring the overall health of the system.

The Interface node provides the network port connection and the file services for the IBM SONAS system. These nodes can operate at up to 10 Gb speeds with optional adapters to provide extremely fast access to data. They are connected to the rest of the SONAS system via a redundant high speed InfiniBand data network.

The system has the concept of a storage pod. Each storage pod consists of a pair of storage nodes and one or two storage controllers. Each storage controller contains 60 disks, and can have one storage expansion attached for 60 additional disks per controller. Each storage pod supports a maximum of 240 hard disk drives. A maximum of 30 storage pods are supported for a maximum of 7200 hard disk drives in a single system.

These systems are configured within three predefined, customizable rack configurations. The Base Rack (2851-RXA) contains the management node, the InfiniBand switches, and from two to six interface nodes with up to one storage pod. Each Storage Expansion Rack (2851-RXB) contains up to two storage pods, for a maximum of 480 disks. The Interface Expansion Rack (2851-RXC) contains up to twenty additional interface nodes.

## 4.3 SONAS features

SONAS is designed to deliver cloud storage at petabyte scale, enabling cloud applications and services to be uncoupled from the underlying storage infrastructure, which allows the business to adjust quickly to change. As a result, SONAS can easily integrate with your organization's strategies to develop a more dynamic enterprise. Some of the important features of SONAS are now discussed (also see Figure 4-2).

### Centrally managed, centrally deployed

SONAS enables you to cluster and centrally deploy and manage a large scale out NAS storage environment, in order to gain a unified centralized management capability for security, provisioning and configuration.

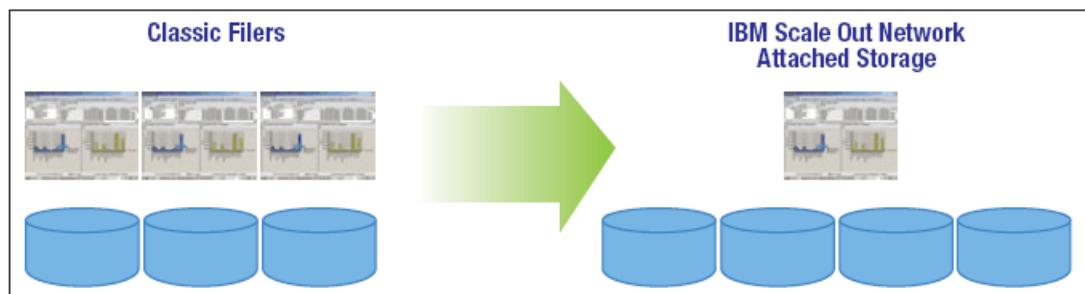


Figure 4-2 SONAS unified management view

The global cluster provides intelligent load balancing, dynamic thin provisioning, geographical distribution, performance optimization, and advanced replication—all globally applied and centrally managed.

### Automated, integrated tiered storage and information life-cycle management

SONAS supports users across the organization with a comprehensive suite of storage capabilities, including tiered storage and ILM.

When file systems grow from terabytes to petabytes and to millions and billions of files, the task of managing and migrating this scale of data can become an immense challenge. Backup and archive becomes complex, expensive and slow because of the large amount of data that must be scanned to identify what must be backed up. SONAS is designed to solve these problems by providing extreme scale out capability in a single global namespace, with automated, integrated, policy-driven ILM and hierarchical storage management built in.

The integrated ILM capability allows you to manage a petabyte-level global namespace in logical storage pools instead of individual disks. The architecture enables easy dynamic growth and transparent data migration, supporting the ability to make changes to your storage infrastructure without having to plan weeks in advance. You can centrally provision storage nearly instantaneously, on a quota basis, by user, group or location. Extensive global reporting and global access control capabilities are standard features.

SONAS (Figure 4-3) provides a powerful high-performance scan engine that makes ILM possible at the level of petabytes of data with millions and billions of files. The high-performance scan engine enables fast searches, with ILM data movement, back-ups, and restores done in parallel by all nodes in the system.

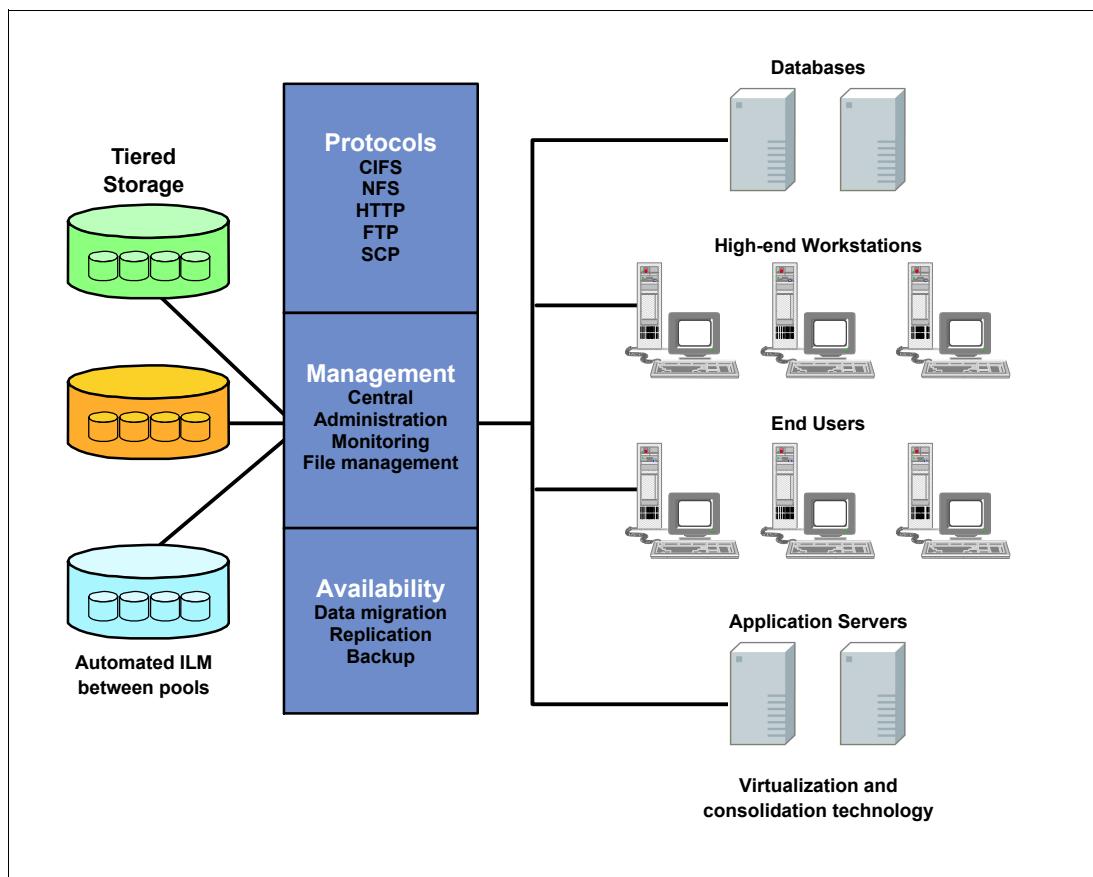


Figure 4-3 SONAS tiered storage and ILM

The clustered architecture means all nodes share in performing the high-performance scan, and all nodes can participate in the transparent movement of ILM data or backup data to other storage pools or external removable media. ILM is performed at the individual file level, thus greatly optimizing storage usage while enabling maximum business flexibility. Physical data movement between pools, or migration and recall to and from tape, is transparent to the global namespace and to the logical user paths, directory locations, and applications.

### Protecting data and replicating between sites

SONAS offers data protection through space-efficient snapshots that protect against accidental deletion or modification of files, and that enable you to restore at the file level. The solution also provides for synchronous replication as well as bandwidth-optimized asynchronous replication to multiple sites.

## Leveraging unique capabilities and modular hardware

In addition to extreme scale out capability and integrated ILM, SONAS enables your organization to utilize an array of uniquely scalable, globally clustered hardware capabilities. For instance, it has wide area network (WAN) capabilities that enable local caching of remote files for fast service (Figure 4-4).

The solution is self-tuning, with all data automatically striped across all disks in a logical storage pool for high performance. All nodes share equally in the reading and writing of files in parallel from all disks, thus providing intelligent load balancing, eliminating of hot spots, and ensuring very high performance. Storage capacity is only allocated when written, providing dynamic thin provisioning.

The solution is also self-healing, providing automatic failover, fallback, and fully dynamic load balancing. The modular configuration of interface nodes and storage node building blocks can be upgraded or downgraded dynamically, giving you the ability to scale in real time.

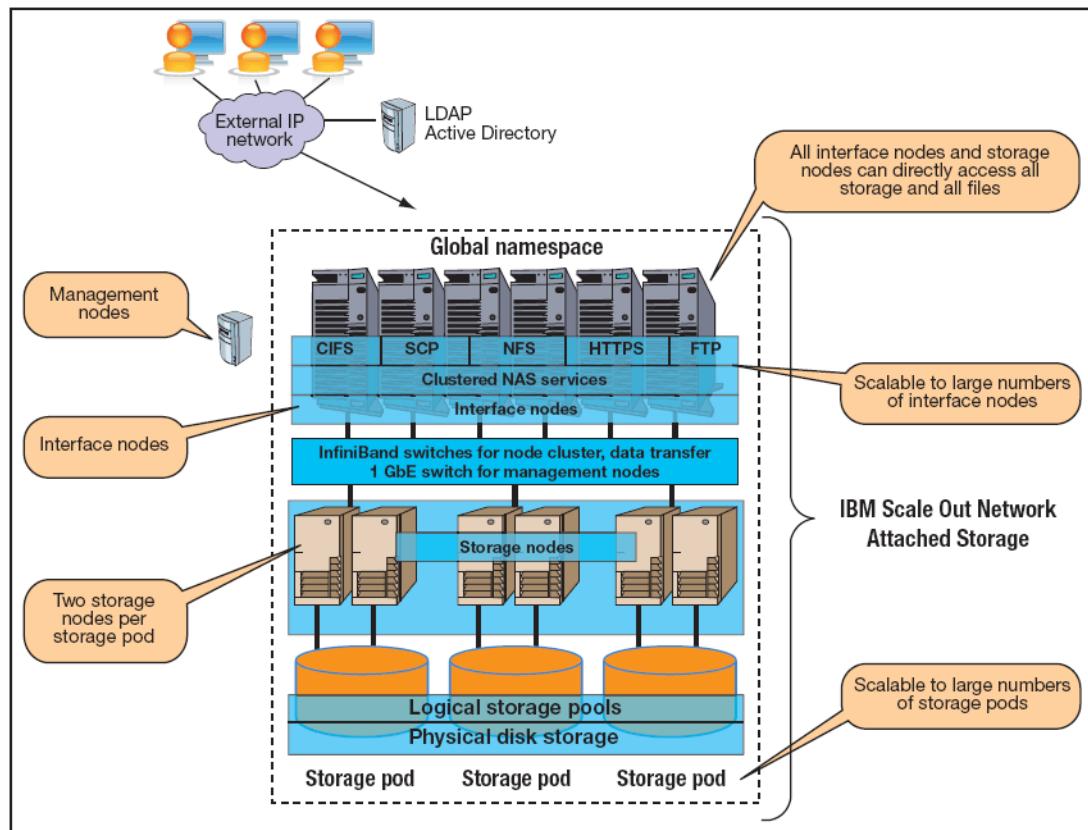


Figure 4-4 SONAS - Storage performance, scalability, and flexibility.

Organizations can take advantage of numerous flexible, modular hardware configuration possibilities. The initial versions of SONAS will support any combination of up to 30 interface nodes and 30 storage pods, flexibly configured to suit your requirements. Storage pods range from 4 to 16 U in size. Each pod can provide reliable storage from 27 to 480 terabytes of data. Storage pods and interface nodes can be combined into one globally clustered scale out NAS system, storing up to 14.4 petabytes of data. This provides extreme flexibility in configuring, adding and subtracting interface nodes and storage nodes in any way your workload requires.

For example, a system for archival might be configured with 2 interface nodes and 20 storage pods, whereas a system for email might be configured with 20 interface nodes and 2 storage

pods. SONAS provides extreme high density storage, and exploits leading-edge technology such as InfiniBand.

### Driving a dynamic infrastructure

SONAS supports the most dynamic infrastructures, including remote office and disaster recovery infrastructures (Figure 4-5). Organizations in every industry can gain significant competitive advantages by implementing dynamic infrastructures that enable them to improve service, reduce cost and manage risk. IBM Scale Out Network Attached Storage (SONAS) is designed to serve as a highly dynamic, flexible, elastic storage element of your infrastructure, driving greater levels of responsiveness through consolidation, resiliency, and scalability.

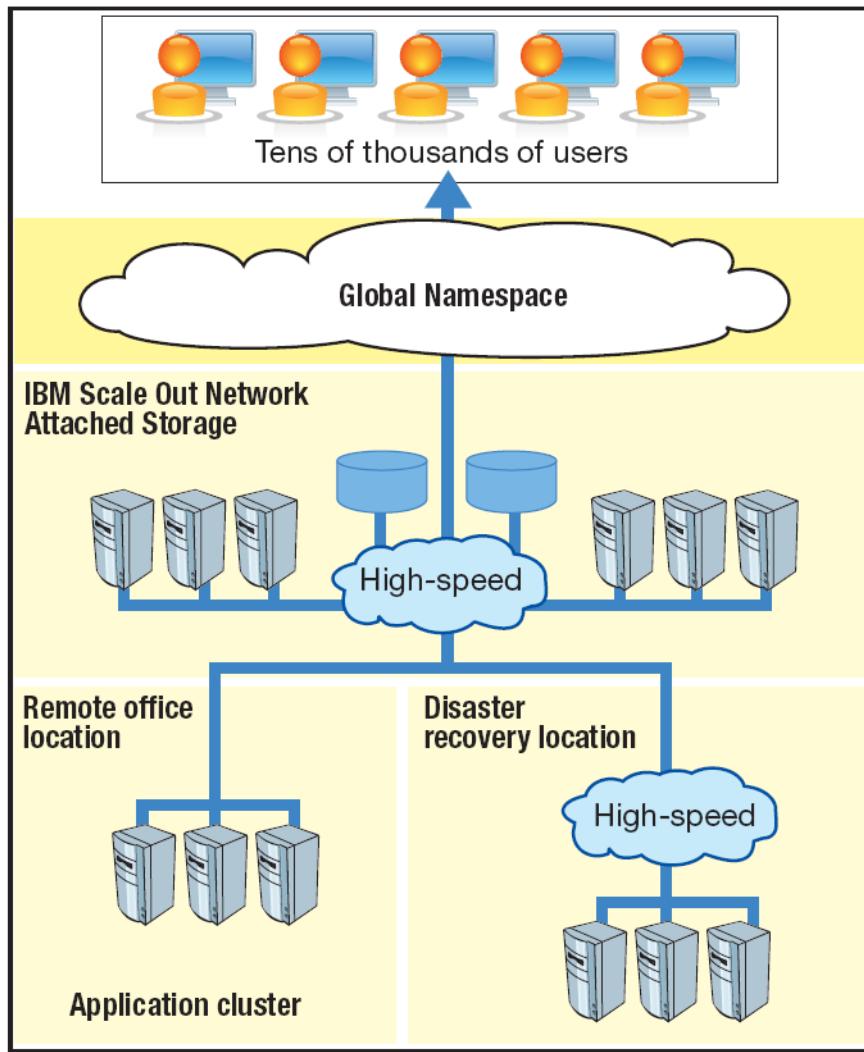


Figure 4-5 SONAS - Dynamic Infrastructure

## 4.4 Components within a SONAS solution

The main components of the SONAS system are the Interface node (2851-SI1), Management node (2851-SM1), Storage node (2851-SS1), Storage controller (2851-DR1), and Disk Storage expansion Unit (2851-DE1). These components are assembled into one of three rack configurations with Ethernet and InfiniBand (IB) switches.

The minimum SONAS system configuration consists of:

- ▶ Two Interface nodes
- ▶ Two 36-port 4X DDR InfiniBand switches
- ▶ One Management node
- ▶ Two Storage nodes with one Storage controller

The maximum size of a SONAS system, in terms of Interface nodes and Storage pods, depends on whether the 36-port or 96-port InfiniBand switch is selected. Each of the following major components requires one IB port on each IB switch:

- ▶ Management node
- ▶ Interface node
- ▶ Storage node

Three InfiniBand ports of each IB switch are reserved for the following components:

- ▶ Two reserved for future use.
- ▶ One for the required Management node.
- ▶ The remaining IB ports are available for Interface nodes and Storage nodes.

#### 4.4.1 Interface node

The Interface node provides the connections to your IP network for attaching to the SONAS system for network file serving capabilities (CIFS, NFS, FTP). A SONAS system contains a minimum of two Interface nodes and a maximum of 30.

The Interface node (2851-SI1) is a 2U server containing the following:

- ▶ Two Intel Xeon® E5530 (Nehalem EP) quad-core processors
- ▶ 32 GB of DDR3 memory standard, with a feature to add an additional 32 GB of memory
- ▶ Four onboard 10/100/1000 Ethernet ports (two available for client use)
- ▶ Two 300 GB 2.5-inch SFF 10K RPM SAS Slim-HS hard disk drives with mirroring between the two HDDs
- ▶ Four PCIe Gen 2.0 x8 adapter slots (two available for client use)
- ▶ Integrated Baseboard Management controller (IBMC)
- ▶ Two redundant hot-swappable power supplies
- ▶ Six redundant hot-swappable cooling fans

The Interface node contains two redundant hot-swappable 300 GB 2.5-inch 10K RPM SAS HDDs with mirroring between them for high availability. The HDDs contain the SONAS System Software product, which hosts the operating system and all other software needed for an operational SONAS system.

Two of the PCIe adapter slots are already populated with two single-port 4X Double Data Rate (DDR) InfiniBand Host Channel Adapters (HCA). The two HCAs attach to two independent InfiniBand switches in the SONAS system and interconnect the Interface nodes to the Management node(s) and the Storage nodes.

Two of the PCIe adapter slots are available for customer use to add more adapters for host IP interface connectivity.

Each Interface node comes standard with two 10/100/1000 Ethernet ports available to connect to your IP network. Additional Ethernet connectivity may be achieved by adding one of the following features:

- ▶ 1100 (Quad-port 1GbE NIC)
- ▶ 1101 (Dual-port 10 Gb Converged Network Adapter)

Each Interface node is connected to the two InfiniBand switches by one InfiniBand cable to each switch, a total of two cables. The InfiniBand Host Channel Adapters (HCA) in the Interface nodes have an X4 port. The 36-port InfiniBand switches have QSFP connectors and the 96-port IB switches have X4 connects.

For an Interface node (2851-SI1) in the base rack (2851-RXA) no InfiniBand cables need to be ordered. Copper InfiniBand cables are automatically provided for all Interface nodes in the base rack. The length of the copper InfiniBand cables provided is based on the position of the Interface node in the rack.

#### 4.4.2 Management node

The Management node provides the user interface for configuring, administering, and monitoring the SONAS system. A single Management node is required. The Management node contains two redundant hot-swappable 300 GB 2.5-inch 10K RPM SAS HDDs with mirroring between them for high-availability. The hard disk drives contain the SONAS System Software product, which hosts the operating system and all other software needed for an operational SONAS system.

The Management node (2851-SM1) is a 2U server containing the following:

- ▶ Two Intel Xeon E5530 (Nehalem EP) quad-core processors
- ▶ 32 GB of DDR3 memory
- ▶ Four onboard 10/100/1000 Ethernet ports (two for connecting to customer network for management access)
- ▶ Two 300 GB 2.5-inch SFF 10K RPM SAS Slim-HS hard disk drives with mirroring between the two HDDs
- ▶ One non-mirrored 300 GB 2.5-inch SFF 10K RPM SAS Slim-HS hard disk drive for centralized log/trace file collection
- ▶ Four PCIe Gen 2.0 x8 adapter slots
- ▶ Integrated Baseboard Management Controller (IBMC)
- ▶ Two redundant hot-swappable power supplies
- ▶ Six redundant hot-swappable cooling fans

Two of the PCIe x8 adapter slots are already populated with two single-port 4X Double Data Rate (DDR) InfiniBand Host Channel Adapters (HCA). The two HCAs attach to two independent InfiniBand switches in the SONAS system and interconnect the Management node to the other components of the SONAS system.

The Management node comes with two InfiniBand copper cables to connect it to the two InfiniBand switches in the base rack. Both the primary Management node and the optional redundant Management node are assumed to be in the SONAS base rack with the two InfiniBand switches.

#### 4.4.3 Storage node

The Storage node provides the InfiniBand connection to the InfiniBand cluster interconnect and direct fibre-channel attachment to the SONAS Storage controller. Storage nodes must be configured in high-availability (HA) pairs. The two Storage nodes in the HA pair are connected to one or two SONAS Storage controllers.

The Storage node (2851-SS1) is a 2U server containing the following:

- ▶ Two Intel Xeon E5530 (Nehalem EP) quad-core processors
- ▶ 8 GB of DDR3 memory
- ▶ Four onboard 10/100/1000 Ethernet ports

- ▶ Two 300 GB 2.5-inch SFF 10K RPM SAS Slim-HS hard disk drives with mirroring between the two HDDs
- ▶ Four PCIe Gen 2.0 x8 adapter slots
- ▶ Integrated Baseboard Management Controller (IBMC)
- ▶ Two redundant hot-swappable power supplies
- ▶ Six redundant hot-swappable cooling fans

Two of the onboard Ethernet ports connect the storage node to the internal private management network, and two for a NULL Ethernet connection to the DASD Disk Storage controller.

The Storage node contains two redundant hot-swappable 300 GB 2.5-inch 10K RPM SAS HDDs with mirroring between them for high-availability. The hard disk drives contain the SONAS System Software product which hosts the operating system and all other software needed for an operational SONAS system.

All of the PCIe x8 adapter slots in the storage node are already populated with adapters. Two of the PCIe adapter slots are populated with two single-port 4X DDR InfiniBand HCAs for attaching to the two InfiniBand switches in the SONAS system. The other two PCIe x8 adapter slots are populated with two dual-port 8 Gbps Fibre Channel Host Bus Adapters (HBAs) for attaching to the SONAS Storage controller.

The SONAS Storage controller (2851-DR1) is a high-performance 4U Storage controller containing:

- ▶ Dual redundant hot-swappable RAID controllers
- ▶ Dual redundant hot-swappable power supply and cooling modules
- ▶ Support for 60 3.5-inch SAS/SATA HDDs

Each RAID controller contains:

- ▶ 4 GB of cache
- ▶ Two 8 Gbps FC host ports
- ▶ One drive-side SAS expansion port

The Storage controller supports RAID 1, 5, and 6. One high-density disk Storage expansion unit may be attached to the Storage controller. The Storage controller comes with four FC optical cables for attaching it to the two Storage nodes.

All sixty hard disk drives in the Storage controller must be the same; therefore, a quantity of six of feature #1300, #1301, or #1310 must be ordered.

The following table shows the total raw storage capacity of the Storage controller when populated with the different hard disk drive features:

*Table 4-1 Raw storage capacity of the storage controller*

Quantity	Feature	Description	Total raw storage capacity
6	1300	10-pack of 7.2K RPM 1 TB SATA	60 TB
6	1301	10-pack of 7.2K RPM 2 TB SATA	120 TB
6	1310	10-pack of 15K RPM 450 GB SAS	27 TB

Features #9011, #9012, #9013, and #9014 are plant-only features and are used to indicate into which Storage controller location (1-4) this particular Storage controller is to be placed during manufacturing. The rack must be populated from the bottom of the rack (EIA position 1) to the top of the rack (EIA position 42) for stability reasons. Therefore, the following rules apply to the placement of Storage controllers within the rack:

- ▶ You may not have a Storage controller in location #4 (EIA positions 29-32) unless you have a Storage controller in location #3 (EIA positions 21-24).
- ▶ You may not have a Storage controller in location #3 (EIA positions 21-24) unless you have a Storage controller in location #2 (EIA positions 9-12).
- ▶ You may not have a Storage controller in location #2 (EIA positions 9-12) unless you have a Storage controller in location #1 (EIA positions 1-4).

Additionally, features #9013 and #9014 are not valid when plant-merging the storage controller into the Base Rack (2851-RXA), since the Base Rack only holds two Storage controllers.

The SONAS disk Storage expansion unit (2851-DE1) is a 4U high-density disk enclosure supporting 60 3.5 inch SATA or SAS hard disk drives. One disk Storage expansion unit may be attached to a single SONAS Storage controller. Each disk Storage expansion unit contains the following:

- ▶ Two SAS switch modules which provide SAS connections to the storage controller
- ▶ Two redundant hot-swappable power supply and cooling units
- ▶ Support for 60 3.5-inch SAS or SATA HDDs

The disk Storage expansion unit must be physically located in the same rack and in adjacent EIA positions as the SONAS Storage controller to which it is attaching.

All 60 hard disk drives in the disk Storage expansion unit must be the same; therefore, a quantity of six of feature #1300, #1301, or #1310 must be ordered.

Table 4-2 shows the total raw storage capacity of the disk Storage expansion unit when populated with the different types of hard disk drive features.

*Table 4-2 Raw storage capacity of the disk Storage expansion unit*

Quantity	Feature	Description	Total raw storage capacity
6	1300	10-pack of 7.2K RPM 1 TB SATA	60 TB
6	1301	10-pack of 7.2K RPM 2 TB SATA	120 TB
6	1310	10-pack of 15K RPM 450 GB SAS	27 TB

Features #9021, #9022, #9023, and #9024 are plant-only features and are used to indicate into which disk Storage expansion unit location (1-4) this particular disk Storage expansion unit is to be placed during manufacturing. A disk Storage expansion unit must be attached to a Storage controller. The Storage controller attached to a disk Storage expansion unit should be in the EIA position immediately adjacent and below the disk Storage expansion unit.

Therefore, the following rules apply to the placement of Storage controllers within the rack:

- ▶ You may not have a disk Storage expansion unit in disk Storage expansion unit location #1 (EIA positions 5-8) unless you have a Storage controller in Storage controller location #1 (EIA positions 1-4).
- ▶ You may not have a disk Storage expansion unit in disk Storage expansion unit location #2 (EIA positions 13-16) unless you have a Storage controller in Storage controller location #2 (EIA positions 9-12)
- ▶ You may not have a disk Storage expansion unit in disk Storage expansion unit location #3 (EIA positions 25-28) unless you have a Storage controller in storage controller location #3 (EIA positions 21-24)
- ▶ You may not have a disk Storage expansion unit in disk Storage expansion unit location #4 (EIA positions 33-36) unless you have a Storage controller in Storage controller location #4 (EIA positions 29-32)

Additionally, features #9023 and #9024 are not valid when plant-merging the Storage controller into the Base Rack (2851-RXA), since the Base Rack only holds two disk Storage expansion units.

#### 4.4.4 Infiniband switches

The major components of a SONAS system (Interface node, Storage node, and Management node) are interconnected by a high-performance low-latency InfiniBand 4X Double Data Rate (DDR) fabric. Two redundant InfiniBand switches are incorporated inside each SONAS system.

For small and medium configuration, a 1U 36-port 4X DDR InfiniBand switch is available. For larger configurations, a 7U 96-port 4X DDR InfiniBand switch is available. Two identical IB switches must be ordered for a SONAS system, either two 36-port IB switches or two 96-port IB switches. These IB switches are described in the following sections.

##### 36-port IB switch

The SONAS 36-port IB switch (2851-I36) is a 4X DDR InfiniBand switch providing 36 QSFP ports, with each port operating at 20 Gbps. This IB switch provides a maximum backplane bandwidth of 1.44 Tbps and contains an embedded IB fabric manager. The switch provides two redundant hot-swap power supplies.

##### 96-port IB switch

The 96-port IB switch (2851-I96) provides a 96-port 4X DDR InfiniBand switch with up to 96 4X DDR X4 switch ports. The 96-port IB switch is intended for large SONAS system configurations. The IB switch provides a maximum backplane bandwidth of 3.84 Tbps. The 96-port IB switch comes standard with the following:

- ▶ Two 96-port InfiniBand Switch Fabric boards
- ▶ One 24-port 4X DDR Line Board
- ▶ One Hi-Memory Management board containing an embedded IB fabric manager
- ▶ Two Power Supply Units (PSUs)
- ▶ All fan assemblies

The 96-port switch comes standard with one 24-port 4X DDR line board providing 24 4X DDR (20 Gbps) IB ports. Up to three additional SLB-2024 24-port 4X DDR line boards may be added for a total of 96 ports.

The 96-port IB switch comes standard with two SLB-2004 Switch Fabric boards. Up to two additional SLB-2004 Switch Fabric boards may be added to provide additional backplane bandwidth.

The 96-port IB switch comes standard with two power supplies. Up to two additional PSUs may be added for redundancy. The two standard power supplies are capable of powering a fully configured 96-port IB switch with:

- ▶ Four SFV-2004 Switch Fabric boards
- ▶ Four SLB-2024 24-port 4X DDR line boards
- ▶ Two SMB-HM Hi-Memory Management boards

The following options may be added to the 96-port InfiniBand switch:

- ▶ FC 1500 96-port InfiniBand Switch Fabric board
- ▶ FC 1501 24-port 4X DDR InfiniBand Line Board
- ▶ FC 1502 Hi-Memory Management Board
- ▶ FC 1503 Power Supply

## 4.5 Summary of features and benefits

Here is a summary of the features and benefits of SONAS.

### **Massive scalability**

Supports multiple petabytes of storage for organizations that need billions of files in a single file system. Supports the ability to rapidly add massive amounts of storage capacity. Supports up to 256 file systems per system.

### **Flexibility**

- ▶ Access to your data in a single global namespace allowing all users a single, logical view of files through a single drive letter such as a Z drive.
- ▶ Tiered storage for highly available primary data and secondary storage for less accessed data.
- ▶ Industry standard protocols: CIFS, NFS, and FTP.

### **Consolidation**

Your organization can consolidate and manage data to avoid problems associated with administering an array of disparate storage systems. It is highly scalable, helps conserve floor space, and can help reduce your capital expenditure and enhance your operational efficiency. Its advanced architecture virtualizes and consolidates your file space into a single, enterprise-wide file system, which can translate into reduced total cost of ownership.

### **GPFS**

GPFS integrates into organizational environments by bringing together mixed server and storage components to provide a common view to enterprise file data. It also provides online storage management, scalable access, and information life cycle tools to manage large volumes of data.

### **Data protection**

- ▶ Snapshots, up to 256 per file system
- ▶ Supports RAID 5, 6

## **Cloud Storage**

- ▶ In a cloud environment, applications and services are not tethered to specific hardware components. Instead, processing is handled across a distributed, globally accessible network of resources, which are dispensed on demand.
- ▶ Self-managing, autonomic system that enables capacity, provisioning, and other IT service management decisions to be made dynamically, without human intervention or increased administrative costs.
- ▶ Seamless elasticity to scale computing resources up or down, as required, to fulfil changing organizational needs without service interruption.
- ▶ Highly resilient and secure applications, and an underlying infrastructure capable of meeting expected levels of availability, reliability, and integrity.
- ▶ A highly standardized environment that facilitates simultaneous service deployment and upgrades for all users, no matter where they reside.
- ▶ Lowers the cost of service access via economies of scale.
- ▶ Clouds can provide rapid access to computing capacity at a lower cost of ownership, enabling companies to perform operations that may have previously been unaffordable or impractical.

## **Interface**

Supports both command line interface (CLI) and browser-based graphical user interface (GUI).

## **Advanced features**

Integrated Tivoli Storage Manager (TSM) backup and archive client.

## **Drive support**

Supports both SAS and SATA drives.

## **4.6 More information**

Further information about SONAS can be found here:

- ▶ <http://www-03.ibm.com/systems/storage/network/sonas/index.html>
- ▶ <http://publib.boulder.ibm.com/infocenter/sonasic/sonaslic/index.jsp>



# Storage Area Networking

Companies are searching for more efficient ways to manage ever-expanding volumes of data and to make that data accessible throughout the enterprise. This is propelling the move of storage into the network. The Storage Area Network (SAN) infrastructure offers simplified storage management, scalability, flexibility, availability, and improved data access, movement, and backup. Also, the products for the data center make SAN networking easy because they include converged switches, Ethernet switches and routers, which make SAN infrastructure more reliable and easy to manage in a data center.

In this chapter, we introduce the IBM Dynamic Infrastructure Networking portfolio and the SAN Fabric switches portfolio.

## 5.1 Overview

IBM products and solutions provide integrated SMB and enterprise SAN solutions with multiprotocol local, campus, metropolitan, and global storage networking with high performance networks to deliver reliable services.

IBM portfolio for Data Center Networking and Storage Area Networking provides a wide array of products to choose, from entry-level products to enterprise-level products.

In the coming sections we talk about the following solutions for the IBM Information Infrastructure:

- ▶ SAN Fabric solutions
- ▶ Data Center Networking solutions

## 5.2 SAN fabric solutions

IBM System Storage SAN switch products provide a broad range of storage networking options designed with a common architecture and integrated enterprise SAN management capabilities, and supported by the broadest range of IBM open server and storage devices. The interconnection of IBM and compatible switches can support the creation of scalable, dual redundant core-to-edge SAN fabrics that can support high performance, scalability, and fault tolerance required by e-business applications and enterprise storage management applications.

Table 5-1 shows the different models of the SAN switches categorized into entry level, mid-range, enterprise level, and multiprotocol routers.

*Table 5-1 SAN switches and routers*

Entry Level San Switch	Mid Range San Switch	Enterprise Level San Switches	Multiprotocol Router
IBM System Storage SAN24B-4 Express	IBM System Storage SAN80B-4	IBM System Storage SAN768B	IBM System Storage SAN04B-R
Cisco MDS 9124 Express for IBM System Storage	IBM System Storage SAN40B-4	IBM TotalStorage SAN384B	Cisco MDS 9222i for IBM System Storage
	Cisco MDS 9134 for IBM System Storage	IBM TotalStorage SAN256B	
		Cisco MDS 9513 for IBM System Storage	
		Cisco MDS 9506 for IBM System Storage	
		Cisco MDS 9509 for IBM System Storage	

### 5.2.1 IBM System Storage SAN24B-4 switch

The SAN24B-4 is a high performance scalable switch that provides 24 fabrics with the “Ports on Demand” feature, so you can scale your network as you grow. You can get the switch with an 8-port licence and then upgrade it conveniently up to 24 by just enabling the licence. With

auto-sensing link speeds at 1, 2, 4, and 8 Gbps and a flexible design to configure this switch as a fabric switch or an access gateway, it is suitable for small to mid-sized businesses.

A single SAN24B-4 Express switch can serve as the cornerstone of a Storage Area Network for those who want to obtain the benefits of storage consolidation and are just beginning to implement Fibre Channel storage systems. Such an entry-level configuration can consist of one or two Fibre Channel links to a disk storage array or to an LTO tape drive. An entry-level 8-port storage consolidation solution can support up to seven servers with a single path to either disk or tape. The “Ports on Demand” feature is designed to enable a base switch to grow to 16 or 24 ports to support more servers and more storage devices without taking the switch offline. Figure 16-1 shows the SAN24B-4 fabric switch.



Figure 5-1 IBM System Storage SAN24B-4 Express

### **Highlights**

- ▶ Foundation for new infrastructure simplification and business continuity solutions for servers running Microsoft Windows, UNIX, Linux, and IBM AIX and OS/400® operating systems
- ▶ Ports on Demand scalability from 8 to 16 to 24 ports
- ▶ Provides new levels of performance with 8 Gbps Fibre Channel (FC) technology

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san24b-4/express/index.html>

### **5.2.2 Cisco MDS 9124 Express for IBM System Storage**

This switch provides 24 auto-sensing Fibre Channel ports capable of speeds of 4, 2, and 1 Gbps in a compact 1RU form-factor chassis, and is designed to meet the performance and scalability requirements of the most demanding environments. The base MDS 9124 comes with eight ports activated, two redundant hot-swappable power supplies, and eight shortwave SFPs. Enhanced flexibility of MDS 9124 is provided by the 9124 8-port activation license. Using this functionality, customers can start with a base configuration of eight ports and upgrade to 16 and 24 ports. Figure 5-2 on page 96 shows the MDS 9124 Multilayer Fabric Switch.

Higher availability solutions can be created using multiple Cisco MDS 9124 switches. Such implementations would be well-suited to server clustering environments. Such a configuration could support from six to 22 servers, each with dual Fibre Channel adapters cross-connected to redundant 9124 switches, which are cross-connected to a dual-controller storage system.



Figure 5-2 MDS 9124 Express for IBM Storage

### Highlights

- ▶ Foundation for new infrastructure simplification and business continuity solutions for servers running Microsoft Windows, UNIX, Linux, NetWare, and IBM OS/400 operating systems.
- ▶ Designed for high availability with hot-swappable, dual power supplies and non-disruptive firmware upgrades.
- ▶ Cisco MDS 9000 family compatibility supports scalability and consistent service as the SAN grows.
- ▶ Enterprise Package and Fabric Manager Server Package provide added intelligence and value.

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/ctype/9124/index.html>

### 5.2.3 IBM System Storage SAN40B-4

The IBM System Storage SAN40B-4 SAN fabric switch (Figure 5-3 on page 97) provides 24, 32, or 40 active ports and is designed for high performance with 8 Gbps link speeds and backward compatibility to support links running at 4, 2, and 1 Gbps link speeds. High availability features make it suitable for use as a core switch in midrange environments or as an edge switch in enterprise environments where a wide range of SAN infrastructure simplification and business continuity configurations are possible. IBM POWER® Systems, System x, System z, and many non-IBM disk and tape devices are supported in many common operating system environments. Optional features provide specialized distance extension, dynamic routing between separate or heterogeneous fabrics, link trunking, FICON, performance monitoring and advanced security capabilities.

Dynamic Path selection can be used for optimizing the performance and load balancing, and the switch can be managed using web tools. The built-in USB port can be used for firmware download, configuration upload and download, and supportsave, and the switch supports nondisruptive firmware downloads. New features in Fabric OS v6.2.0 make the switch virtual fabric capable. A single physical chassis can be subdivided into two or more logical switches creating a logical fabric with other switches.

### Highlights

- ▶ High port density design with up to 40 ports in an efficient, space saving 1U height
- ▶ Simple-to-use midrange and enterprise SAN fabric switch for IBM POWER Systems, System x, System z, and other server environments
- ▶ New levels of performance with 8 Gbps Fibre Channel (FC) technology

- ▶ Nondisruptive capacity activation from 24 to 32 to 40 ports with Ports on Demand scalability
- ▶ High availability with redundant, hot-swappable fans and power supplies and nondisruptive software upgrades



*Figure 5-3 IBM System Storage SAN40B-4*

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san40b-4/index.html>

#### 5.2.4 IBM System Storage SAN80B-4

The IBM System Storage SAN80B-4 SAN fabric switch (Figure 5-4 on page 98) provides 48, 64, or 80 active ports and is designed for high performance with 8 Gbps link speeds and backward compatibility to support links running at 4, 2, and 1 Gbps link speeds. High availability features make it suitable for use as a core switch in mid-range environments or as an edge switch in enterprise environments where a wide range of SAN infrastructure simplification and business continuity configurations are possible. IBM Power Systems™, System x, System z, and many non-IBM disk and tape devices are supported in many common operating system (OS) environments. Optional features provide specialized distance extension, dynamic routing between separate or heterogeneous fabrics, link trunking, Fibre Connection (FICON), performance monitoring, and advanced security capabilities.

The SAN80B-4 fabric switch (Figure 5-4 on page 98) requires Fabric OS v6.1.0 or later. Port hardware is based on the GoldenEye2 ASIC. Each ASIC can support 32 ports at 1, 2, 4, and 8 Gbps link speeds. The base model of the switch comes with 48 ports enabled, and the POD licenses are available in 16-port increments. New features in Fabric OS v6.2.0 make the switch virtual fabric capable. A single physical chassis can be subdivided into two or more logical switches creating a logical fabric with other switches. Integrated Routing is a licensed feature that is supported on every port of the switch and requires the POD license for all 80 ports. The ports on the switch are grouped in 8-port groups matching the trunk group, and with ISL Trunking speeds of up to 64 Gbps can be achieved per trunk. Dynamic Path selection can be used for optimizing the performance and load balancing, and the switch can be managed using web tools.

**Important:** The USB port supports only a 2-GB Brocade branded USB drive. The 4 and 8 Gbps link speeds are supported only with Brocade branded SFPs.

The built-in USB port can be used for firmware download, configuration upload and download, and supports save, and the switch supports non-disruptive firmware downloads. The switch has two hot-swappable, redundant 300W power supplies and three hot-swappable fan assemblies. Both the power supplies and the fan assemblies are field replaceable units, and they have a status LED on them.

## Highlights

- ▶ High port density design with up to 80 ports in an efficient, compact 2U height helps save rack space.
- ▶ Robust midrange and enterprise SAN fabric switch for IBM POWER Systems, System x, System z, and other server environments.
- ▶ Provides new levels of performance with 8 Gbps Fibre Channel (FC) technology.
- ▶ Ports on Demand scalability supports non-disruptive capacity activation from 48 to 64 to 80 ports.
- ▶ Designed to support high availability with redundant, hot-swappable fans and power supplies and non-disruptive software upgrades.



Figure 5-4 IBM System Storage SAN80B-4

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san80b-4/index.html>

### 5.2.5 Cisco MDS 9134 for IBM System Storage

A wide range of IBM System Storage medium-size and enterprise storage area network (SAN) IT simplification and business continuity solutions can be created with the Cisco MDS 9134 for IBM System Storage stackable fabric switch. Infrastructure simplification solutions for the IBM System i®, System p, System x and System z families of servers include storage consolidation and high-availability server clustering with IBM System Storage disk storage arrays. Business continuity solutions include data protection with IBM System Storage tape libraries and devices and IBM Tivoli Storage Manager data protection software; and disaster protection with IBM System Storage disk metro and global mirroring disaster recovery solutions.

The Cisco MDS 9134 for IBM System Storage is designed to address the needs of medium-sized businesses and large enterprises with a wide range of Storage Area Network (SAN) capabilities. It can be used as part of a high performance simple SAN with single-switch or stacked switch configurations for business-class customers in support of IT simplification and business continuity solutions. It can also be used as an edge switch for device aggregation with 10 Gbps core director configurations for large enterprise customers.

Fabric connectivity capabilities can be the basis for IT simplification solutions for IBM System i, System p, System x and System z servers and storage consolidation and high-availability server clustering with IBM System Storage disk storage arrays. Business continuity capabilities can help businesses protect valuable data with IBM System Storage tape libraries and IBM Tivoli Storage Manager data protection software. Advanced connectivity capabilities can help businesses protect against major disasters with IBM System Storage disk metro and global mirroring disaster recovery solutions.

## Highlights

- ▶ Simple-to-use 4 and 10 Gigabit per second performance for simplification and business continuity solutions with Windows, UNIX, Linux, NetWare, IBM OS/400 and IBM z/OS servers.
- ▶ Cost-effective “green” switch requires up to 50 percent less power per port.
- ▶ Stackable design provides pay-as-you-grow scalability and flexibility with On-Demand port activation features.
- ▶ Designed to support high availability with redundant, hot swappable power supplies and fans and non-disruptive firmware upgrades.
- ▶ Includes Virtual SAN (VSAN) capability for SAN consolidation into virtual SAN islands on a single physical fabric.
- ▶ Enterprise, Mainframe and Fabric Manager Server Packages provide added intelligence and value.

**Note:** The MDS 9134 Multilayer Switch supports N-Port identifier virtualization (NPV) to reduce the number of Fibre Channel domain IDs in SANs.

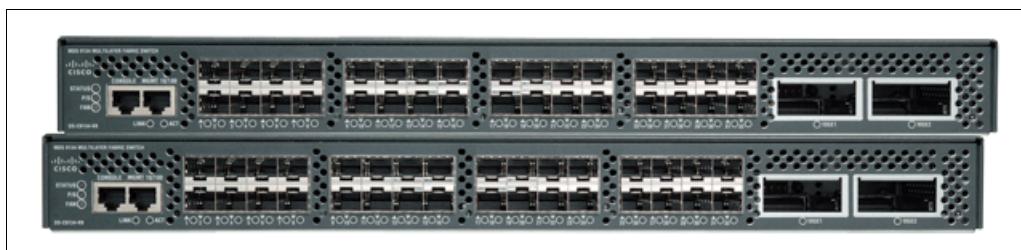


Figure 5-5 Cisco MDS 9134 for IBM System Storage (Stacked)

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/ctype/9134/index.html>

## 5.2.6 IBM TotalStorage SAN256B

The IBM TotalStorage SAN256B (Figure 5-6 on page 100) is designed to provide outstanding performance, enhanced scalability and a design ready for high-performance 4 Gbps, 8 Gbps, and 10 Gbps capable hardware and expanded capability features. The SAN256B is well suited to address enterprise SAN customer requirements for infrastructure simplification and improved business continuity.

The SAN256B director interoperates with other members of the IBM TotalStorage SAN b-type and m-type families. It can be configured with a wide range of highly scalable solutions that address demands for integrated IBM System z and open system server enterprise SANs.

## Highlights

- ▶ High availability with built-in redundancy designed to avoid single points of failure.
- ▶ Highly scalable director with 16, 32, or 48 Fibre Channel (FC) ports per port switch blade and from 16 to 384 ports in a single domain.
- ▶ Multiprotocol router blade with sixteen FC ports and two Internet Protocol (IP) ports for SAN routing and distance extension over IP.

- ▶ iSCSI blade enables servers to access storage over IP (Ethernet).
- ▶ 10 Gbps Fibre Channel blade provides extended distance ISL connectivity between directors over dark fibre or DWDM.
- ▶ Fibre Channel switch blades support either 4, 2, and 1 Gbps link speeds or 8, 4, and 2 Gbps link speeds.
- ▶ Sixteen and 32 port switch blades support IBM FICON.
- ▶ Interoperable with other IBM TotalStorage SAN b-type and m-type switches and directors.
- ▶ Advanced security with comprehensive policy-based security capabilities.
- ▶ Advanced fabric services such as end-to-end performance monitoring and fabric-wide health monitoring.



*Figure 5-6 IBM TotalStorage SAN256B*

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san256b/index.html>

### 5.2.7 IBM System Storage SAN384B

The IBM System Storage SAN384B fabric backbone (Figure 5-7 on page 101) is designed to be the premier platform for consolidation of your data center connectivity, providing high-performance and highly available data networking. Providing new levels of performance with industry-leading 8 Gbps Fibre Channel (FC) technology, it is also one of the first members of the IBM System Storage b-type SAN family designed to exploit Brocade's new Data Center Fabric architecture.

The SAN384B inter-operates with other members of the IBM System Storage b-type SAN family as well as other fabrics.

- ▶ It can be configured with a wide range of connectivity options, including 10, 8, 4, 2 and 1 gigabits per second (Gbps) Fibre Channel, up to 4 Gbps Fibre Connectivity (FICON), and Fibre Channel over Internet Protocol (FCIP) over 1 gigabit per second Ethernet (GbE).
- ▶ It is also designed to enable support for emerging high-performance and high-function network protocols, including Fibre Channel over Converged Enhanced Ethernet (FCoCEE).

- The SAN384B is designed to serve as the basis for transforming existing networks into a unified, high-performance data center fabric, connecting applications with their data and virtual servers with virtual storage.

As a member of the IBM System Storage family of b-type SAN products, the SAN384B is designed to participate in fabrics containing other b-type SAN devices manufactured by Brocade. This versatile hardware can serve as a new top tier (or backbone) in a complex fabric and provide connections to other b-type SAN directors, switches and routers.

## Highlights

- Drive new levels of performance with 8 Gbps Fibre Channel (FC) technology in a compact design.
- Reduce total cost of ownership (TCO) through consolidation of network resources.
- Protect existing infrastructure investment while positioning for future technologies; manage your infrastructure with greater flexibility and scalability.
- Unify the management framework for consolidated and virtualized resources.
- Improve energy efficiency by combining higher band-width with reduced power consumption.



Figure 5-7 IBM TotalStorage SAN384B

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san384b/index.html>

### 5.2.8 IBM System Storage SAN768B

The IBM System Storage SAN768B fabric backbone (Figure 5-8 on page 102) is designed to be the premier platform for consolidation of your data center connectivity, providing high-performance and highly available data networking. Providing new levels of performance with industry-leading 8 Gbps Fibre Channel (FC) technology, it is also the first member of the IBM System Storage b-type family designed to exploit Brocade's new Data Center Fabric architecture.

The SAN768B interoperates with other members of the IBM System Storage b-type and m-type families as well as other fabrics.

- It can be configured with a wide range of connectivity options, including 10, 8, 4, 2 and 1 gigabits per second (Gbps) Fibre Channel, up to 4 Gbps Fibre Connections (FICON), and Fibre Channel over Internet Protocol (FCIP) over 1 Gbps Ethernet (GbE).

- ▶ It is also designed to enable support for emerging high-performance and high-function network protocols, including Fibre Channel over Converged Enhanced Ethernet (FCoCEE).
- ▶ The SAN768B is designed to serve as the basis for transforming existing networks into a unified, high-performance data center fabric, connecting applications with their data and virtual servers with virtual storage.

As a member of the IBM System Storage family of b-type products, the SAN768B is designed to participate in fabrics containing other b-type and m-type devices manufactured by Brocade. This versatile hardware can serve as a new top tier (or backbone) in a complex fabric and provide connections to other b-type and m-type directors, switches and routers

### **Highlights**

- ▶ Drive new levels of performance with 8 Gbps Fibre Channel (FC) technology.
- ▶ Reduce total cost of ownership (TCO) through consolidation of network resources.
- ▶ Protect existing infrastructure investment while positioning for future technologies.
- ▶ Manage your infrastructure with greater flexibility and scalability.
- ▶ Unify management framework for consolidated and virtualized resources.
- ▶ Improve energy efficiency by combining higher band-width with reduced power consumption.



*Figure 5-8 IBM TotalStorage SAN768B*

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san768b/>

### **5.2.9 Cisco MDS 9506 for IBM System Storage**

The Cisco MDS 9506 for IBM System Storage (Figure 5-9) supports 1, 2, 4, 8, and 10 Gbps Fibre Channel switch connectivity and intelligent network services to help improve the

security, performance, and manageability required to consolidate geographically dispersed storage devices into a large enterprise SAN.

The Cisco MDS 9506 for IBM System Storage utilizes two Supervisor-2 Modules designed for high availability and performance. The Supervisor-2 Module combines an intelligent control module and a high-performance crossbar switch fabric in a single unit. It uses Fabric Shortest Path First (FSPF) multipath routing, which provides intelligence to load balance across a maximum of 16 equal-cost paths and to dynamically reroute traffic if a switch fails.

Each Supervisor-2 Module provides the necessary crossbar bandwidth to deliver full system performance in the Cisco MDS 9506 director with up to four Fibre Channel switching modules. It is designed to eliminate the impact on system performance of the loss or removal of a single crossbar module.

## Highlights

- ▶ Provides Fibre Channel throughput of up to 4 Gbps per port and up to 64 Gbps with each PortChannel Inter-Switch Link connection.
- ▶ Offers scalability from 12 to 192 Fibre Channel ports.
- ▶ Offers 10 Gbps ISL ports for inter-Data Center links over metro optical networks.
- ▶ Offers Gigabit Ethernet IP, GbE ports for iSCSI or FCIP connectivity over global networks.
- ▶ High-availability design with support for non-disruptive firmware upgrades.
- ▶ Includes Virtual SAN (VSAN) capability for SAN consolidation into virtual SAN islands on a single physical fabric.
- ▶ Enterprise, SAN Extension over IP, Mainframe and Storage Services Enabler and Fabric Manager Server Packages provide added intelligence and value.



Figure 5-9 Cisco MDS 9506 for IBM System Storage

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/ctype/9506/index.html>

## 5.2.10 Cisco MDS 9509 for IBM System Storage

The Cisco MDS 9509 for IBM System Storage (Figure 5-10 on page 105) provides 1, 2, 4, 8, and 10 Gbps Fibre Channel switch connectivity and intelligent network services to help improve the security, performance, and manageability required to consolidate geographically dispersed storage devices into a large enterprise SAN.

The Cisco MDS 9509 for IBM System Storage utilizes two Supervisor-2 Modules to support high availability and performance. The Supervisor-2 Module combines an intelligent control module and a high-performance crossbar switch fabric in a single unit. It uses Fabric Shortest Path First (FSPF) multipath routing, which supports load balancing across a maximum of 16 equal-cost paths that dynamically reroute traffic if a switch fails.

### Highlights

- ▶ Provides Fibre Channel throughput of up to 8 gigabits per second (Gbps) per port and up to 64 Gbps with each PortChannel Inter-Switch Link connection.
- ▶ Offers scalability from 12 to 336 1, 2, 4, and 8-Gbps Fibre Channel ports
- ▶ Offers 10-Gbps ISL ports for inter-data center links over metro optical networks.
- ▶ Offers Gigabit Ethernet IP (GbE) ports for iSCSI or FCIP connectivity over global networks.
- ▶ High-availability design with support for non-disruptive firmware upgrades.
- ▶ Includes Virtual SAN (VSAN) capability for SAN consolidation into virtual SAN islands on a single physical fabric.
- ▶ Enterprise, SAN Extension over IP, Mainframe and Storage Services Enabler and Fabric Manager Server packages provide added function and value.



Figure 5-10 Cisco MDS 9509 for IBM System Storage

**Note:** For additional product details, go to:

<http://www.ibm.com/servers/storage/san/ctype/9509/index.html>

### 5.2.11 Cisco MDS 9513 for IBM System Storage

The Cisco MDS 9513 for IBM System Storage (Figure 5-11 on page 106) supports 1, 2, 4, 8, and 10 Gbps Fibre Channel switch connectivity and intelligent network services to help improve the security, performance, and manageability required to consolidate dispersed SAN islands into a large-enterprise SAN.

The Cisco MDS 9513 for IBM System Storage utilizes two Supervisor-2 modules to support high availability. The Supervisor-2 Module provides industry-leading scalability, intelligent SAN services, non-disruptive software upgrades, stateful process restart, and failover and redundant operation. Dual crossbar switching fabric modules provide a total internal switching bandwidth of 2.4 terabytes per second (Tbps) for interconnection of up to 11 Fibre Channel switching modules.

Fibre Channel switching modules improve performance, flexibility, and density. The Cisco MDS 9513 for IBM System Storage requires a minimum of one Fibre Channel switching module and allows a maximum of 11. These modules are available in 12-, 24- or 48-port 4 and 8 Gbps configurations, enabling the Cisco MDS 9513 to support 12 to 528 Fibre Channel

ports per chassis. Optionally, a 4-port 10-Gbps Fibre Channel module is available for high-performance Inter-Switch Link (ISL) connections over metro optical networks.

## Highlights

- ▶ Provides Fibre Channel throughput of up to 8 gigabits per second (Gbps) per port and up to 64 Gbps with each PortChannel Inter-Switch Link connection.
- ▶ Offers scalability from 12 to 528 1, 2, 4, and 8 Gbps Fibre Channel ports.
- ▶ Offers 10-Gbps ISL ports for inter-data center links over metro optical networks.
- ▶ Offers Gigabit Ethernet (GbE) IP ports for iSCSI or FCIP connectivity over global networks.
- ▶ Features high-availability design with support for non-disruptive firmware upgrades.
- ▶ Includes Virtual SAN (VSAN) capability for SAN consolidation into virtual SAN “islands” on a single physical fabric.
- ▶ Provides added function and value through Enterprise, SAN Extension over IP, Mainframe, Storage Services Enabler, and Fabric Manager Server packages.



Figure 5-11 Cisco MDS 9513 for IBM System Storage

**Note:** For additional product details, go to:<http://www.ibm.com/systems/storage/san/ctype/9513/index.html>

## 5.2.12 IBM System Storage SAN04B-R multiprotocol router

A wide range of IBM System Storage mid-range and enterprise Storage Area Network (SAN) infrastructure simplification and business continuity solutions can be created with the IBM System Storage SAN04B-R multiprotocol router. Infrastructure simplification solutions for the IBM Power Systems and System x families include disaster tolerance over metropolitan and global IP networks with IBM System Storage disk arrays, tape libraries, and IBM Tivoli Storage Manager data protection software. Separate SAN islands can also be consolidated using Fibre Channel routing. Support for System z servers is provided via the optional High-Performance Extension and FICON CUP Activation features.

Local site infrastructure simplification solutions may be extended to one or more remote sites for enhanced data protection and disaster tolerance. The IBM System Storage SAN04B-R multiprotocol router provides Fibre Channel over IP and FCIP Tunneling Service for distance extension, which can enable cost-effective and manageable metro and global business continuity solutions. This extended distance connectivity can help create consolidated remote tape vaulting data protection plus metro mirror and global mirror disk-based, disaster-tolerant solutions.

Since the introduction of Storage Area Networks, clients have built multiple SAN networks (or islands) for different applications, often with fabric switch components from different manufacturers. Some islands were built by different departments within a company, while other islands resulted from mergers, acquisitions, or reorganizations. Dissimilar SAN equipment with different capabilities or a desire to isolate important applications has constrained opportunities for enhanced infrastructure simplification and vital business continuity solutions.

The IBM System Storage SAN04B-R multiprotocol router can provide Fibre Channel FC-FC Routing Service, which allows the interconnection of multiple SAN islands without requiring that the separate fabrics be merged into a single large SAN. This capability can help create a tiered or extended enterprise SAN infrastructure without having to redesign or reconfigure the entire environment.

### Highlights

- ▶ Designed for high performance with 4 Gigabit per second (Gbps) Fibre Channel (FC) ports and hardware-assisted traffic processing for line-rate performance across Ethernet Internet Protocol (IP) ports.
- ▶ Utilizes existing Internet, IP-based Metropolitan Area Network (MAN) or Wide Area Network (WAN) infrastructures for metro and global SAN extension for business continuity solutions.
- ▶ Enables consolidation of Storage Area Network (SAN) islands for infrastructure simplification without compromising security.
- ▶ Hardware-based compression, large window sizes and selective acknowledgement of IP packets designed to optimize performance of SAN extension over IP networks.
- ▶ Eight virtual FCIP tunnels per IP port are enabled by the High-Performance Extension feature to help maximize scalability and utilization of MAN/WAN resources.
- ▶ Integrated IBM System Storage SAN b-type (Brocade) switch management helps simplify installation and administration and helps provide fabric investment protection.
- ▶ FICON Accelerator uses special emulation techniques to reduce or eliminate degradation for selected applications such as IBM z/OS Global Mirror (XRC) and tape pipelining.

Figure 5-12 shows the IBM System Storage SAN04B-R multiprotocol router.



Figure 5-12 IBM System Storage SAN04B-R multiprotocol router

**Note:** For additional product details, go to:

<http://www.ibm.com/systems/storage/san/b-type/san04b-r/index.html>

### 5.2.13 Cisco MDS 9222i for IBM System Storage

The Cisco MDS 9222i for IBM System Storage (Figure 5-13 on page 109) is designed to address the needs of medium-sized businesses and large enterprises with a wide range of Storage Area Network (SAN) capabilities. It can be used as a cost-effective high performance SAN extension over IP router switches for midrange SMB clients in support of IT simplification and business continuity solutions. It can also provide remote site device aggregation and SAN extension connectivity to large customer data center directors.

A wide range of IBM System Storage mid-range and enterprise Storage Area Network (SAN) IT simplification and business continuity solutions can be created with the Cisco MDS 9222i for IBM System Storage multiservice modular switch. IT simplification solutions for IBM Power Systems, System i, System p, System x, and System z servers include storage consolidation and high-availability server clustering with IBM System Storage disk storage arrays. Business continuity capabilities can help businesses protect valuable data with IBM System Storage tape libraries and IBM Tivoli Storage Manager data protection software. Advanced connectivity capabilities can help business protect against major disasters with IBM System Storage disk metro and global mirroring disaster recovery solutions.

#### Highlights

- ▶ Multiservice design for high performance business continuity solutions with Windows, UNIX, Linux, NetWare, IBM OS/400, and IBM z/OS servers.
- ▶ Cost-effective “green” switch design requires up to 27 percent less power per port.
- ▶ Modular design provides scalability and configuration flexibility.
- ▶ Excellent availability with redundant, hot-swappable components and nondisruptive firmware upgrades.
- ▶ Includes Virtual SAN (VSAN) capability for SAN consolidation into virtual SAN islands on a single physical fabric.
- ▶ Enterprise, Mainframe and Fabric Manager Server Packages provide added intelligence and value.



*Figure 5-13 Cisco MDS 9222i for IBM System Storage*

For additional product details, go to:

<http://www.ibm.com/systems/storage/san/ctype/9222/index.html>

## 5.3 Data center networking solutions

As you consolidate and virtualize your IT environment, capitalizing on the latest networking technologies and approaches can help you save money, improve service, and reduce the risk of security breaches. IBM Networking Strategy and Optimization Services: network infrastructure optimization for consolidation and virtualization provides services to plan and justify a networking infrastructure that supports and fully contributes to a dynamic, flexible IT environment.

Table 5-2 shows the different models of the Ethernet switches available from IBM.

*Table 5-2 IBM Ethernet Switches*

IBM b-type Ethernet switches and routers	IBM j-type Ethernet Switches and routers	Cisco Nexus 5000
IBM Converged Switch B32	IBM Ethernet Switch J08E/J16E	Cisco Nexus 5010/5020
IBM Ethernet Switch B24X	IBM Ethernet Switch J48E	
IBM r-series Ethernet switches	IBM Ethernet Router J02M/J06M/J011M	
IBM c-series Ethernet switches		
IBM g-series Ethernet switches		
IBM m-series Ethernet/IP routers		
IBM Ethernet Switch B08S and IBM Ethernet Switch B16S		

### 5.3.1 IBM Converged Switch B32

As organizations evolve towards a dynamic infrastructure, they need new ways to reduce the complexity of their environments. To address this challenge, IBM offers a versatile switch that supports both Fibre Channel (FC) and Ethernet LAN data in one fabric using FCoE to help data centers simplify their growing infrastructures. The IBM Converged Switch B32 (Figure 5-14 on page 110) is designed to provide outstanding performance with a reliable platform that helps reduce cabling complexity, equipment acquisition costs, and operational

costs associated with space, power consumption, and cooling. This multiprotocol top-of-rack switch features excellent space efficiency and low power consumption, leading the way toward a “greener” data center.



Figure 5-14 IBM Converged Switch B32

### Key features

- ▶ Designed for outstanding performance with eight Fibre Channel (FC) ports concurrently active at 8 Gbps and twenty-four CEE ports concurrently active at 10 Gbps link speeds.
- ▶ High density design with 32 ports in a 1 U enclosure.
- ▶ Exceptional “green” energy efficiency significantly reduces power consumption while generating less heat.
- ▶ Enterprise-class availability features such as hot-swappable, redundant and integrated fan and power supply assemblies.
- ▶ Streamlines management by utilizing IBM System Storage Data Center Fabric Manager (DCFM) and extensions for FCoE and CCE.
- ▶ CEE ports are capable of transporting both FC storage and Ethernet LAN traffic—eliminating the need for separate server SAN and LAN adapters and cables.
- ▶ Advanced ASIC technology provides FC port trunking and Ethernet link aggregation.
- ▶ Common Brocade Fabric OS supports the entire IBM System Storage SAN b-type family helps protect SAN infrastructure investments with backward compatibility

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/b32/index.html>

### 5.3.2 IBM Ethernet Switch B24X

The IBM Ethernet Switch B24X (Figure 5-15) is a compact, high-performance, highly-available, and high-density 10 Gigabit Ethernet (GbE) solution designed for mission critical data centers, large enterprises, and High-Performance Computer (HPC) requirements. With an ultra-low latency, cut-through, non-blocking architecture, full wire-speed throughput, this switch provides a cost-effective solution for server or compute-node connectivity.



Figure 5-15 IBM Ethernet Switch B24X

## **Key features**

- ▶ 24x ports of dual-speed 10/1 GbE SFP+ ports plus 4x 10/100/1000 MbE RJ45 ports.
- ▶ Capable of line speed, full-duplex throughput on all ports—488 Gbps total switch capacity and ultra-low latency (1.5 micro-seconds).
- ▶ 1 + 1 redundant, hot-swappable and load-sharing 300 W AC Power Supplies for high availability.
- ▶ Hot-swappable, resilient triple-fan assembly with automatic speed control for efficient front-to-back cooling—2+1 redundant fans in assembly.
- ▶ Variety of SFP+ transceivers available including 1 GbE and 10 GbE Short Reach and Long Reach and available low-power consuming (1.0 watts) SFP+ optics up to 300 meters.
- ▶ Supports low-cost, low-latency (0.25 micro-seconds), low-energy-consuming (0.1) direct attached SFP+ copper (Twinax) cabling up to 5 meters.
- ▶ A 1U, high-density top-of-rack data center switch for 10 GbE server access and aggregation with 24x 10 GbE/1 GbE dual-speed (SFP+) ports plus 4x 10/100/1000 MbE (RJ45) ports.
- ▶ Flexibility to mix 10 GbE and 1 GbE servers, protecting investments and streamlining migration to 10 GbE-capable server farms.

**Note:** For more information on specification, model no, product no, and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/x-series/index.html>

### **5.3.3 IBM r-series Ethernet switches**

IBM r-series Ethernet switches (Figure 5-16 on page 112) are available in four chassis models and allow network designers to standardize on a single product family for end-of-row, aggregation, and backbone switching. In addition to their data center and enterprise roles, the switches, with their high-density and compact design, are an ideal solution for High-Performance Computing (HPC) environments and Internet Exchanges and Internet Service Providers (IXPs and ISPs) where non-blocking, high-density Ethernet switches are needed.



Figure 5-16 IBM r Series Ethernet switches

### Key features

- ▶ 4, 8, 16, and 32-slot high-capacity modular switches for end-of-row, aggregation, and core switching in data centers, large enterprises, HPC, IXP, and ISP networks.
- ▶ Powerful suite of unicast and multicast IPv4 and IPv6 protocol support.
- ▶ Interchangeable half-height line modules reduce sparing costs, TCO, and provide cost-effective modular growth
- ▶ Highly-dense chassis design supports up to 512 10 GbE or 1,536 wire-speed 1 GbE ports in a single 32-slot chassis.
- ▶ Highly-available design features redundant and hot-pluggable hardware, hitless Layer 2 software upgrades, and graceful BGP and OSPF restart.
- ▶ Advanced non-blocking Clos fabric features adaptive self-routing with graceful system degradation in the event of two or more module failures.
- ▶ End-to-End QoS supported with hardware-based honoring and marking and congestion management.
- ▶ Scalable hardware-based IP routing to 512,000 IPv4 routes per line module.
- ▶ Highly available chassis design supports hot-swappable 1:1 management module redundancy, N+1 switch fabric module redundancy, M+N power module redundancy, and N+1 fan redundancy.
- ▶ Interface modules include 16-port 10 GbE (SFP+), 2-port and 4-port 10 GbE (XFP), 24-port 1 GbE (RJ45 and SFP), and 48-port 1 GbE (MRJ21) modules.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/r-series/specifications.html>

### 5.3.4 IBM c-series Ethernet switches

IBM C-Series Ethernet switches (Figure 5-17) are powerful enablers of advanced converged enterprise backbones. Featuring state-of-the-art Quality of Service and wire-speed unicast and multicast routing, they enable the efficient rollout of converged backbones, providing reliable transport of Voice over IP (VoIP), video services, and mission critical data. The platform's low latency, high-touch processing and deep buffering makes it an ideal fit for a data center top-of-the-rack server access switch.



*IBM c-series copper and fiber 24, 48 and 50 port Ethernet switches*

Figure 5-17 IBM C Series Ethernet switches

#### Key features

- ▶ Flexible model configurations include 24x ports of 1 GbE or 48x ports of 1 GbE with SFP and RJ-45 options and 2x 10 GbE XFP uplinks available.
- ▶ The system offers wire-speed, non-blocking performance in all configurations.
- ▶ Hot-swappable, resilient six-fan fan tray with sensors to automatically regulate speed.
- ▶ Comprehensive hardware-based security and policies including hardware-based Layer 3 and Layer 2 ACLs (both inbound and outbound) with logging.
- ▶ 64 MB of deep buffering for each 24-port 1 GbE group or 2-port 10 GbE group (64 MB to 192 MB total) excels at handling transient bursts in traffic.
- ▶ Advanced Carrier-Grade Ethernet services include platforms capable of MPLS (VPLS, VLL), Multi-VRF, MPLS VPNs, along with Provider Bridges, Provider Backbone Bridges.
- ▶ Comprehensive IPv4 unicast and multicast routing support based on the rich feature set of Brocade Multi-Service IronWare.
- ▶ Full Layer 2 switching capabilities facilitate network resiliency include STP/RSTP/MSTP, PVST/PVST+ compatibility, Metro Ring Protocol (MRP), IEEE 802.3ad Link Aggregation (LACP), Virtual Switch Redundancy Protocol (VSRP), and jumbo frames.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/c-series/index.html>

### 5.3.5 IBM g-series Ethernet switches

IBM g-series Ethernet access switches (Figure 5-18 on page 114) provide enterprise organizations with a flexible and feature-rich solution for building a secure and converged network edge. Upgradable with 10-Gigabit Ethernet, PoE, and IronStack stacking technology, the switches provide enterprises with the cost and operational benefits of a “pay-as-you-grow” architecture.



Figure 5-18 IBM g series Ethernet switches

### Key features

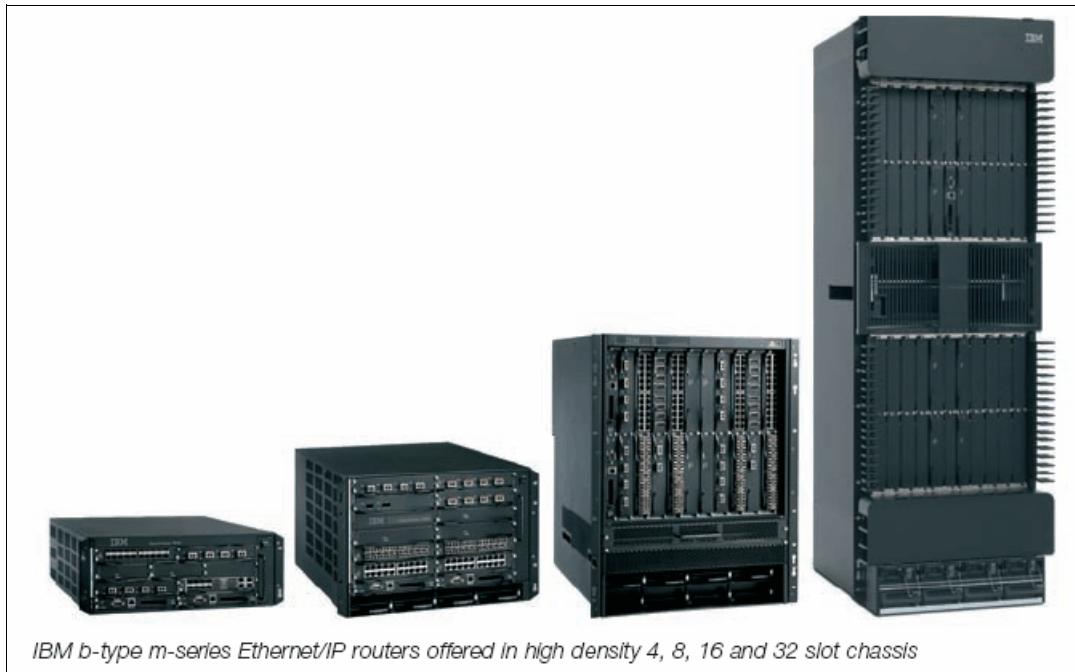
- ▶ High density, 48x 1 GbE Class 3 (15.4 watts) Power over Ethernet (POE) capable ports with redundant removable load-sharing power supplies.
- ▶ 4x 100/1000 Mbps Ethernet combination SFP ports available for connectivity using SFP transceivers for extended distances (total 48x 1 GbE ports active on a system concurrently).
- ▶ Flexible, pay-as-you-grow architecture with modular 2-port 10 GbE option (B48G).
- ▶ IBM Ethernet Switch B48G: 48x 10/100/1000 Mbps Ethernet RJ45 ports including 4x 100/1000 Mbps Ethernet SFP combination ports and optional 2-port 10 GbE module.
- ▶ IBM Ethernet Switch B50G: 48x 10/100/1000 Mbps Ethernet RJ45 ports including 4x 100/1000 Mbps Ethernet SFP combination ports and 2x 10 GbE CX4 stacking ports for connectivity to another B50G.
- ▶ Flexible and resilient design offering redundant, removable, load-sharing power supplies, field-upgradable 10 GbE module (B48G) and IronStack stacking capabilities (B50G).
- ▶ Advanced Layer 2 unicast and multicast support including IGMP and PIM snooping to improve bandwidth utilization.
- ▶ Flexible options to upgrade the software to Edge Layer 3, adding support for IP routing protocols such as RIPv1/v2 and OSPFv2.
- ▶ Highly available system design featuring N+1 redundant, hot-swappable power supplies.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/g-series/index.html>

### 5.3.6 IBM m-series Ethernet/IP routers

High performance multi-service IP/MPLS routers(Figure 5-19 on page 115) help virtualize data center core routing and are available in four high density chassis. Featuring state-of-the-art QoS and wire-speed unicast/multicast routing for IPv4, IPv6, and MPLS services, they enable the efficient rollout of converged backbones, providing reliable transport of Voice over IP (VoIP), video services, and mission-critical data.



*IBM b-type m-series Ethernet/IP routers offered in high density 4, 8, 16 and 32 slot chassis*

Figure 5-19 IBM m Series Ethernet/IP routers

### Key features

- ▶ 4, 8, 16, and 32-slot high-capacity modular routers ideal for a wide range of advanced applications in the high-security data center core, Internet edge and aggregation routing, large-enterprise backbone, high-performance computing (HPC), and Metropolitan Area Networks (MAN).
- ▶ Wire-speed IPv4, IPv6, and MPLS routing featuring full Forwarding Information Base (FIB) programming in hardware.
- ▶ High-performance, wire-speed, non-oversubscribed port density featuring up to 128 10 GbE, 1,536 1 GbE, 256 OC-12/48, or 64 OC-192 ports in a single 32-slot chassis.
- ▶ Fully distributed, non-blocking architecture with up to 3.2 Tbps data capacity (~2 billion pps) per system.
- ▶ Exceptional 320 Gbps cross-module link aggregation supports up to 32 10 GbE or OC-192 links enabling high-bandwidth inter-switch trunking in the backbone.
- ▶ Scalable hardware-based IP routing to 512,000 IPv4 and 112,000 IPv6 routes in hardware, 2 million IPv4 BGP routes and up to 256 BGP peers.
- ▶ Highly available chassis design supports hot-swappable 1:1 management module redundancy, N+1 switch fabric module redundancy, M+N power module redundancy, and N+1 fan redundancy.
- ▶ Interface modules include 4-, 2-port 10 GbE (XFP), 48-port 1 GbE (MRJ21), 20-port 1 GbE (RJ-45 and SFP), 2-port OC-192 PoS/SDH (XFP), and 8-, 4-, 2-port OC-12/48 PoS/SDH (SFP) modules.

### 5.3.7 IBM s-series Ethernet Switch

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/m-series/index.html>

IBM s-series Ethernet Switch modular PoE-capable switches (Figure 5-20) provide an industry-leading scalable, low-latency, fault-tolerant infrastructure for cost-effective deployment of Voice over IP (VoIP), wireless, and high-capacity data services throughout the enterprise. Designed to extend control from the network edge to the backbone, the switches provide intelligent network services, including superior quality of service (QoS), predictable performance, advanced security, comprehensive management, and integrated resiliency. A common operating system and shared interface and power supply modules between the Ethernet Switch B08S and B16S help reduce the cost of ownership by minimizing operational expenses and improving return on investment (ROI).



Figure 5-20 IBM s Series Ethernet switches

#### Key features

- ▶ Advanced chassis-based convergence solution provides a scalable, secure, low-latency and fault-tolerant infrastructure for cost-effective deployment of Voice over IP (VoIP), wireless, and high-capacity data services throughout the enterprise.
- ▶ 8- and 16-slot systems for maximum deployment versatility. Highly available 1+1 management, fabric, and N+1 power redundant architecture enables resilient and fault-tolerant network infrastructures.
- ▶ The B16S can scale to 384 IEEE 802.3af Class 3 PoE 10/100/1000 Mbps ports, each capable of delivering 15.4 watts to provide customers with a convergence-ready infrastructure that will scale to support future growth.
- ▶ Robust PoE auto-detection with IEEE 802.1AB LLDP and LLDP-MED enables support for PoE and non-PoE devices along with auto-configuration of VoIP endpoints, simplifying device deployment.
- ▶ Resilient Advanced Layer 2 protocol support including Protected Link Groups, IEEE 802.3ad Link Aggregation (LACP), UDLD, Virtual Switch Redundancy Protocol (VSRP), Metro Ring Protocol (MRP), and STP/RSTP/MSTP to build a highly tolerant network infrastructure.

- ▶ Advanced Layer 2 unicast and multicast support including IGMP and PIM snooping to improve bandwidth utilization, with flexibility to upgrade to Full Layer 3 and IGMPv1/v2/v3, IGMP Proxy, and PIM-SM/-SSM/-DM multicast routing optimizes network traffic.
- ▶ Flexible options to upgrade the software to Full IPv4 Layer 3, including support for IP routing protocols such as RIPv1/v2, OSPFv2, BGP-4, and support for multicast routing, and Full IPv4+IPv6 Layer 3, adding support for RIPng, OSPFv3, 6-to-4 static tunnels, and IPv6 ACLs.
- ▶ Future-proof with available IPv6 management and interface modules that can integrate today with existing IPv4 switches within and across the network.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/ethernet/b-type/s-series/index.html>

### 5.3.8 IBM Ethernet Switch J08E and IBM Ethernet Switch J16E

The IBM Ethernet Switch J08E and IBM Ethernet Switch J16E (Figure 5-21) are designed to deliver the performance, scalability, and high availability required for today's high-density data center and cloud computing environments. Supporting a variety of GbE and 10 GbE line cards and featuring a built-in migration path to 100 GbE deployments, the J08E and J16E provide the highly scalable solution required by today's high-performance data centers and are positioned to support even more demanding network environments in the future.

The high-density, high-performance J08E and J16E are also used for aggregating access switches deployed in data center top-of-rack or end-of-row applications, as well as for supporting Gigabit Ethernet server access in data center end-of-row deployments. The J08E delivers up to 960 million packets per second (Mpps) of high-density, wire-speed 10 GbE performance, while the J16E delivers approximately 1.9 billion packets per second (Bpps) of 10 GbE performance. Both systems are designed to provide sufficient capacity to support the most demanding data center networks.



Figure 5-21 IBM j-type Ethernet switches

## Key features

- ▶ High-performance 8-slot (J08E) and 16-slot (J16E) switches support data center as well as campus LAN core and aggregation layer deployments.
- ▶ Scalable switch fabric delivers up to 320 Gbps per slot.
- ▶ 48-port 10/100/1000BASE-T and 100BASE-FX/1000BASE-X line cards support up to 384 (J08E) or 768 (J16E) GbE ports per chassis.
- ▶ Eight-port 10GBASE-X line cards with SFP+ interfaces deliver up to 64 (J08E) or 128 (J16E) 10 GbE ports per chassis.
- ▶ Carrier-class architecture includes redundant internal routing engines, switch fabrics, power and cooling, ensuring uninterrupted forwarding and maximum availability.
- ▶ All IBM j-type switches and routers run the modular, fault-tolerant Juniper Networks JUNOS Software operating system.
- ▶ Fourteen (J08E) rack-unit (RU) and 21 (J16E) RU chassis Eight (J08E) and sixteen (J16E) dedicated I/O slots.
- ▶ 6.2 (J08E) and 12.4 (J16E) Tbps backplane capacity.
- ▶ 320 Gbps (full duplex) per slot fabric capacity.
- ▶ Full 10 GbE line-rate forwarding (even under failure conditions).
- ▶ Dedicated data, control and management planes.
- ▶ LCD panel for system monitoring Energy efficient: 200,000 packets per second per watt.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/j-type/j08e/index.html>

### 5.3.9 IBM Ethernet Switch J48E

Running Juniper Networks' JUNOS Software operating system, the IBM Ethernet Switch J48E (Figure 5-22) was designed for high-performance server access deployments. A single switch can be deployed initially; as requirements grow, Virtual Chassis technology allows up to nine additional switches to be interconnected over a 128 gigabit-per-second (Gbps) backplane and managed as a single device, with a single configuration file and OS image. Modular Gigabit Ethernet (GbE) and 10-Gigabit Ethernet (10 GbE) uplink module options enable Virtual Chassis technology to be extended to switches in different racks or even in different data centers.



Figure 5-22 IBM Ethernet Switch J48E

## Key features

- ▶ Full Layer 2 and Layer 3 Ethernet switching Virtual Chassis technology enables up to 10 switches to be interconnected as a single logical device supporting up to 480 ports in data center top-of-rack or end-of-row applications.

- ▶ Interconnected switches in a Virtual Chassis configuration share a single control plane and operating system, and automatically assign master (active) and backup (hot-standby) Routing Engines.
- ▶ Integrated ASIC-based Packet Forwarding Engine and Routing Engine (RE) deliver switching and routing functionality at wire rates.
- ▶ Front-panel LCD display offers flexible interface for performing device bring-up and configuration rollbacks, reporting switch alarm and LED status, or restoring the switch to its default settings.
- ▶ Eight ports of IEEE 802.3af-compatible Class 3 Power over Ethernet (PoE).
- ▶ Single rack unit-height device (1RU) 48 10/100/1000BASE-T front-panel ports.
- ▶ Optional GbE or 10 GbE front-panel uplink modules for connecting to other switches or upstream devices.
- ▶ Scalable to 480 server access ports with up to 20 10 GbE uplinks to the core.
- ▶ Back-panel Virtual Chassis ports interconnect up to 10 switches over a 128 Gbps backplane.
- ▶ Redundant, internal hot-swappable power supplies.
- ▶ Hot-swappable fan tray with redundant blowers.
- ▶ Dual Routing Engines with graceful Routing Engine switchover (GRES).
- ▶ Single management interface.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www.ibm.com/systems/networking/hardware/j-type/j48e/index.html>

### 5.3.10 IBM Ethernet Router J02M/J06M/J11M

IBM Ethernet Routers J02M, J06M and J11M (Figure 5-23) deliver high-port density as well as performance of up to 960 Gbps throughput, scalability, and reliability in a space-efficient package. The routers offer fully redundant hardware that includes a redundant Switch Control Board (SCB) and Routing Engines (REs) plus fan trays and power supplies designed to increase system availability.



Figure 5-23 IBM Ethernet Router J02M/J06M/J11M

### Key features

- ▶ High performance Ethernet L2/L2VPN/L3/L3VPN router delivers advanced routing features, including network virtualization with MPLS, low-latency multicast, and Quality of Service, without compromising performance.
- ▶ Redundant hardware and high availability features designed to ensure that the network is always up and running with:
  - Redundant hardware: cooling, power supplies, Routing Engines, and Switch Control Boards
  - Modular operating system
  - Separate data and control planes
  - Graceful restart
  - Non-stop routing
  - MPLS FRR
  - VPLS multi-homing
- ▶ Excellent performance to ensure that services and customers stay connected:
  - Powered by custom-designed application-specific integrated circuits (ASICs)
  - Enhanced QoS capabilities
  - Additional packet processing flexibility
  - Scaling enhancements including route lookup, next hop, IFL scaling, and interface accounting
  - Additional control storage capacity to provide headroom for future JUNOS Software operating system features
  - Enhanced multicast
- ▶ Operational efficiencies and simplicity delivered through JUNOS Software operating system.
- ▶ Each chassis scales in size with choices of 2, 6, or 11 slots that can be populated with line cards for access or network interfaces.

- ▶ Flexible port densities and WAN interfaces (Dense Port-Count Line Cards).
- ▶ Simultaneous support for Layer 2 and Layer 3 Ethernet services.
- ▶ Can be deployed in two-tier collapsed architectures, which can yield operational savings through reduced power, cooling and space requirements.
- ▶ 2, 6, and 11-slot systems with full duplex throughput per slot provide versatile port densities and WAN interfaces.
- ▶ Flexible Architecture with IPv6, IPv4, industry leading IP/MPLS and VPLS.
- ▶ Powered by the I-chip ASIC, the Ethernet router family includes features such as enhanced QoS capabilities and scaling enhancements and advanced packet processing performance—each slot provides line-rate 40 Gbps packet forwarding.

**Note:** For more information on specification, model no, product no and type, visit:

<http://www-03.ibm.com/systems/networking/hardware/j-type/m-series/index.html>

## 5.4 Cisco Nexus 5000

As organizations evolve towards a dynamic infrastructure, they need new ways to reduce the complexity of their environments. To address this challenge, IBM offers versatile Cisco switches that support Fibre Channel, Converged Enhanced Ethernet and Fibre Channel over Ethernet (FCoE) to help data centers simplify their growing infrastructures.

### 5.4.1 Cisco Nexus 5010/5020

The Cisco Nexus 5010 for IBM System Storage and Cisco Nexus 5020 for IBM System Storage FCoE switches help reduce costs through data center infrastructure simplification. A unified fabric over 10 Gigabit Ethernet (GbE) for server LAN and SAN traffic enables consolidation of server adapters, cables, and top-of-rack (TOR) switches by up to 50 percent.

#### Key features

- ▶ Ports and power connections are at the rear, closer to server ports, helping keep cable lengths as short and efficient as possible.
- ▶ IEEE Data Center Bridging features for lossless transmission, priority flow control, and enhanced transmission selection.
- ▶ Standards-based FCoE protocol preserves existing Fibre Channel network management models and tools, helping protect investments in software and staff training.
- ▶ Unified Fabric designed to consolidate all data center I/O onto Layer 2 Ethernet and reduce capital and operating costs by reducing the number of server adapters, cables, and upstream switches needed.
- ▶ Server I/O consolidation reduces energy consumption by eliminating the need for separate Fibre Channel adapters, cables, and switches.
- ▶ Consistent management is provided through consistency of both Cisco NX-OS Software and Cisco MDS 9000 SAN-OS Software management models and tools.
- ▶ Multiprotocol switches with 10 Gbps Fibre Channel over Ethernet (FCoE), 10 Gbps Converged Enhanced Ethernet, traditional 1/10 Gbps Ethernet ports and optional 1, 2 and 4 Gbps Fibre Channel (FC) ports.
- ▶ Cisco Nexus 5010 for IBM System Storage provides eight 1/10 GbE and twelve 10 GbE fixed ports with one expansion module slot.

- ▶ Cisco Nexus 5020 for IBM System Storage provides sixteen 1/10 GbE and 24 10-GbE fixed ports with two expansion module slots
- ▶ Expansion modules include eight 1, 2, 4 Gbps FC ports; four 10 GbE and four 1, 2, 4 Gbps FC ports; six 10 GbE ports.
- ▶ 10 GbE ports are capable of transporting both storage and LAN traffic—eliminating the need for separate server SAN and LAN adapters and cables.
- ▶ Dual speed 1, 10 GbE ports help provide a smooth transition to 10 Gigabit Ethernet.

**Note:** For more information on specification, model no, product no and type, visit:  
<http://www.ibm.com/systems/networking/hardware/ethernet/c-type/nexus/index.html>



# IBM system storage tape systems

Backup and Restore is the most simple and basic solution to protect and recover your data from failure by creating another copy of data from the production system. The second copy of data allows you to restore data to the time of the data backup. Backup is a daily IT operation task where production, application, systems, and user data are copied to a different data storage media, in case they are needed for restore.

Over the past few years, the growth in the demand for data storage and reliable backup and archiving solutions has greatly increased the need to provide manageable and cost-effective tape library products. The value of using tape for backup purposes has only gradually become obvious and important in these environments.

System administrators are clamoring for technologies that enable them to efficiently and economically manage the explosive growth in stored data. As the amount of data increases, the backup process takes longer and longer.

Tape storage is able to provide effective solutions to backups and archives residing on disk and also helps maintain data availability, reduce storage costs, and provide disaster recovery functionality.

Also, often the size of the business does not correlate with the size of the tape solution. A direct relationship does not necessarily exist between small, medium, and large businesses and entry level, midrange, and enterprise storage solutions. It is best to use company business needs and workloads in choosing the correct size tape system solution. Many of the IBM tape products are scalable solutions and therefore can fit into more than one workload size. The tape systems in this chapter are listed in order of workload size (entry-level, midrange, enterprise).

For any additional information or the latest updates, see *IBM System Storage Solutions Handbook*, SG24-5250.

## 6.1 IBM tape systems for entry level workloads

Here is a list of IBM tape system solutions intended for entry level businesses requiring backup or low-cost, real-time archival of their data:

- ▶ IBM System Storage TS2230 Tape Drive Express Model
- ▶ IBM System Storage TS2240 Tape Drive Express Model
- ▶ IBM System Storage TS2340 Tape Drive Express Model
- ▶ IBM System Storage TS2900 Tape Autoloader Express
- ▶ IBM System Storage TS3100 Tape Library
- ▶ IBM System Storage TS3200 Tape Library
- ▶ IBM System Storage TS3310 Tape Library
- ▶ IBM TotalStorage 3580 Tape Drive
- ▶ IBM System Storage 7212 Storage Device Enclosure Express Model
- ▶ IBM System Storage 7214 Storage Device Enclosure

### 6.1.1 IBM System Storage TS2230 Tape Drive Express Model

The IBM System Storage TS2230 Tape Drive Express LTO3 HH Model is the entry-level IBM System Storage tape product family offering. By leveraging advanced Linear Tape-Open technology and the half-high format, the TS2230 Tape Drive is suited for handling the backup, save and restore, and archival data storage needs of a wide range of small systems. See Figure 6-1 on page 125.

The TS2230 has a storage capacity of up to 800 GB (with 2:1 compression) in conjunction with the IBM TotalStorage LTO Ultrium 400 GB data cartridge, which has double the capacity of the Ultrium 2 technology. Along with its higher capacity, the performance of the TS2230 Tape Drive has more than doubled over the previous generation of half-high LTO drives in the market for a native data transfer rate of up to 60 MBps. The TS2230 Tape Drive provides an excellent alternative to slower and smaller capacity 1/4-inch, 4 mm and 8 mm DLT/SDLT tape drives.

The TS2230 Tape Drive houses the Half-High Ultrium 3 Tape Drive. The TS2230 became available at the end of 2006 and might be an ideal tape drive for small clients who want a reliable tape drive with LTO technology. The TS2230 Tape Drive provides an excellent migration path from digital linear tape (DLT or SDLT), 1/4-inch, 4 mm, or 8 mm tape drives. The TS2230 Tape Drive Express Model incorporates third-generation IBM LTO Ultrium technology. The maximum tape drive throughput data rate performance is up to 60 MBs native data transfer rate. IBM Ultrium 3 Tape Drives can read and write LTO Ultrium 2 data cartridges and can read LTO Ultrium 1 data cartridges.

The TS2230 can be attached to IBM System i, IBM System p, IBM System x, Microsoft Windows, Hewlett-Packard UNIX (HP-UX), Sun Solaris, UNIX, Linux, and PC servers. To determine the latest update of the supported servers, visit the web at:

<http://www.ibm.com/systems/storage/tape/library.html>

#### TS2230 highlights

The IBM System Storage TS2230 Tape Drive Express Model contains the following features:

- ▶ Half-high LTO 3
- ▶ Lower list price than full-high LTO 3 tape drives

- ▶ LVD Ultra160 SCSI attach
- ▶ 3 Gbps SAS attach
- ▶ WORM capable
- ▶ Up to 800 GB compressed; 400 GB native capacity per cartridge based on 2:1 compression
- ▶ Up to 60 MBps native sustained data transfer rate based on 2:1 compression



*Figure 6-1 IBM System Storage TS2230 Tape Drive Express Model*

### **6.1.2 IBM System Storage TS2240 Tape Drive Express model**

The System Storage TS2240 Tape Drive, as seen in Figure 6-2 on page 126, is an excellent tape storage solution for businesses requiring backup or low-cost, real-time archival storage of their data. The TS2240, with a half-high form factor, offers the same high capacity of full-high LTO 4 tape drives. The TS2240 has a physical storage capacity of up to 1.6 TB (with 2:1 compression) in conjunction with the new IBM System Storage LTO Ultrium 800 GB data cartridge, which provides up to double the capacity of Ultrium 3 cartridges.

The native data transfer performance of the TS2240 Tape Drive has increased over the previous LTO half-high generation to up to 120 MB/sec. The TS2240 Tape Drive continues to provide an excellent alternative to slower and smaller capacity 1/4-inch, 4 mm and 8 mm DLT/SDLT Tape Drives.

The IBM System Storage TS2240 Tape Drive (3580 Model H4S) is an external stand-alone or rack-mountable shelf unit, designed for the family of IBM Ultrium tape products. The TS2240 Tape Drive is a high-capacity data storage device that offers high performance and is designed for backup and restore by midrange open systems applications. The TS2240 Tape Drive incorporates the Linear Tape-Open (LTO) IBM System Storage Ultrium 4 half-high Tape Drive.

The TS2240 Tape Drive Model H4S is encryption-capable and supports Application-Managed Encryption (AME). The TS2240 Tape Drive can use the T10 encryption method. Encryption is only supported with the LTO Ultrium 4 data cartridge. The TS2240 is a client-replaceable unit (CRU). In case the TS2240 has a failure, IBM provides a replacement rather than repairing the tape drive.

#### **TS2240 highlights**

The IBM System Storage TS2240 Tape Drive Express model contains the following features:

- ▶ Features the new IBM Ultrium 4 Tape Drive in a half-high form factor
- ▶ IBM Ultrium 4 technology is designed to support encryption of data and continues to support write once, read many (WORM) operation
- ▶ Hardware encryption available
- ▶ 3 Gbps SAS attach

- ▶ Up to 1.6 TB compressed; 800 GB native capacity per cartridge based on 2:1 compression
- ▶ Up to 120 MBps native sustained data transfer rate based on 2:1 compression
- ▶ Large internal data transfer buffer
- ▶ Backward compatibility with previous generations of LTO Ultrium cartridges



*Figure 6-2 IBM System Storage TS2240 Tape Drive Express model*

### **6.1.3 IBM System Storage TS2340 Tape Drive Express model**

The IBM System Storage TS2340 Tape Drive features SCSI Ultra160 Low Voltage Differential (LVD) as well as 3 Gbps SAS interface for connection to a wide spectrum of open system servers. The TS2340 is designed to exceed your most demanding backup and restore needs. The IBM Ultrium 4 technology is designed to support encryption of data. The hardware encryption and decryption core and control core resides in the IBM Ultrium 4 Tape Drive (available to the TS2340 with the 3 Gbps SAS interface).

A larger internal data buffer helps improve data access rates and reduce cartridge fill and rewind times along with dynamic channel calibration to help increase data throughput. In addition to reading and writing to LTO Ultrium 3 tape cartridges, the TS2340 can read LTO Ultrium 2 cartridges as seen in Figure 6-3 on page 127.

The TS2340 Tape Drive is available in two models, which are determined by the attachment interfaces. The TS2340 Tape Drive Model L43 uses a Small Computer Systems Interface (SCSI) Ultra160 Low Voltage Differential (LVD) attachment, and Model S43 uses a 3 Gbps Serial-Attached SCSI (SAS) interface for connecting to open systems servers.

The TS2340 Model S43 has two SFF-8088 interfaces for connecting to open systems servers. Write Once Read Many (WORM) cartridges are supported and recognized when loaded.

The TS2340 Tape Drive Model S43 is encryption-capable and supports Application-Managed Encryption (AME). The TS2340 Tape Drive uses the T10 encryption method. Encryption is only supported with the LTO Ultrium 4 Data Cartridge. The TS2340 is a client-replaceable unit (CRU). In case the TS2340 has a failure, IBM provides a replacement.

For error codes and messages, there is a Single Character Display (SCD) at the front of the TS2340 Tape Drive. The TS2340 Tape Drive can be attached to IBM System i, IBM System p, IBM System x, Microsoft Windows, Hewlett-Packard UNIX (HP-UX), Sun Solaris, UNIX, Linux, and PC servers.

To determine the latest supported servers, visit:

<http://www.ibm.com/servers/storage/tape/compatibility/pdf/>

## TS2340 highlights

The IBM System Storage TS2340 Tape Drive Express Model contains the following features:

- ▶ Model L43 - One IBM Ultrium 4 Tape Drive, LVD Ultra160 SCSI attach
- ▶ Model S43- One IBM Ultrium 4 Tape Drive, 3 Gbps SAS attach
- ▶ Next generation of LTO technology
- ▶ Hardware encryption available
- ▶ WORM capable
- ▶ Up to 1.6 TB compressed; 800 GB native capacity per cartridge based on 2:1 compression
- ▶ Up to 120 MBps native sustained data transfer rate based on 2:1 compression
- ▶ Large internal data transfer buffer
- ▶ Backwards compatibility with previous generations of LTO Ultrium cartridges

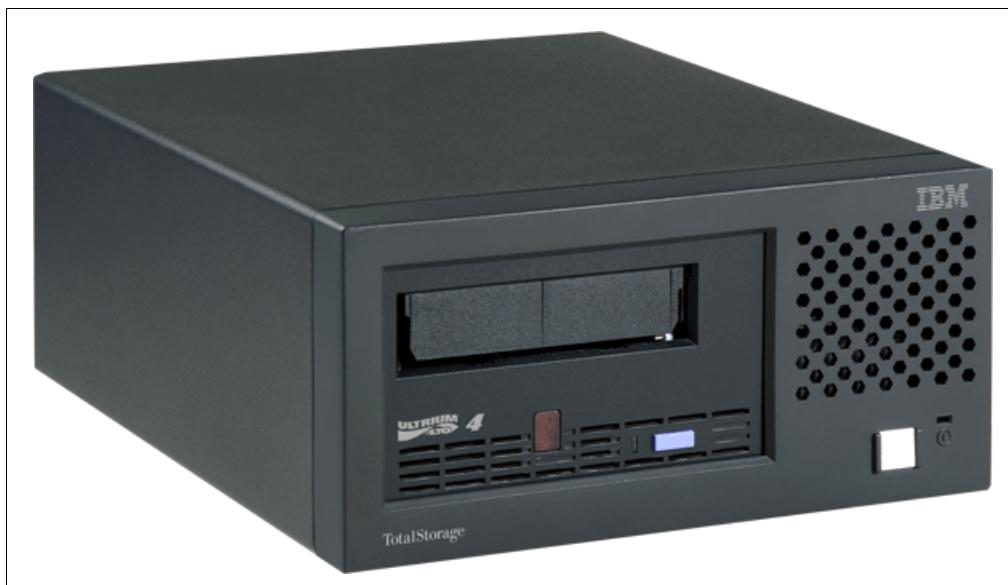


Figure 6-3 IBM System Storage TS2340 Tape Drive Express model

### 6.1.4 IBM System Storage TS2900 Tape Autoloader Express

The IBM System Storage TS2900 Tape Autoloader (Machine Type 3572) provides compact high capacity, low-cost solutions for simple unattended data backup. The library has a compact 1U form factor with easy access to tape cartridges via a removable magazine. The IBM System Storage TS2900 Tape Autoloader is an external stand-alone or rack-mountable unit that incorporates an IBM Ultrium 3 or Ultrium 4 Half-High Tape Drive. It is equipped with a Serial Attached SCSI (SAS) host adapter attachment that has a data transfer rate of up to 3 Gbps. Refer to Figure 6-4.



Figure 6-4 IBM System Storage TS2900 Tape Autoloader Express

The IBM System Storage TS2900 Tape Autoloader has a removable cartridge magazine providing nine data cartridge slots, including a configurable two slot I/O station. IBM System Storage TS2900 Tape Autoloader is an entry point for IBM Linear Tape-Open (LTO) tape automation. This autoloader uses the IBM patented high density (HD) slot technology.

The cartridges that are supported in the IBM System Storage TS2900 Tape Autoloader include:

- ▶ IBM LTO Tape Cartridge Ultrium 4 (800 GB native physical capacity)
- ▶ IBM LTO Tape Cartridge Ultrium 3 (400 GB native physical capacity)
- ▶ IBM LTO Tape Cartridge Ultrium 2 (200 GB native physical capacity)
- ▶ IBM LTO Tape Cartridge Ultrium 1 (100 GB native physical capacity)
- ▶ WORM cartridges

Note that cartridge support is dependent on the tape drive that is installed in the IBM System Storage TS2900 Tape Autoloader. Only the cartridge types that are supported by the LTO3 or LTO4 drive that is installed are supported in the TS2900.

The library media capacity can be further increased by using hardware compression (2:1 compression factor). The library supports the movement of any media generation in any slot or drive. It is set in the host application to limit any operations that might result in unsupported media issues.

The TS2900 has a 3 Gbps single-port SFF-8088 SAS connector. This is the same connector for all of the other IBM tape products that support the SAS interface. The drive is integrated into the library. There is no drive field-replaceable unit (FRU) or client-replaceable unit (CRU), because the entire library is a CRU.

Designed for tape automation, the TS2900 supports 3 Gbps attachment to IBM Power Systems, IBM System x, Intel, and other open systems server platforms. To determine the latest supported servers, visit:

<http://www.ibm.com/systems/storage/tape/>

The IBM Ultrium 4 LTO Tape Drive with a Fibre Channel or a SAS interface is encryption-capable. The IBM LTO4 Tape Drive supports Application-Managed Encryption (AME), System-Managed Encryption (SME), and Library-Managed Encryption (LME).

## TS2900 highlights

The IBM System Storage TS2900 Tape Autoloader Express Mode contains the following features:

- ▶ IBM half-high LTO 4 supports the encryption of data for increased security with archived data.
- ▶ Supports HH LTO 3 or HH LTO4 tape technology from IBM with a 3 Gbps SAS interface.
- ▶ A single I/O station to help support continuous library operation.
- ▶ Removable magazine to facilitate the offsite relocation of media and archival data.
- ▶ Features IBM half-high LTO technology designed for reliable performance in small-to-medium open system environments.
- ▶ HH LTO 3 tape drives can read and write to LTO 2 media and read LTO 1 media; HH LTO 4 tape drives can read and write to LTO 3 media and read LTO 2 media.
- ▶ Supports WORM media.

- ▶ Bar code reader allows for the option of synchronous or random access of media cartridges, facilitating operation.
- ▶ Adheres to LTO specifications.

### 6.1.5 IBM System Storage TS3100 Tape Library Express model

IBM System Storage TS3100 Tape Library provides compact, high-capacity, low-cost solutions for simple, unattended data backup. It is designed to support the new IBM LTO Ultrium 4 half-high (HH) Tape Drive and the IBM LTO Ultrium 3 HH Tape Drive, to help increase capacity and performance with Low Voltage Differential (LVD) SCSI and 3 Gb Serial Attached SCSI (SAS) attachments.

TS3100 media capacity is up to 8.8 TB (17.6 TB with 2:1 compression) data storage per unit. Figure 6-5 shows the IBM System Storage TS3100 Tape Library.



Figure 6-5 IBM System Storage TS3100 Tape Library

The IBM System Storage TS3100 Tape Library Express Model comes as two different products. They are very similar, with the basic difference being the amount of drives that can be installed. The two express model products are as follows:

- ▶ The IBM System Storage TS3100 Tape Library Express Model comes with a single Ultrium 3 or Ultrium 4 tape drive with a 24 cartridge capacity.
- ▶ The IBM System Storage TS3100 Tape Library Express Model featuring half-high Ultrium technology allows up to 2 Ultrium half-high tape drive(s) and a 24 tape cartridge capacity.

The IBM System Storage TS3100 Tape Library is available as follows:

- ▶ 3573 2UL - IBM System Storage TS3100 Tape Library Model L2U Driveless
  - Ultrium 4 Full Height: LVD SCSI (95P5002), 3 Gbps SAS (95P5006); Fibre Channel (95P5004)
  - Ultrium 3 Full Height: LVD SCSI (23R7260); 4 Gbps Fibre Channel (23R7261)
  - Ultrium 4 Half-Height: 3 Gbps SAS (45E2243)
  - Ultrium 3 Half-Height: LVD SCSI (95P4998); 3 Gbps SAS (95P5000)

### TS3100 highlights

The IBM System Storage TS3100 Tape Library Express Model contains the following features:

- ▶ IBM LTO Ultrium 3 or IBM LTO Ultrium 4 in either full or half height technologies.
- ▶ Supports 4 Gbps Fibre Channel and LVD SCSI attachments.
- ▶ Ultrium 4 native data rate of 120 MBps.

- ▶ Ultrium 3 Full Height native data rate up to 80 MBps.
- ▶ Ultrium 3 Half Height native data rate up to 60 MBps.
- ▶ Ultrium 4 native data capacities up to 19.2 TB (38.4 with 2:1 compression).
- ▶ Ultrium 3 native data physical capacities up to 9.6 TB (up to 19.2 TB using 2:1 compression).
- ▶ 2U form factor with 24 data-cartridge slots. The cartridges are housed in two removable magazines, left and right.
- ▶ A single mail slot on the left cartridge magazine provides import/export facilities for cartridges, without interrupting library operation.
- ▶ Sequential or random access mode with a standard bar-code reader.
- ▶ Operator front control panel contains power button, front panel LEDs, control keys, and the operator control panel display.
- ▶ Remote library management through a web interface.

For the most up to date and detailed operating system and attachment requirements, see:

[http://www.ibm.com/servers/storage/tape/compatibility/pdf/ts3100\\_ts3200\\_interop.pdf](http://www.ibm.com/servers/storage/tape/compatibility/pdf/ts3100_ts3200_interop.pdf)

For more information on the IBM System Storage TS3100 Tape Library, refer to the following book:

*IBM System Storage Tape Library Guide for Open Systems*, SG24-5946

For more technical information, see the IBM System Storage TS3100 Tape Library and TS3200 Tape Library Setup, Operator and Service Guide (GA32-0545-07) on the web at:

<http://www.ibm.com/support/docview.wss?uid=pub1ga32054507>

## 6.1.6 IBM System Storage TS3200 Tape Library

Like the IBM System Storage TS3100 Tape Library, the IBM System Storage TS3200 Tape Library is a dual- or single-drive tape library, offering high capacity and performance technology for the midrange environments. The TS3200 Tape Library is an external 4U standalone or rack-mountable unit that incorporates up to two full height Linear Tape-Open (LTO) IBM TotalStorage Ultrium 3 or Ultrium 4 tape drives or four Ultrium 3 or Ultrium 4 half height tape drives.

The IBM System Storage TS3200 Tape Library Express Model is an excellent tape storage solution for organizations with existing digital linear tape or requiring high-performance automated tape backup. The TS3200 is also designed for organizations that have limited physical space in their IT environments. Operating in a rack environment allows organizations the advantage of placing the TS3200 in a standard 19-inch rack, which provides 76.8 TB of compressed tape storage in just a 4U space. Remote management and a bar code reader are standard in the library, and it can run in sequential or random access mode. Optional features available are rack mount kit, additional power supply, and Path Failover.

The TS3200 has IBM patented Multi-Path Architecture for sharing the library robotics. This allows a library with two drives to be partitioned into two logical libraries, for sharing between servers and/or applications.

Figure 6-6 on page 131 shows the IBM System Storage TS3200 Tape Library.



Figure 6-6 IBM System Storage TS3200 Tape Library

The IBM System Storage TS3200 Tape Library is available as follows:

- ▶ 3573 4UL: TS3200 Tape Library Model L4U Driveless
  - Ultrium 4 Full Height: LVD SCSI (95P5002), 3 Gbps SAS (95P5006); Fibre Channel (95P5004)
  - Ultrium 3 Full Height: LVD SCSI (23R7260); 4 Gbps Fibre Channel (23R7261)
  - Ultrium 4 Half-Height: 3 Gbps SAS (45E2243)
  - Ultrium 3 Half-Height: LVD SCSI (95P4998); 3 Gbps SAS (95P5000)

Designed to support up to two IBM LTO Ultrium Full Height Tape Drives or up to four IBM LTO Ultrium Half Height Tape Drives, to help increase capacity and performance.

## TS3200 highlights

The IBM System Storage TS3200 Tape Library contains the following features:

- ▶ Designed to support the new IBM Linear Tape-Open (LTO) Ultrium 4 Half-High (HH) Tape Drive and the IBM LTO Ultrium 3 HH Tape Drive, to help increase capacity and performance with Low Voltage Differential (LVD) SCSI and 3 Gb Serial Attached SCSI (SAS) attachments.
- ▶ 4U form factor with 48 data cartridges, four removable magazines, including a three-slot I/O station.
- ▶ Sequential or random access mode with a standard barcode reader.
- ▶ The front panel integrates the power button, front panel LEDs, control keys, and the operator control Panel display, for direct library management.
- ▶ Remote library management through a web interface.

For the most up-to-date and detailed operating system and attachment requirements, see:

[http://www.ibm.com/servers/storage/tape/compatibility/pdf/ts3100\\_ts3200\\_interop.pdf](http://www.ibm.com/servers/storage/tape/compatibility/pdf/ts3100_ts3200_interop.pdf)

For more information on the IBM System Storage TS3200 Tape Library, see:

*IBM System Storage Tape Library Guide for Open Systems*, SG24-5946

## 6.1.7 IBM System Storage TS3310 Tape Library

Designed around a 5U high modular base library unit, the TS3310 is designed to scale vertically with expansion for LTO tape cartridges, drives, and redundant power supplies. The base library module, model L5B, is the entry point for the product family. It contains all of the necessary robotics and intelligence to manage the 5U high library system, which houses up to 41 cartridges (35 storage slots and 6 Input/Output slots) and two LTO generation 4 and/or generation 3 tape drives.

Each model E9U contains 92 physical LTO cartridge storage cells and space for up to four LTO 4 and/or LTO 3 tape drives. The TS3310 supports either the standard or WORM LTO data cartridge. Additionally, the E9U has space for up to two (one redundant) power supply modules. (At least one power supply module must be installed if a drive is present in the E9U.)

Figure 6-7 shows the IBM TS3310 base L5B unit with one expansion module.



Figure 6-7 IBM System Storage TS3310 Tape Library - base and expansion

### TS3310 highlights

The IBM System Storage TS3310 Tape Library contains the following features:

- ▶ TS3310 is a modular library, 56 TB up to 641 TB (2:1 compression) (35 to 401 LTO storage slots)

- From 2 to 18 4 Gbps Fibre Channel and 3 Gbps SAS (LTO4 only), SCSI-U160 (LTO3 only) hot-swappable tape drives
- Vertical expansion over 400 LTO cartridges
- Supports Logical Partitioning using Multipath Architecture
- Optional features; Capacity on demand, Rack Mounting, Path Failover (Data and Control), Redundant power
- ▶ TS3310 Base library module supports 28 TB native capacity (35 slots), up to two drives, 6-slot cartridge I/O station, 2 logical libraries, robotics and control logic, barcode reader and remote management capability (standard), native SMI-S support, and license key to support initial E9U expansion.



Figure 6-8 TS3310 upgrade path

- ▶ One to four expansion modules can be installed, as you can see in Figure 6-8.

The addition of each expansion module provides a total of 92 storage slots, which are enabled through the use of “Capacity on Demand” licenses. Note that the base module ships with licensing for 82 slots. This effectively means that when you add the first expansion module, half the slots are immediately available without the requirement to acquire additional licenses.

You can configure the I/O slots in each module as a group to operate as I/O slots or storage slots (at least one group must operate as I/O slots). This provides a high degree of flexibility. In a library configuration of one L5B base unit and one 9EU expansion unit, for example, there are three possible combinations:

- ▶ A total of 6 I/O slots (all in the base module)
- ▶ A total of 12 I/O slots (using the slots in the expansion module)
- ▶ A total of 18 I/O slots (using the slots in the base module and the expansion module)

For the latest features, functions, and specifications regarding the TS3310, see:

<http://www.ibm.com/systems/storage/tape/ts3310/index.html>

## 6.1.8 IBM TotalStorage 3580 Tape Drive

The IBM TotalStorage 3580 Tape Drive is the smallest in the family of IBM Ultrium tape solutions. It is an external, stand-alone, Small Computer System Interface (SCSI)-attached tape drive that attaches to System i, System p, System x, RS/6000® SP, and other UNIX and PC servers supporting OS/400, IBM AIX, Sun Solaris, HP-UX, Microsoft Windows NT®, Microsoft Windows 2000 Server, Microsoft Windows Server 2003, and Red Hat and SUSE LINUX using a supported SCSI adapter. Refer to Figure 6-9.

The IBM TotalStorage 3580 model L33 Tape Drive is an external drive incorporating the 3rd and latest generation of IBM LTO technology. This is an external stand-alone or rack-mountable unit, similar to previous models of the 3580 and is the entry point for the family of IBM Ultrium tape products as seen below in Figure 6-9. The 3580 Tape Drive provides an excellent migration path from digital linear tape (DLT or SDLT), 1/4-in., 4mm, or 8mm tape drives. The 3580 model L33 can read and write LTO Ultrium 2 Data Cartridges and read LTO Ultrium 1 Data Cartridges.

For additional information regarding the IBM TotalStorage 3580 Tape Drive, visit the web at:

<http://www-03.ibm.com/systems/storage/tape/3580/index.html>

### 3580 highlights

- ▶ Integrates into the following storage environments: Server (non-IBM and IBM), Automated library, and SAN-attached.
- ▶ Adheres to the widely supported LTO specification, which promotes standardization and allows for multiple media and drive providers.
- ▶ Provides superior performance and capacity attributes for unattended backup within midrange and enterprise server environments.
- ▶ Compatible with major operating systems and ISV applications.
- ▶ Uses advanced technologies that optimize throughput, increase cartridge capacity, and provide superior data protection.

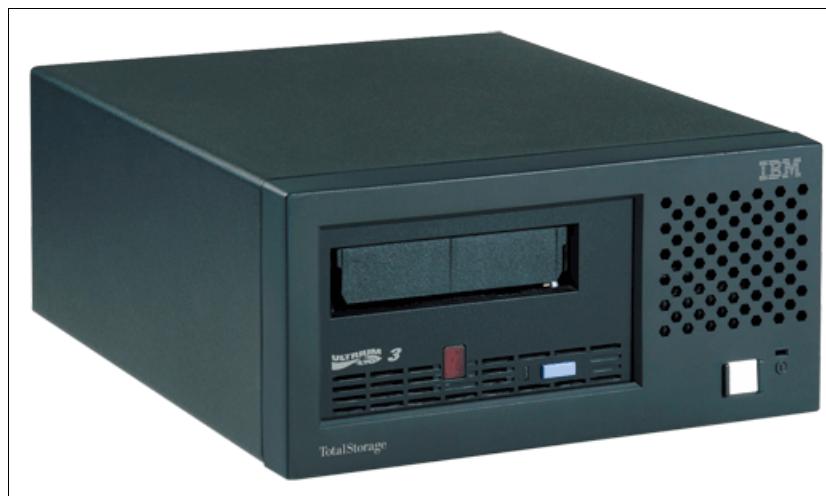


Figure 6-9 3580 Model L33/L3H

## 6.1.9 IBM System Storage 7212 Storage Device Enclosure Express Model

The IBM System Storage 7212 Storage Device Enclosure Express Model (as seen in Figure 6-10), allows you to package the latest technology options in tape drives and a

DVD-RAM optical drive in a low-profile, modular design for rack-mount or limited-space desktop applications.

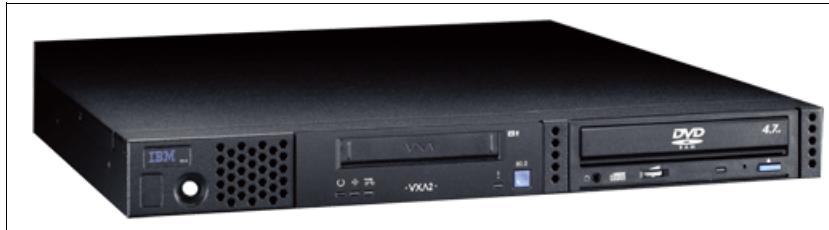


Figure 6-10 IBM System Storage 7212 Storage Device Enclosure Express Model

The IBM System Storage 7212 Storage Device Enclosure Express Model features two popular tape drive technology options. The 7212 Express Model packaging is a low-profile, modular design that is an excellent choice for rack-mount or limited-space desktop applications.

### 7212 highlights

- ▶ Features a compact design that can be configured with up to two storage devices.
- ▶ Can be configured for one EIA unit (1U) of a standard 19-inch server rack or as a low-profile desktop solution.
- ▶ Offers storage device options for 4 mm and 1/4-inch (QIC) tape drive formats.
- ▶ Low-profile storage solution for environments in which cabling space and server storage bays are limited.
- ▶ Connects to IBM System i and System p workstations and servers.
- ▶ Compatible with tape and optical drives.
- ▶ Storage options drive types
  - DAT72 Media: 4 mm tape
    - Native physical capacity: 36 GB
    - Compatibility: DDS-4, DDS-3
  - SLR60/SLR100 Media: SLR(QIC)
    - Native physical capacity: 37.5 or 50 GB
    - Compatibility: MLR1, MLR3, SLR5, SLR60

For additional information on the IBM System Storage 7212 External Enclosure Device Model visit the web at:

<http://www.ibm.com/systems/storage/tape/7212/index.html>

### 6.1.10 IBM System Storage 7214 Storage Device Enclosure

The IBM System Storage 7214 Storage Device Enclosure (as seen in Figure 6-11 on page 136) features the latest technology options in tape drives and DVD optical drives. The 7214 Storage Enclosure is a low-profile design that is an excellent choice for mounting in your System p 19" rack.



Figure 6-11 IBM System Storage 7214 Storage Device Enclosure

Despite the decreasing availability of server bays for storage devices, it is still important to consolidate storage devices in a single, convenient location to minimize space and cabling impacts. The IBM System Storage 7214 Tape and DVD Enclosure Express is designed to mount in one EIA unit of a standard IBM Power Systems 19-inch rack, and can be configured with one or two tape or DVD drives. The 7214 Express enclosure attaches to SAS-based models of the IBM Power Systems through external serial attached SAS adapters. The 7214 Express also attaches to some open system adapters.

The SAS electronic interface on the 7214 Express is designed to provide faster transfer rates, greater convenience and a reduction in space required for system-to-device cabling.

## 7214 highlights

Here are some highlights of the IBM System Storage 7214 Storage Device Enclosure:

- ▶ 1U slim profile designed for 19-inch rack system environments.
- ▶ Features IBM half-high LTO technology designed for reliable performance in small-medium open system environments.
- ▶ Supports DAT72, DAT160, DVD-RAM and DVD-ROM drives.
- ▶ IBM half-high LTO 4 supports the encryption of data for increased security with archived data.
- ▶ Supports 3 GB/sec IBM SAS interface.
- ▶ Dual-drive enclosure, side-by-side.
- ▶ Offers choices of HH LTO4 and DAT160 tape and DVD storage technologies.
- ▶ Control card sensor designed to track drive function and notify user of maintenance requirements.
- ▶ Adheres to LTO specifications.
- ▶ HH LTO 4 tape drives can write to LTO 3 media and read LTO 2 media; WORM media also available.
- ▶ DAT160 tape drives are read-write compatible with DAT72 and DDS4 media.
- ▶ Typical compression:
  - 2:1 for tape drives
  - 3:1 for DVD optical drives
- ▶ DAT72 4 mm tape drive:
  - Storage capacity of up to 72 GB with a data transfer rate of up to 6 MB per second (assumes 2:1 compression).
- ▶ DAT160 4 mm format tape drive.

For additional information on the IBM 7214 Storage Enclosure, visit the web at:

<http://www.ibm.com/systems/storage/tape/7214/index.html>

## 6.2 IBM tape systems for midrange level workloads

Here is a list of IBM tape system solutions intended for midrange level businesses requiring backup or low-cost, real-time archival of their data:

- ▶ IBM System Storage TS2340 Tape Drive Express Model
- ▶ IBM System Storage TS7650 ProtecTIER Deduplication Appliance
- ▶ IBM System Storage TS3100 Tape Library
- ▶ IBM System Storage TS3200 Tape Library
- ▶ IBM System Storage TS3310 Tape Library
- ▶ IBM System Storage TS3400 Tape Library
- ▶ IBM System Storage TS3500 Tape Library
- ▶ IBM TotalStorage 3580 Tape Drive
- ▶ IBM System Storage TS7650G ProtectTIER Deduplication Gateway

### 6.2.1 IBM System Storage TS2340 Tape Drive Express Model

Refer to 6.1.3, “IBM System Storage TS2340 Tape Drive Express model” for information about the TS2340 Tape drive.

### 6.2.2 IBM System Storage TS7650 ProtecTIER Deduplication Appliance

The IBM System Storage TS7650 ProtecTIER Deduplication Appliance, as seen in Figure 6-12 on page 138, is a preconfigured solution of IBM storage, IBM server and the IBM revolutionary ProtecTIER data deduplication software designed to improve backup and recovery operations. This is not just a bundle of components, but a truly integrated solution that makes it easy to harness the power of deduplication without making radical changes to the existing environment. The solution is available in four configurations designed to meet the disk-based data protection needs of a wide variety of organizations, from mid-sized IT environments to enterprise data centers.

The IBM System Storage TS7650ProtecTIER Deduplication Appliance provides:

- ▶ Up to 500 MB/sec or more inline data deduplication performance
- ▶ Up to 25 times or more storage capacity reduction
- ▶ Emulation of up to 12 virtual libraries, 256 virtual drives and 128,000 virtual cartridges
- ▶ Simplified configuration and deployment

ProtecTIER’s native replication technology enables virtual tape cartridges to be replicated to a remote location for enhanced disaster recovery and business continuity. By eliminating the need to physically transport actual tape cartridges, systems, storage and data can be recovered quicker and more reliably in the event of a disaster or major system outage. It also lowers the total cost of ownership of backup and recovery by eliminating the costs associated with moving and storing physical tape cartridges.



Figure 6-12 TS7650 ProtecTIER Deduplication Appliance

### TS7650 ProtecTIER Deduplication Appliance features

The IBM System Storage TS7650 ProtecTIER Deduplication Appliance offers many features that can create savings in physical storage, processing, and network bandwidth. Some of the main features are:

- ▶ Emulation of up to 12 virtual libraries, 256 virtual drives and 128,000 virtual cartridges
- ▶ IBM ProtecTIER with patented HyperFactor® data deduplication technology
- ▶ ProtecTIER Native Replication technology
- ▶ IBM System x server for enterprise-level performance
- ▶ IBM Storage Controller with highly reliable Fibre Channel drives
- ▶ Rack, cables, and other components needed to provide a complete solution
- ▶ Up to 500 MB/sec or more inline data deduplication performance
- ▶ Up to 25 times or more storage capacity reduction
- ▶ Simplified configuration and deployment

The IBM System Storage TS7650 ProtecTIER Deduplication Appliance is available in the following four configurations:

- ▶ TS7650 ProtecTIER Deduplication Appliance
  - 7 TB configuration with performance up to 100 MB/sec or more inline
    - Inline data deduplication with a physical capacity of 7 TB and usable capacity of 175 TB (based on deduplication ratio of 25:1)
  - 18 TB configuration with performance up to 250 MB/sec or more inline
    - Inline data deduplication with a physical capacity of 18 TB and usable capacity of 450 TB (based on deduplication ratio of 25:1)
    - Flexible and scalable growth to 36 TBA
  - 36 TB configuration with performance up to 500 MB/sec or more inline

- Inline data deduplication with a physical capacity of 36 TB and usable capacity of 900 TB
- Up to nine times faster than the competition delivers
- 36 TB dual-node cluster configuration with performance up to 500 MB/sec or more
  - Inline data deduplication with a physical capacity of 36 TB and usable capacity of 900 TB
  - High availability

For additional information on IBM System Storage ProtecTIER products, refer to:

*The IBM System Storage TS7650G and TS7650 ProtecTIER Servers, SG24-7652*

For the latest features and support visit us on the web at:

<http://www.ibm.com/systems/storage/tape/index.html>

### **6.2.3 IBM System Storage TS3100 Tape Library**

Refer to 6.1.5 “IBM System Storage TS3100 Tape Library Express model” on page 129 for information about the TS3100 tape library.

### **6.2.4 IBM System Storage TS3200 Tape Library**

Refer to 6.1.6, “IBM System Storage TS3200 Tape Library” for information about the TS3200 tape library.

### **6.2.5 IBM System Storage TS3310 Tape Library**

Refer to 6.1.7, “IBM System Storage TS3310 Tape Library” for information about the TS3310 tape library.

### **6.2.6 IBM System Storage TS3400 Tape Library**

The IBMSystem Storage TS3400 Tape Library offers the high capacity and performance advantage of the IBM System Storage TS1130 or TS1120 Tape Drives in a smaller automation footprint for IBM Power Systems, Systemx, Systemz and other open systems environments. Refer to Figure 6-13 on page 140.

The TS3400 tape library is an external 5U standalone or rack-mountable unit supporting one or two TS1130 tape drives or one to two TS1120 tape drives.

The IBM System Storage TS1130 Tape Drive has a native capacity of 1000 GB (1.0 TB) when using the IBM 3592 Extended Data Cartridge (JB), or 640 GB when using the IBM 3592 Enterprise Cartridge (JA). The IBM TS1130 Tape Drive has a dual-ported switched fabric 4 Gbps Fibre Channel attachment and a data transfer rate of up to 160 MBps per drive.

The IBM System Storage TS1120 Tape Drive has a native capacity of 700 GB when using the IBM Extended Data Cartridge (JB), or 500 GB when using the IBM Data Cartridge (JA). The IBM System Storage TS1120 Tape Drive has a native rate of up to 104 MB/s and a dual-ported switched fabric 4 Gbps Fibre Channel attachment. The tape drives must be ordered separately with the final order.

The IBM System Storage TS3400 Tape Library supports the IBM TS1120 and the TS1130 built-in encryption capabilities. The supported encryption methods are Application-Managed

Encryption (AME), System-Managed Encryption (SME), and Library-Managed Encryption (LME).

The TS3400 tape library has two removable cartridge magazines, providing 18 data cartridge slots. Up to three slots can be used for I/O slots, and up to two slots can be used as cleaning cartridge slots. The TS3400 tape library provides a media capacity of up to 18 cartridges, allowing for up to 18TB of storage (54TB with 3:1 compression) when using 1TB extended capacity cartridges.

Remote management via a web browser allows you to communicate directly with the library and perform a wide range of user, operator, and administrator tasks without being at the operator panel. To take further advantage of your investment, you can partition the library into two logical partitions to share the library between different applications. To support continued processing, the TS3400 tape library is equipped with control path and datapath failover.



Figure 6-13 IBM System Storage TS3400 Tape Library

### TS3400 features

- ▶ Supports TS1130 or TS1120 tape drives in a small form factor.
- ▶ Supports 1 to 2 TS1130 or TS1120 tape drives.
- ▶ Native data rate of up to 160 MB per drive.
- ▶ Capacity for growth up to 18 TB in a 5U form factor.
- ▶ Media capacity of up to 18 TB (54 TB with 3:1 compression).
- ▶ Control path and data path automatic failover.
  - Enhance the autonomic capabilities of the library.
  - Designed to improve the reliability of your backup processes.
- ▶ Supports IBM tape drive encryption.
  - Helps secure sensitive at-rest data.
  - Built-in encryption is designed to prevent performance drain on host systems.

For latest information about the TS3400, see:

<http://www.ibm.com/systems/storage/tape/ts3400/index.html>

## 6.2.7 IBM System Storage TS3500 Tape Library

The IBM System Storage TS3500 Tape Library is a highly scalable, automated tape library for mainframe and open systems backup and archive in midrange to enterprise environments. It was formerly known as IBM TotalStorage Tape Library 3584.

The TS3500 tape library supports System z via the IBM 3953 Tape System (3953 tape system) or the IBM Virtualization Engine TS7740, which enable System z hosts to access the TS3500 tape library cartridge inventory and allow connection to TS1130, TS1120, and IBM TotalStorage 3592 Model J1A tape drives.

The TS3500 tape library can support up to four 3953 tape systems, and up to eight IBM Virtualization Engine TS7740 subsystems per physical library.

The TS3500 tape library's entry base frame provides a more flexible upgrade path for users who want to expand their tape storage at the time of need. Capacity on Demand (CoD) configurations for TS3500 tape library L-frame models include the entry level configuration, an intermediate configuration, and a full capacity configuration. S-frame models also allow two CoD configurations.

The TS3500 Model HA1 allows two robotic accessors to operate simultaneously in two to 16 frame configurations. Figure 6-14 shows the minimum and maximum 16 frame TS3500 configuration.



Figure 6-14 IBM System Storage TS3500 Tape Library minimum and maximum configuration

### TS3500 highlights

- ▶ TS7700 Virtualization Engine
  - Allows quick access to active data on virtual volumes on disk and reduces overall solution cost storing inactive data on volumes on tape.

- Optimize data read and write to tape
- Supports tape automation in a System z environment
- ▶ 3593 tape system
  - Supports tape automation in a System z environment
  - Also supports the TS7700 Virtualization Engine
- ▶ Dual accessor option
  - Helps increase the mount performance and overall system availability.
  - Two accessors can operate simultaneously in multiple frame configurations.
- ▶ Flexible upgrade path
  - Start with an entry base frame and expand at the time of need.
  - Capacity on Demand configurations available.
- ▶ Remote, web browser-based management
  - Access key management functions from any network connected computer.
- ▶ Redundant power supplies and AC feeds
- ▶ Control-path and data-path automatic failover
- ▶ Mixed LTO Ultrium and 3592 media
- ▶ Support a heterogeneous environment
- ▶ Supports TS1130/TS1120 and TS1040 tape drive encryption
  - Helps you secure sensitive at-rest data.

### **6.2.8 IBM TotalStorage 3580 Tape Drive**

Refer to 6.1.8, “IBM TotalStorage 3580 Tape Drive” for information about the IBM Total Storage 3580 Tape drive.

### **6.2.9 IBM System Storage TS7650G ProtecTIER Deduplication Gateway**

The TS7650G ProtecTIER Deduplication Gateway, as seen in Figure 6-15, comprised of the TS7650G hardware combined with IBM System Storage ProtecTIER Enterprise Edition software, is designed to address the data protection needs of enterprise data centers. The solution offers high performance, high capacity, scalability, and a choice of disk-based targets for backup and archive data.



Figure 6-15 TS7650G ProtecTIER Gateway

### **TS7650G ProtecTIER Deduplication Gateway offers:**

- ▶ Virtual tape emulation of up to 16 virtual tape libraries per single node or two node cluster configuration and up to 512 per two node cluster or 256 virtual tape drives per TS7650G
- ▶ In-line data deduplication powered by HyperFactor TM technology
- ▶ Multicore virtualization and deduplication engine
- ▶ Clustering support for higher performance
- ▶ Fibre Channel ports for host and server connectivity
- ▶ Performance - up to 1000 MB/s or more sustained inline deduplication (clustered nodes)
- ▶ Emulation of the IBM TS3500 tape library with IBM Ultrium 2 or Ultrium 3 tape drives
- ▶ Emulation of the Quantum P3000 tape library with DLT tape drives
- ▶ Scales to 1 PB of physical storage over 25 PB of user data

The TS7650G ProtecTIER Deduplication Gateway is an enterprise-class data protection platform designed to quickly and safely protect business information while reducing the amount of space required to store it.

Deploying the TS7650G ProtecTIER Deduplication Gateway can help organizations more efficiently protect their corporate data on disk-based storage while helping them manage the exponential growth of new data through reduction and elimination of duplicate data in their backups.

For additional information on IBM System Storage ProtecTIER products, refer to:

*The IBM System Storage TS7650G and TS7650 ProtecTIER Servers, SG24-7652*

## **6.3 IBM tape systems for enterprise level workloads**

Here is a list of IBM tape system solutions intended for enterprise level businesses requiring backup or low-cost, real-time archival of their data:

- ▶ IBM System Storage TS1120 Tape Drive
- ▶ IBM System Storage TS1130 Tape Drive
- ▶ IBM System Storage TS7650G ProtectTIER Deduplication Gateway
- ▶ IBM System Storage TS3400 Tape Library
- ▶ IBM System Storage TS3500 Tape Library
- ▶ IBM Virtualization Engine TS7700

### **6.3.1 IBM System Storage TS1120 Tape Drive**

The IBM System Storage TS1120 Tape Drive (machine type 3592-E05) is the second generation 3592-type drive. It is supported in IBM tape libraries, IBM frames that support stand-alone installation, and in an IBM TotalStorage 3592 Model C20 (3592 C20 frame) attached to a Sun StorageTek 9310 library.

The TS1120 tape drive uses the existing 3592 media, which is available in rewritable or WORM format to store 100 GB, 500 GB, and 700 GB native capacity, depending on cartridge media. The 3592 JA/JW media helps reduce resources to lower total costs, whereas the 3592 JJ/JR media is designed to support applications that require rapid access to data.

TS1120 tape drives can be shared among supported open system hosts on a SAN, or between FICON and ESCON mainframe hosts when attached to an IBM System Storage TS1120 Tape Controller Model C06 (TS1120 tape controller). Sharing drives optimizes drive utilization and helps reduce infrastructure requirements. Figure 6-16 shows the TS1120 tape drive. The TS1120 features dual-port 4 Gbps Fibre Channel interfaces.



Figure 6-16 IBM TS1120 tape drive

## Highlights

- ▶ Supports IBM Systems and selected open system platforms.
- ▶ Supported on existing IBM and Sun StorageTek automation.
- ▶ Offers native data transfer rate of up to 104 MBps—over 2.5 times as fast as the IBM TotalStorage 3592 Tape Drive and over seven times as fast as the 3590.
- ▶ Data transfer rate up to 260 MBps with 3:1 compression.
- ▶ Up to 700 GB native cartridge capacity, a 1.6 times increase over the IBM TotalStorage 3592 Tape Drive and five times as much as the 3590 H Models.
- ▶ Supports up to 1.5 TB (uncompressed in a System z9® environment) on a 3592 JA/JW cartridge.
- ▶ Supports fast access with a 3592 JJ/JR cartridge.
- ▶ Helps support regulatory compliance requirements for records retention with WORM media.
- ▶ Up to 2.1 TB on a 3592 JB/JX cartridge.
- ▶ Supports encryption and key management.
  - Supports a single encryption key management approach, which may help reduce audit and compliance costs.
  - Helps to avoid the need for host-based encryption of data or the use of specialized encryption appliances.

## Media support

The TS1120 tape drive can initialize short length JJ cartridges to 60 or 100 GB and initialize (or re-initialize) standard length JA cartridges to 60, 100, 300 or 500 GB to support fast access to data or to help address data growth and facilitate interchange. At typical

compression ratios, the 3592 JA cartridge can provide usable capacity of up to 1 TB in an open system environment, and up to 1.5 TB in an IBM System z9 environment when used with a TS1120 tape drive.

### More information

For additional product details, refer to:

<http://www.ibm.com/systems/storage/tape/drives/index.html>

## 6.3.2 IBM System Storage TS1120 Tape Controller Model C06

The IBM System Storage TS1120 Tape Controller Model C06 (model type 3592-C06) provides performance and reliability for IBM System z clients. The IBM System Storage TS1120 Tape Controller Model C06, has up to four 4 Gbps FICON attachments. The TS1120 Tape Controller also has up to eight ESCON attachments, or an intermix of ESCON and FICON attachments. Up to 16 IBM System Storage TS1120 Tape Drives or IBM TotalStorage 3592 Tape Drives can be attached to a single TS1120 Tape Controller.

The controller can be installed in an IBM System Storage 3952 Tape Frame Model F05 , an IBM 3953 Tape Frame Model F05, or in a stand-alone rack, supporting 3592 Tape Drives installed in IBM 3494 frames, IBM 3584 frames, IBM 3592 Model C20 frames, and stand-alone racks.

TS1120 tape drives can be shared among supported open system hosts on a Storage Area Network (SAN), or between FICON and ESCON mainframe hosts when attached to an IBM System Storage TS1120 Tape Controller (TS1120 tape controller). Sharing drives optimizes drive utilization and helps reduce infrastructure requirements.

The TS1120 Tape Controller provides up to 1.7 times the throughput of the IBM TotalStorage 3592 Tape Controller Model J70, with 4 Gbps FICON attachment using the 3592 Model J1A Tape Drive.

The TS1120 Tape Controller has many of the reliability and availability characteristics that the 3592 Model J70 offered, such as redundant power supplies with automatic failover and hot swap capabilities, redundant cooling, and support for the IBM TS3000 System Console (TSSC) attachment, previously known as the IBM TotalStorage Master Console (TSMC).

The TS1120 Tape Controller also includes application performance and capacity enhancements that are available with the 3592 Model J70, such as capacity scaling commands. The effect of capacity scaling is to potentially reduce the average locate time to a random record (from load point) to as little as 30% of the normal locate time. Figure 6-17 shows the IBM TS1120 Tape Controller.

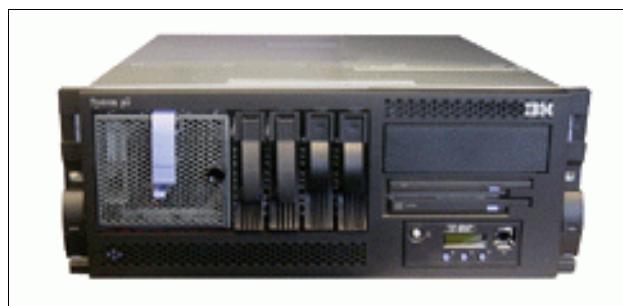


Figure 6-17 IBM TS1120 Tape Controller

### **IBM System Storage TS1120 Tape Controller highlights**

- ▶ Enables System z attachment for the IBM System Storage TS1120 Tape Drive.
- ▶ Supports the IBM System Storage TS3400, TS3500 and TotalStorage 3494 Enterprise Tape Libraries, StorageTek 9310 Powderhorn Tape Library; and stand-alone rack and frame environments.
- ▶ Designed to fully exploit the high performance, capacity, and reliability of the TS1120 tape drive.
- ▶ Designed to support the 700GB extended capacity, 500GB standard capacity and 100 GB fast-access formats of the IBM 3592 tape cartridges.
- ▶ Enables tape drive and tape cartridge sharing between ESCON and FICON enabled System z servers.
- ▶ Supports TS1120 tape drive encryption.

#### **6.3.3 IBM System Storage TS1130 Tape Drive**

The IBM System Storage TS1130 Tape Drive (also referred to as the 3592 Model E06 and EU6) is the third tape drive generation of the IBM 3592 tape family. Refer to Figure 6-18. This generation provides higher capacity and performance compared to the predecessor 3592 Model E05.

The TS1130 records in two recording formats supporting both encryption and non-encryption. Enterprise format 3 (EFMT3) is used to represent the non-encrypted recording format, and enterprise encrypted format 3 (EEFMT3) is used to denote the encrypted recording format. With these recording formats, the non-compressed capacity of the extended length MEDIA9 and MEDIA10 cartridges is increased from 700 GB to 1 TB.

The 3592 Model E06 is downward read compatible (n-2) to the 3592 Model J1A format (EFMT1) and is downward write compatible (n-1) to the 3592 Model E05 formats (EFMT2/EEFMT2). All current media types are supported.



Figure 6-18 Front View of TS1130 Tape

The 3592-E06 supports all of the same subsystems and automation environments as the previous models. The 3592-E06 and 3592 cartridges support multiple automation libraries

and can be easily transported between environments (consider the compatibility requirements for silo-attached 3592 tape drives).

The TS1120 tape controller offers ESCON and FICON attachment of TS1130 tape drives in a TS3400, TS3500 or 3494 tape library, 3952 C20 frame or rack to support drives in a 3494 tape library the tape controller must reside in an IBM 3952 Tape Frame Model F05.

To help optimize drive utilization and reduce infrastructure requirements, the TS1130 tape drives can be shared among supported open system hosts on a Storage Area Network (SAN) or between IBM FICON and ESCON mainframe hosts when attached to an IBM System Storage TS1120 Tape Controller.

To further protect mission-critical data, the TS1130 tape drive provides advanced technology—such as error correction code and factory-written servo tracks on the tape cartridge—to provide precise head positioning. In addition, unique functions such as virtual backhitch and a high-resolution directory help improve small file write performance and improve recall access to data, respectively.

The IBM 3592 cartridges used in the TS1130 tape drive are available in short, standard and extended lengths and in rewritable and WORM formats. Cartridges can be ordered in packs of 20 and can be labeled and initialized, initialized only, or unlabeled and uninitialized. An RFID label option is also available.

### **Highlights of the TS1130 Tape Drive**

- ▶ Provides information security with support for encryption and key management.
  - Supports a single encryption key management approach, which may help reduce audit and compliance costs.
  - Helps to avoid the need for host-based encryption of data or the use of specialized encryption appliances.
- ▶ Optimizes information retention with support for existing IBM tape automation.
- ▶ Supports Write Once Read Many (WORM) cartridges to help satisfy compliance requirements.
- ▶ Offers high performance and high capacity for storage consolidation.
- ▶ Up to 3 TB on a 3592 JB/JX cartridge.
  - High capacity helps reduce the need for additional tape drives and cartridges.
  - Uses fewer drives to reduce complexity of your tape infrastructure.
- ▶ 320 MBps in open system environments where data typically compresses at 2:1.
- ▶ 350 MBps in a mainframe environment where data typically compresses at 3:1.
- ▶ Virtual backhitch and high resolution directory which will improve access to data and reduce wear and tear on media.
- ▶ IBM Power Systems, System i, System p, System z, and System x support.

#### **6.3.4 IBM System Storage TS7650G ProtectTIER Deduplication Gateway**

Refer to 6.2.9, “IBM System Storage TS7650G ProtectTIER Deduplication Gateway” for information about the TS7650G ProtectTIER Deduplication Gateway.

### **6.3.5 IBM System Storage TS3400 Tape Library**

Refer to 6.2.6, “IBM System Storage TS3400 Tape Library” for information about the IBM System Storage TS3400 Tape Library.

### **6.3.6 IBM System Storage TS3500 Tape Library**

Refer to 6.2.7, “IBM System Storage TS3500 Tape Library” for information about the IBM System Storage TS3500 Tape Library,

### **6.3.7 IBM Virtualization Engine TS7700**

The IBM Virtualization Engine TS7700 (TS7700 Virtualization Engine) is a family of mainframe virtual-tape solutions that are designed to optimize tape processing. With one solution, the implementation of a fully integrated tiered storage hierarchy of disk and tape leverages the benefits of both technologies to help enhance performance and provide the capacity needed for today’s tape processing requirements. Deploying this innovative subsystem can help reduce batch processing time, total cost of ownership and management overhead.

The IBM Virtualization Engine TS7700 provides tape virtualization for the IBM System z environment. The Virtualization Engine TS7700, shown in Figure 6-19, is designed to provide improved performance and capacity to help lower the total cost of ownership for tape processing. It introduces a new modular, scalable, high-performing architecture for mainframe tape virtualization. The TS7700 is available as the TS7740 R1.5, which brings significant enhancements over its previous release and now also comes as a disk-only solution, the TS7720, which does not require physical tape attachment.



*Figure 6-19 IBM Virtualization Engine TS7700*

The Virtualization Engine TS7700 integrates the advanced performance, capacity, and data integrity design of the 3592 Tape Drives, the IBM industry-leading tape technology, with high-performance disk and a new advanced IBM System p server to form a storage hierarchy managed by robust storage management firmware with extensive self management capability. It includes functions such as advanced policy management to control physical volume pooling, cache management, dual copy, dual copy across a grid network, and copy mode control. The TS7700 offers enhanced statistical reporting and a single, standards-based management interface for TS7700 management.

### **TS7700 Virtualization Engine highlights**

- ▶ System z FICON attachment
- ▶ TS7740 with ~14 TB cache
- ▶ TS7720 disk-only with ~40 TB or ~70TB cache
- ▶ Support for 2 or 3 cluster grids
- ▶ Copy Export for standalone cluster
- ▶ 3592 drives including native TS1120/TS1130 support
- ▶ 3584 libraries
- ▶ 3494 libraries (w/ 3592) (RPQ required with R1.6 or higher)
- ▶ 256 Virtual Drive addresses
- ▶ 256 Logical Paths per port
- ▶ Out-of-Band Encryption support
- ▶ Broadband Call Home (ECC)

## **6.4 External tape enclosures**

IBM offers a wide range of external tape drives and external enclosure technology to help support business continuance in the workplace. These models include:

- ▶ IBM 7206 Model 336 External DAT72 (DDS Gen 5) Tape Drive
- ▶ IBM DDS Generation 5 USB Tape Drive
- ▶ IBM DDS Generation 6 USB Tape Drive
- ▶ IBM TotalStorage 7207 External Tape Drive
- ▶ IBM System Storage 7212 Storage Device Enclosure Express Model
- ▶ IBM System Storage 7214 Storage Device Enclosure
- ▶ Half High Tape Drive External Enclosure
- ▶ 1U Tape Drive External Enclosure

### **6.4.1 IBM TotalStorage 7206 Model 336 External DDS Gen 5 Tape Drive**

The IBM 7206 Model 336 External DAT72 (DDS Gen 5) Tape Drive (as seen in Figure 6-20 on page 150), is designed to be a cost-effective tape drive featuring the popular DAT72 (DDS) tape technology. It is designed to offer improved data quality and performance and increased capacity compared to the IBM 7206 Model 220. The 7206 Model 336 supports a migration path to greater tape storage capacity at a price point similar to IBM 7206-220 DDS4 tape drives.

The IBM 7206 Model 336 External DDS Gen 5 (DAT72) Tape Drive can be attached to System p servers via an Ultra2, Ultra3, or Ultra320 SCSI LVD interface.

The 7206 Model 336 tape drive can achieve a media capacity up to 72 GB with 2:1 data compression, nearly twice the capacity of the previous IBM 7206-220 DDS4 tape drive. The 7206 Model 336 offers a sustained data transfer rate of up to 6 MB per second (with 2:1 compression).

For more information, visit the web at:

<http://www.ibm.com/systems/storage/tape/7206/336/index.html>

### IBM 7206 Model 336 highlights

Here are some highlights for the IBM TotalStorage 7206 Model 336 External DDS Gen 5 Tape Drive:

- ▶ Designed for improved data rate compared to IBM 7206 Model 220
- ▶ Designed for read and write compatibility with previous generation 4 mm tape media  
Read and write compatible with two previous generations of DDS tape technology
- ▶ Capacity of up to 72 GB per media cartridge
- ▶ Data transfers up to 21 GB per hour
- ▶ Compatible with most IBM System i and IBM System p server models
- ▶ Limited lifetime warranty on IBM DAT72 (DDS Gen 5) media



Figure 6-20 IBM TotalStorage 7206 Model 336 External DDS Gen 5 Tape Drive

#### 6.4.2 IBM DDS Generation 5 USB tape drive

The IBM DDS Generation 5 USB tape drive (as seen in Figure 6-21 on page 151), is the entry point into the IBM DDS tape drive family and offers dependable capacity and performance for value-conscious small and medium or distributed large enterprise businesses. DDS/DAT technology has the proven reliability and low cost of ownership to effectively meet the demanding backup, archival, and regulatory compliance requirements of your System x environment.



Figure 6-21 IBM DDS Generation 5 USB tape drive

IBM DDS Generation 5 technology delivers a capacity of up to 72 GB on a single data cartridge and a transfer rate of up to 22 GB/hr (assuming a 2:1 compression ratio) at an entry price point. Its USB 2.0 interface supports internal plug and play capability with the latest System x systems, as well as external attachment in one of IBM's external tape drive enclosures. DDS Generation 5 technology is also backward read and write compatible with DDS-3 and DDS-4/DAT 40 media to ensure an easy migration or upgrade path for existing DDS/DAT users.

For more information about the IBM DDS Generation 5 USB Tape Drive, visit the web at:

<http://www.redbooks.ibm.com/abstracts/tips0755.html?Open>

### IBM DDS Generation 5 USB tape drive highlights

- ▶ USB interface allowing for direct internal connections with select System x servers.
- ▶ Eliminates potential RAID conflicts and extra controllers.
- ▶ 5.25-inch half-high form factor.
- ▶ Drive can be converted to 3.5 inch form factor either in the factory (CTO) or in the field using the appropriate enablement kit.
- ▶ Internal USB interface for simplified plug-and-play installation.
- ▶ Optional DDS Tape Enablement kits allow for internal installation in select IBM System x rack-optimized servers.
- ▶ Flexible external USB configuration offerings when used with desktop or 1U rack-mount enclosures.
- ▶ Support for leading operating systems and popular backup software.
- ▶ Up to 36 GB native capacity, and up to 72 GB in compressed mode.
- ▶ Up to 3.0 MBps native back-up rate, and up to 6.0 MBps in compressed mode.
- ▶ USB 2.0 interface.
- ▶ Read/write compatibility with DDS-4, and DDS-3 cartridges.
- ▶ Available internal or external USB port.
- ▶ Available 5.25-inch half-high bay for internal installations.
- ▶ Supported external tape enclosure for external attachment.
  - IBM 1U Rackmount Tape Enclosure
  - IBM Half High Tabletop Tape Enclosure

### 6.4.3 IBM DDS Generation 6 USB Tape Drive

The IBM DDS Generation 6 Internal USB Tape Drive provides optimum capacity, performance, and a low total cost of ownership for small and medium business environments or enterprise workgroups that require the highest capacity and performance DDS (DAT) drive available. The drive supports DDS Generation 6 cartridges, which have a native capacity of 80 GB (160 GB compressed) as well as a transfer rate of up to 6.9 MBps native and up to 13.8 MBps compressed, as seen in Figure 6-22.



Figure 6-22 IBM DDS Generation 6 USB Tape Drive

The IBM DDS Generation 6 USB Tape Drive maintains the competitive total cost of ownership of Digital Data Storage. Its USB interface supports plug and play capability with the latest System x systems, and can be installed internally in supported servers or supported externally in tape drive enclosures. This option is a higher performance and capacity alternative to the IBM DDS Generation 5 drive.

For more information about the IBM DDS Generation 6 USB Tape Drive, visit the web at:

<http://www.redbooks.ibm.com/abstracts/tips0725.html?open>

#### IBM DDS Generation 5 USB tape drive highlights

Here are some highlights for the IBM DDS Generation 6 USB Tape Drive:

- ▶ Highest capacity and performance in the DDS portfolio
- ▶ Up to 80 GB native capacity, and up to 160 GB in compressed mode
- ▶ 6.9 MBps native back-up rate and up to 13.8 MBps in compressed mode
- ▶ USB 2.0 interface
- ▶ Read/write compatibility with DDS Gen-5 and DDS-4 cartridges
- ▶ 5.25 inch half-high form factor; drive can be converted to 3.5 inch form factor either in the factory (CTO) or in the field using the appropriate enablement kit
- ▶ Internal USB interface for simplified plug-and-play installation
- ▶ Optional DDS Tape Enablement Kit allows for internal installation in select IBM System x rack-optimized servers
- ▶ Flexible external USB configuration offerings when used with desktop, 1U rack-mount, or 4U rack-mount enclosures
- ▶ The IBM DDS Generation 6 Media 5 Pack has a limited lifetime warranty

#### **6.4.4 IBM TotalStorage 7207 External Tape Drive**

The IBM TotalStorage 7207 External Tape Drive (shown in Figure 6-23), offers an affordable back-up, archival storage, and data interchange for your iSeries/AS400 and pSeries/RS6000 systems.

The 7207 Model 330 SLR60 External Tape drive provides up to 37.5 GB of capacity and a data rate of 4 MB/sec. Media sizes of 30 GB and 37.5 GB are available. Assuming a compression of 2:1, typical of this tape drive, the tape drive reaches capacities of 60 GB and 75 GB respectively and a transfer rate of 8 MB/sec.



Figure 6-23 IBM TotalStorage 7207 External Tape Drive

#### **IBM TotalStorage 7207 External Tape Drive highlights**

- ▶ SCSI (LVD/SE) attachment to eServer™ iSeries/AS400 and pSeries/RS6000 systems.
- ▶ The 7207 model 330 provides Read/Write compatibility with SLR100, MLR3 and MLR1 (QIC) tape formats and read compatible with SLR5 and DC9250 media.
- ▶ Sustained Data Rate of 4 MB/sec (8 MB/sec with compression) for the 7207 model 330.
- ▶ Capacities of up to 37.5 GB (75 GB when compressed) for the model 330, 4 GB (8 GB with compression) for the 122.
- ▶ Capacity per cartridge (2 options):
  - Up to 30GB native: up to 60GB compressed (Part Number: 14P4209)
  - Up to 5GB native: up to 10GB compressed (Part Number: 35L0661)

For more information about the IBM System Storage 7207 External Tape Drive, visit the web at:

<http://www-03.ibm.com/systems/storage/tape/7212/index.html>

#### **6.4.5 IBM System Storage 7212 Storage Device Enclosure Express Model**

Refer to 6.1.9, “IBM System Storage 7212 Storage Device Enclosure Express Model” for information about the IBM System Storage 7212 Storage Device Enclosure.

#### **6.4.6 IBM System Storage 7214 Storage Device Enclosure**

Refer to 6.1.10, “IBM System Storage 7214 Storage Device Enclosure” for information about the IBM System Storage 7214 Storage Device Enclosure.

#### **6.4.7 Half High Tape Drive External Enclosure**

The Half-High SCSI Tape Enclosure (shown in Figure 6-24), provides a space-saving and low cost alternative to mounting a drive internally in your server. In stealth black, this table or shelf unit becomes an ideal solution when you are looking for a home for one of our wide array of half-high System x tape drives.



Figure 6-24 HH Tape Drive External Enclosure

### Half High Tape Drive External Enclosure highlights

- ▶ Single half-high bays
- ▶ Either table top or shelf form factor.
- ▶ Drive dependant interface of either Single SCSI Enclosure Adaptor Kit (42C3910) or SAS Enclosure Adaptor Kit (40K2599) required.
- ▶ SAS Enclosure Adaptor Kit (40K2599) supports both SAS and SATA Based Drive.

For more information about the HH Tape Drive External Enclosure, visit the web at:

<http://www-03.ibm.com/systems/storage/tape/halfheightapedrive/index.html>

**Note:** The IBM Full High Tape Drive External Enclosure has been withdrawn from the market as of January 2, 2009.

### 6.4.8 1U Tape Drive External Enclosure

The IBM 1U rack-mount external tape enclosure (shown in Figure 6-25), provides a cost-effective solution for adding up to two half-height tape drives externally to your IBM rack-optimized System x server environments.



Figure 6-25 1U Tape Drive External Enclosure

### 1U Tape Drive External Enclosure highlights

- ▶ Two half-high bays
- ▶ 1U Rack-Mount Form Factor
- ▶ Interface of either Single SCSI Enclosure Adaptor Kit (42C3910) or SAS Enclosure Adaptor Kit (40K2599) required (up to 2 Max)
- ▶ SAS Enclosure Adaptor Kit (40K2599) supports both SAS and SATA-based drives

For additional information about the 1U Tape Drive External Enclosure, visit the web at:

<http://www.ibm.com/systems/storage/tape/1utapedrive/index.html>

**Note:** The IBM 4U Tape Drive External Enclosure has been withdrawn from the market as of July 3, 2008.





# Storage solutions

This chapter discusses several storage solutions offered by IBM in the areas of archiving and retention, data deduplication, and cloud storage. They are as follows:

## **Archiving and retention**

IBM Information Archive represents the next generation information retention solution. It is designed as an archiving repository for all types of content (structured or unstructured) to help organizations of any size address complete information retention needs—business, legal, or regulatory.

## **Data deduplication**

IBM System Storage ProtecTIER Solutions are designed to improve backup and recovery operations and help protect valuable data more efficiently and reliably while reducing operational costs and energy usage.

## **Cloud storage solutions**

IBM Smart Business Storage Cloud (SBSC) is a range of flexible storage virtualization solutions and appliances that will help alleviate data storage challenges by enabling quick implementation of highly scalable, global, clustered network-attached storage systems.

## 7.1 Archive and retention

There is a rapidly growing class of data that is best described by the way in which it is managed rather than the arrangement of its bits. The most important attribute of this kind of data is its retention period, hence it is called retention managed data, and it is typically kept in an archive or a repository. In the past it has been variously known as archive data, fixed content data, reference data, unstructured data, or other terms implying its read-only nature. It is often measured in terabytes and is kept for long periods of time, sometimes forever.

IBM Information Archive offers policy-based data retention capabilities designed to support nonerasable, nonrewritable (NENR) or write once read many (WORM) data storage protection, and helps address the needs of regulated and non-regulated industries with long-term data retention and protection requirements.

### 7.1.1 IBM Information Archive

IBM Information Archive (as seen in Figure 7-1), is a consolidated hardware and software offering built with the latest IBM technologies, enabling the archive of data with scalability to multiple petabytes.

In addition to data encryption capabilities, each collection within the IBM Information Archive maintains a set of tamper-proof audit logs, which provide an immutable and retention-protected provenance record for documents in the collection. Audit logs track document ownership and system lifecycle events including document creation and deletion, changes to retention policies, and system software upgrades.



Figure 7-1 IBM Information Archive

IBM Information Archive is the next generation information retention solution, which brings together off-the-shelf IBM hardware and software products along with customized

applications for ease of management and use. It is a universal, scalable, and secure storage repository for structured and unstructured information as a compliant or noncompliant integrated archive appliance.

## **IBM Information Archive is**

- ▶ The Next Generation Information Retention Solution
- ▶ A universal storage repository for all types of content of structured (database) and unstructured (files, email, images, and docs)
- ▶ A robust, scalable, secure information retention, fully integrated hardware, software and services solution
- ▶ A complete business, legal, or regulatory information retention solution for mid-size and enterprise clients

IBM Information Archive is easy to implement, configure, and manage, allowing you to start archiving the next day. It looks like a file server; just simply drag and drop files to IA. Built to industry standards, IA works with any archiving application that supports the standard NAS interface. There is no additional integration work required.

IA allows you to optimize your storage infrastructure immediately. You can do this by offloading your production files to IA right away and gain storage efficiencies, leveraging tape and automatically migrating to tape for cost and energy savings, and storing a single instance of the same files, creating storage space savings.

## **IBM Information Archive features and benefits**

Additional features and benefits of the IBM Information Archive are as follows:

- ▶ Designed to offer quick time-to-value by being able to install and configure quickly and easily
- ▶ Ease of use—manage the archive from a single point, manage data with fewer resources, designed to help reduce the cost
- ▶ Information protection levels and retention policies which address unique data retention needs with flexible information protection levels
  - Stores data in up to three collections per system and assign different levels of protection and retention policies for different kinds of data.
  - Allows compliant and noncompliant storage within same appliance foot-print.
  - Offers Patent-Pending Enhanced Tamper protection.
  - Accepts retention policies from applications or creates them.
  - Accepts time-based and event-based information retention policies to protect information from intentional or accidental deletions or modifications.
  - Accepts retention hold and deletion hold policies to set an indefinite period of retention for a file, such as during legal discovery.
- ▶ Increase capacity and performance designed to grow with your needs  
Storage can be added to increase capacity and nodes to increase performance.
- ▶ Standard-based interfaces  
Industry standard interfaces eliminate the need for customized application programming interface (API) or add-on feature requirements, helping you manage operational costs.
- ▶ Data-deduplication and compression, which helps lower total cost of ownership (TCO) by providing embedded deduplication and compression capabilities

- Designed to optimize storage capacity and to improve productivity.
- ▶ Tiered storage management
  - Designed to allow a cost-effective mix on nearline and offline storage (disk and/or tape) to contain costs while leveraging storage technology for optimum usage.
- ▶ Universal storage repository for all types of content, structured and unstructured, compliant or noncompliant
- ▶ Provides up to three information protection levels offering maximum flexibility.
- ▶ Stores information via multiple access methods.
- ▶ Scales up to 304 TB (Raw Capacity).
- ▶ Maintains data integrity until deletion is permitted by retention policy.
- ▶ Enhanced security and protection with data encryption option.
- ▶ Helps optimize storage consumption with data deduplication and compression features.
- ▶ Offers low Total Cost of Ownership (TCO) by allowing use of mixed media (disk and tape).
- ▶ Increases data security through patent-pending Enhanced Tamper Protection feature.

For additional information about the IBM Information Archive, see *IBM System Storage Solutions Handbook*, SG24-5250.

## 7.2 Data deduplication

Data deduplication solutions from IBM employ an advanced form of data compression that identifies and eliminates redundant data across the data landscape, making it possible to significantly reduce the amount of data that needs to be protected. This in turn dramatically increases the effective capacity of existing disk storage, so that far less physical disk is required to protect the data. Beyond the direct resource savings associated with needing less disk space, which can be in the hundreds of thousands or millions of dollars, the benefits of data deduplication include:

- ▶ Greater productivity that comes from being able to perform more frequent backups with the same amount of physical disk
- ▶ Increased efficiency because of the greater likelihood that data will be able to be restored from disk rather than a slower medium
- ▶ Reduced energy consumption that results from reducing the amount of disk in operation

Data deduplication with IBM technology is shown in Figure 7-2 on page 161.

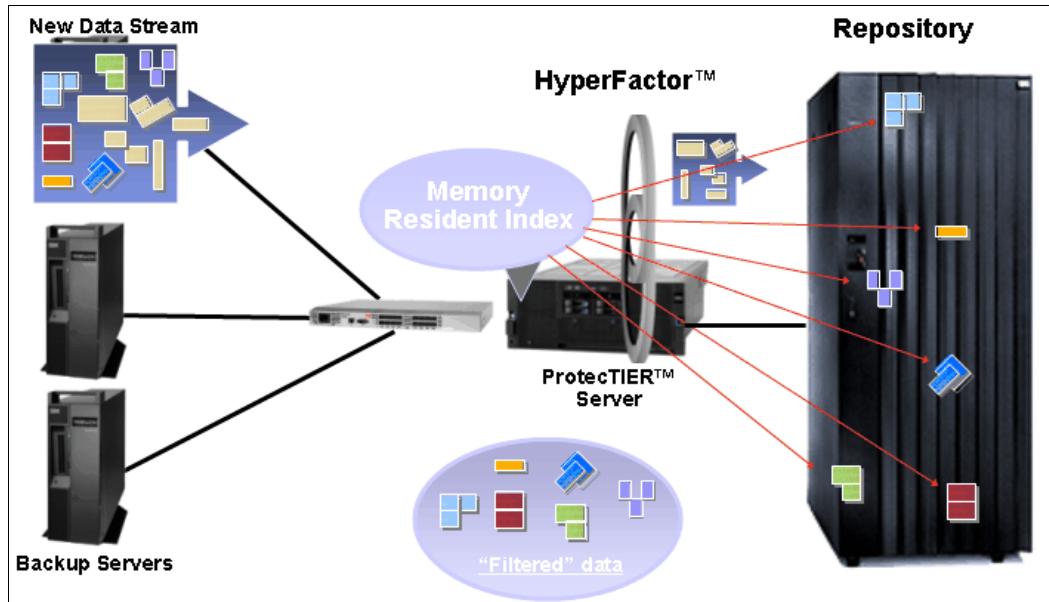


Figure 7-2 Data deduplication with ProtecTIER server

## 7.3 IBM System Storage ProtecTIER solutions

IBM System Storage ProtecTIER products include the following products.

### 7.3.1 IBM System Storage TS7650 ProtecTIER Deduplication Appliance

The IBM System Storage TS7650 ProtecTIER Deduplication Appliance (as seen in Figure 7-3 on page 162), is a preconfigured solution of IBM storage, IBM server and the IBM revolutionary ProtecTIER data deduplication software designed to improve backup and recovery operations. This is not just a bundle of components, but a truly integrated solution that makes it easy to harness the power of deduplication without making radical changes to the existing environment. The solution is available in four configurations designed to meet the disk-based data protection needs of a wide variety of organizations, from mid-sized IT environments to enterprise data centers.



Figure 7-3 IBM System Storage TS7650 ProtecTIER Deduplication Appliance

### TS7650 ProtecTIER Deduplication Appliance features

The IBM System Storage TS7650 ProtecTIER Deduplication Appliance offers many features that can create savings in physical storage, processing, and network bandwidth:

- ▶ Emulation of up to 12 virtual libraries, 256 virtual drives and 128,000 virtual cartridges
- ▶ IBM ProtecTIER with patented HyperFactor data deduplication technology
- ▶ ProtecTIER Native Replication technology
- ▶ IBM System x server for enterprise-level performance
- ▶ IBM Storage Controller with highly reliable Fibre Channel drives
- ▶ Rack, cables, and other components needed to provide a complete solution
- ▶ Up to 500 MB/sec or more inline data deduplication performance
- ▶ Up to 25 times or more storage capacity reduction
- ▶ Simplified configuration and deployment

The IBM System Storage TS7650 ProtecTIER Deduplication Appliance is available in the following four configurations:

- ▶ TS7650 ProtecTIER Deduplication Appliance
  - 7 TB configuration with performance of up to 100 MB/sec or more inline
    - Inline data deduplication with a physical capacity of 7 TB and usable capacity of 175 TB (based on deduplication ratio of 25:1)
  - 18 TB configuration with performance of up to 250 MB/sec or more inline
    - Inline data deduplication with a physical capacity of 18 TB and usable capacity of 450 TB (based on deduplication ratio of 25:1)
    - Flexible and scalable growth to 36 TBA

- 36 TB configuration with performance of up to 500 MB/sec or more inline
  - Inline data deduplication with a physical capacity of 36 TB and usable capacity of 900 TB
  - Up to nine times faster than the competition delivers
- 36 TB Dual-node Cluster Configuration with performance of up to 500 MB/sec or more
  - Inline data deduplication with a physical capacity of 36 TB and usable capacity of 900 TB High Availability

### 7.3.2 TS7650G ProtecTIER Deduplication Gateway

The TS7650G ProtecTIER Deduplication Gateway (as seen in Figure 7-4), comprised of the IBM System Storage TS7650G Server combined with IBM System Storage ProtecTIER Enterprise Edition software, is designed to address the data protection needs of enterprise data centers. The solution offers high performance, high capacity, scalability, and a choice of disk-based targets for backup and archive data.

The TS7650G ProtecTIER Deduplication Gateway is an enterprise-class data protection platform designed to quickly and safely protect business information while reducing the amount of space required to store it. Deploying the TS7650G ProtecTIER Deduplication Gateway can help organizations more efficiently protect their corporate data on disk-based storage while helping them manage the exponential growth of new data through reduction and elimination of duplicate data in their backups.



Figure 7-4 IBM Storage System TS7650G ProtecTIER Deduplication Gateway

#### What the TS7650G ProtecTIER Deduplication Gateway offers

- ▶ Virtual tape emulation of up to 16 virtual tape libraries per single node or two-node cluster configuration and up to 512 per two-node cluster or 256 virtual tape drives per TS7650G
- ▶ In-line data deduplication powered by HyperFactor technology
- ▶ Multicore virtualization and deduplication engine
- ▶ Clustering support for higher performance
- ▶ Fibre Channel ports for host and server connectivity
- ▶ Performance—up to 1000 MB/s or more sustained inline deduplication (clustered nodes)
- ▶ Emulation of the IBM TS3500 tape library with IBM Ultrium 2 or Ultrium 3 tape drives
- ▶ Emulation of the Quantum P3000 tape library with DLT tape drives
- ▶ Scales to 1 PB of physical storage over 25 PB of user data

For more information, see *IBM System Storage Solutions Handbook*, SG24-5250.

## 7.4 Cloud storage solutions

The IBM smart business storage cloud (SBSC) is a range of flexible storage virtualization solutions and appliances that will help alleviate data storage challenges by enabling quick implementation of highly scalable, global, clustered network-attached storage systems.

### 7.4.1 IBM Smart Business Storage Cloud

IBM Smart Business Storage Cloud offers a storage virtualization solution designed to support your storage optimization efforts. It can help alleviate your data storage challenges by enabling quick implementation of a scalable, global file storage system with flexibility in deployment and management options. The solution provides virtualized storage to enable storage and server consolidation, a unified management platform to help reduce outages and storage management labor demands and costs, as well as advanced data replication for cost effective business continuity and disaster recovery.

IBM offers several types of cloud solutions and appliances, for storage and other services: Smart Business on the IBM Cloud, Smart Business Cloud services, and Smart Business Systems.

#### Public Cloud vs. Private Cloud

There are two main scenarios for storage clouds that IBM customers can choose to pursue based on their business drivers and technical strategy.

The two scenarios are defined as Public Storage Cloud and Private Storage Cloud, the key differentiators of these scenarios is that the public storage cloud is designed for customers who do not want to own, manage, or maintain the storage environment thus reducing their capital and operational expenditures cost around storage. The public storage cloud provides for variable billing options and shared tenancy of the storage cloud, giving customers the flexibility to manage the usage and growth of their storage needs. This is the industry standard view of a storage cloud offering and is comparable to storage cloud offering by other vendors.

The Private Cloud has fixed charges and dedicated tenancy, so it is designed for enterprise customers who want flexibility around ownership, management, and maintenance of the storage cloud.

#### Public Cloud

Similar to a rent model, IBM dictates the choice of technology and cloud location, shared infrastructure with variable monthly charges, dynamic physical capacity at the client level, and security measures to isolate client data.

In a Public Cloud IBM owns the physical assets, facilities, and standard contracts with multiple service level agreements (SLA) to meet specific needs. Public Cloud solutions work well for cross industry solutions that are storing from tens of terabytes (TB) to multiple petabytes (PB) of data.

#### Private Cloud

Similar to a purchase or lease model, with a Private Cloud clients have the choice of technology and location on dedicated infrastructure with fixed monthly charges and physical capacity at the client level.

Each application can utilize dynamic capacity by sharing the cloud storage among multiple applications. Furthermore, the Private Cloud provides built-in security through platform

dedication, choice of asset ownership, and custom service level agreements (SLA) to meet specific needs.

Private clouds also work well for cross-industry solutions storing tens of terabytes to multiple petabytes of data.

### 7.4.2 Smart Business Storage Cloud

A Smart Business Storage Cloud is a combination of hardware and software components combined to form a system, or solution, that provides three key features:

- ▶ A global namespace
- ▶ A clustered file system
- ▶ Information Lifecycle Management (ILM)

As shown in Figure 7-5, virtualizing the file sharing system (NFS, CIFS, and so on) using a single, global, namespace means that you see one device rather than individual servers and storage devices that comprise this virtual NAS device.

At the heart of the SBSC system is the IBM General Parallel File System (GPFS). GPFS is one of the most scalable commercial file systems available, installed in thousands of nodes and storing petabytes of data in discrete installations. SBSC enables the virtualization of the NFS service, transparently distributing service requests across multiple servers, which in turn enables the creation of a scale-out NAS farm installation.

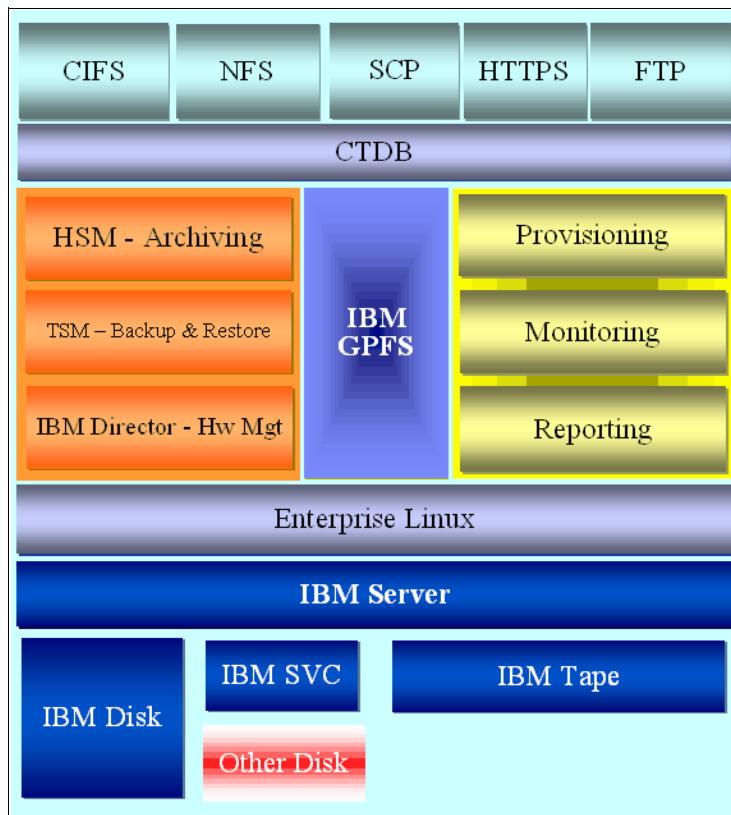


Figure 7-5 SBSC components

The SBSC solution is extremely resilient. It is designed so that there is no single point of failure in the system. It also allows for disaster recovery configurations that use the global file

system. These options include synchronous and asynchronous mirroring of data either on site or between sites, and cross-cluster file system mounts.

SBSC supports snapshots integrated into Windows Explorer using volume shadow copy services.

The SBSC solution also supports fully configurable data lifecycle management. Data can be stored in ways relative to the data value and performance requirements. File placement can be defined by flexible policies, while data can be classified according to service level agreements and placed on appropriate storage tiers automatically at creation time or moved automatically using the integrated ILM functionality. SBSC also supports LTO-4 tape backup with data encryption, which offers protection for archived data.

### 7.4.3 How SBSC works

The SBSC system provides file services by implementing a *scale-out* approach. SBSC uses the wide-striping capability of IBM GPFS to spread the blocks of a single file across as many nodes as possible to combine the streaming performance of many midrange back-end storage devices. All files are accessed by all nodes, which removes the traditional NAS and earlier global namespace implementation limitations of specific files being “pinned” to individual filers. By doing so, a bandwidth of multiple gigabytes per second is possible because the I/O performance of many disks can be combined instead of storing data only to a small RAID device as filers do today.

By fully exploiting the capabilities of GPFS, the integration of a policy-based life-cycle management interface and the possibility to place files in a directory that spans multiple independent storage classes creates a single file system with multiple storage classes—each with its own performance, availability, and cost criteria—on a file basis, not on a filer basis, as has been done in the past.

SBSC utilizes and expands the IBM Tivoli Storage Manager (TSM) and Tivoli Hierarchical Storage Manager (HSM) products to integrate tape as an additional storage class inside the cloud. This allows transparent migration of data between disk and tape storage and provides end-to-end lifecycle management of the data.

The physical implementation of SBSC leverages the IBM BladeCenter for highly efficient and scalable processing with various IBM storage devices. The BladeCenter provides a scalable platform for adding storage controllers into the SBSC pool to achieve the right performance balance. Processing blades share power, cooling, and I/O connectivity within the BladeCenter chassis and achieve very efficient performance versus standalone servers.

To provide a single global namespace to the user, SBSC uses virtualization and redirection technologies available within GPFS clusters. Each SBSC cluster node has internal access to all data blocks simultaneously and is able to assume the responsibility for each of the other nodes in a cluster. This provides the means for a transparent, nondisruptive protocol failover for client applications. Because none of the existing cluster technologies provides a transparent failover of network-based file systems, SBSC introduces an extremely scalable cluster suite dealing with the specifics of file systems to provide a high degree of semantic correctness while being able to scale to very high bandwidths.

### 7.4.4 SBSC and other clustered file systems - differences

While other clustered file systems are just that, SBSC is more of a “storage controller in a grid” meaning that the ownership of data is handled dynamically. In many clustered file system implementations, there is one node that is the default owner of some portion of the

data. To maintain this structure requires high volumes of internode communication, and in case the owning node goes down the IP and data must be taken over by another node. While IP takeover is not a big problem, the takeover of data often proves difficult. As can be seen in Figure 7-6 with SBSC, this problem is completely overcome as any node can see any data at any time.

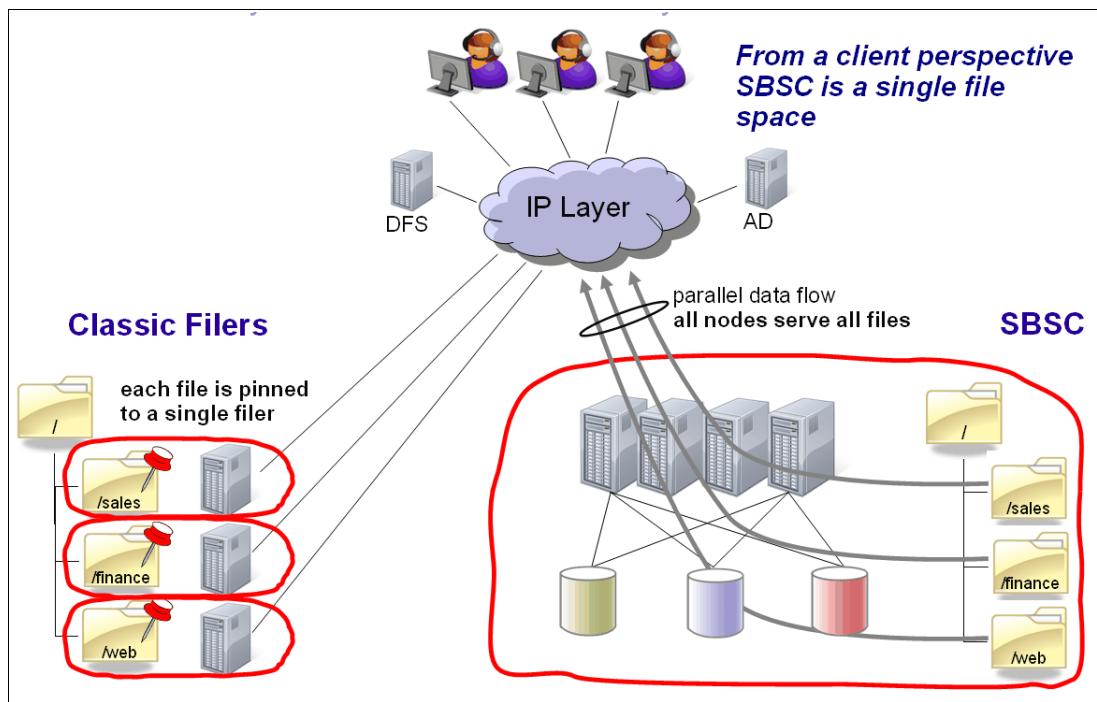


Figure 7-6 The difference between SBSC and traditional approaches

#### 7.4.5 Benefits of using SBSC

The efficient management of data is an ongoing struggle between access and scalability. Providing access to file-level data (that is, those files associated with individual documents, multimedia content, databases, and other applications) becomes more difficult as the number of users with access and the amount of data stored both grow.

Achieving the scalability needed to respond to the growth of data volume typically results in higher hardware and software costs and greater management challenges.

Network-attached storage (NAS) solutions provide simplicity, manageability, and access, but until now, they lacked a single capability that has kept them from playing a role beyond the departmental level: scalability.

If a traditional filer is reaching a scalability or capacity limit, users upgrade to the next higher filer level until they reach the highest available system—this is the *scale-up* approach.

Instead of scaling up in a single high-end enterprise-class server node or building failover clusters to provide high availability for the filers, the SBSC system leverages software functions to build a global namespace and exposes to the user a *single virtual cluster node* with very high scalability.

#### 7.4.6 Continuous availability

SBSC allows disk subsystems to be added, removed, and migrated nondisruptively, as can be seen in Figure 7-7.

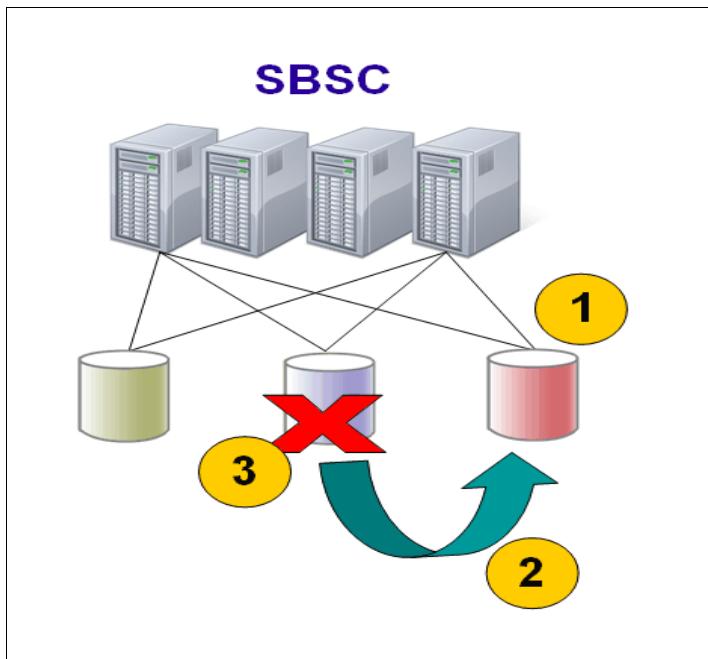


Figure 7-7 Nondisruptive upgrades

1. Add a new disk subsystem
2. Redistribute data excluding storage to be removed
3. Remove the old subsystem

#### 7.4.7 Online transparent data migration

Existing NAS storage can be easily integrated into a cloud by allowing existing devices to become part of the global namespace. This enables migration from old storage to be completed automatically and transparently as shown in Figure 7-8 on page 169.

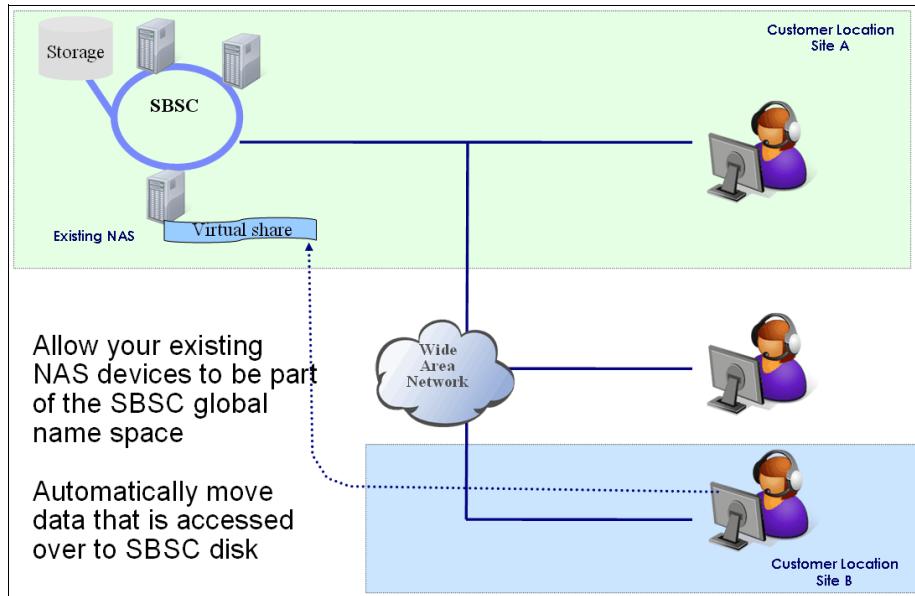


Figure 7-8 *Online data migration*

#### 7.4.8 Summary of benefits

Cloud computing has the potential to make an enormous impact to your business by:

- ▶ Reducing IT labor cost by 50% in configuration, operations, management, and monitoring
- ▶ Improving capital utilization by 75%, significantly reducing license costs
- ▶ Reducing provisioning cycle times from weeks to minutes
- ▶ Improving quality, eliminating 30% of software defects
- ▶ Reducing end user IT support costs by up to 40%

For details, go to:

<http://www.ibm.com/systems/storage/solutions/cloud/index.html>

Storage services are among the easiest to adapt to the cloud computing model. IT storage teams commonly provide storage “as a service” to other departments, so Best Practices and service level agreements have become standardized over the years.

IBM offers an expanding menu of cloud storage services, available on a pay-per-use basis, delivered from state-of-the-art IBM data centers. IBM also helps clients implement public, private, and hybrid cloud storage services, with expert consulting and workload optimized systems.

The following summary shows business, operational, and technical benefits that can be delivered by a Smart Business Storage Cloud.

#### Business benefits

- ▶ Significant storage cost reduction
- ▶ Faster access to data
- ▶ Geographic access to data
- ▶ Smart and Green adaptability
- ▶ “Bottomless” cloud storage

### **Operational benefits**

- ▶ Simplified Infrastructure
- ▶ Single point of management
- ▶ High data availability
- ▶ Seamless scalability
- ▶ Better storage utilization
- ▶ Improved performance
- ▶ Greater application support

### **Technical benefits**

- ▶ Single global namespace
- ▶ Multiprotocol data access
- ▶ Simplified administration and back-up
- ▶ Automated, policy-based placement and migration of files
- ▶ Scalable to billions of files
- ▶ Faster provisioning

#### **7.4.9 Components within an SBSC solution**

The following sections contain a brief overview of the main components of an SBSC system.

##### **Host attachment**

The SBSC host attachments shown in Figure 7-9 on page 171 are primarily provided through clustered CIFS and NFS services. Using the new cluster trivial database (CTDB) it is possible to provide transparent, nondisruptive failover of CIFS and NFS between SBSC nodes. This also provides unparalleled aggregate performance scaling, intelligent load balancing, and simultaneous access to a single file by heterogeneous clients.

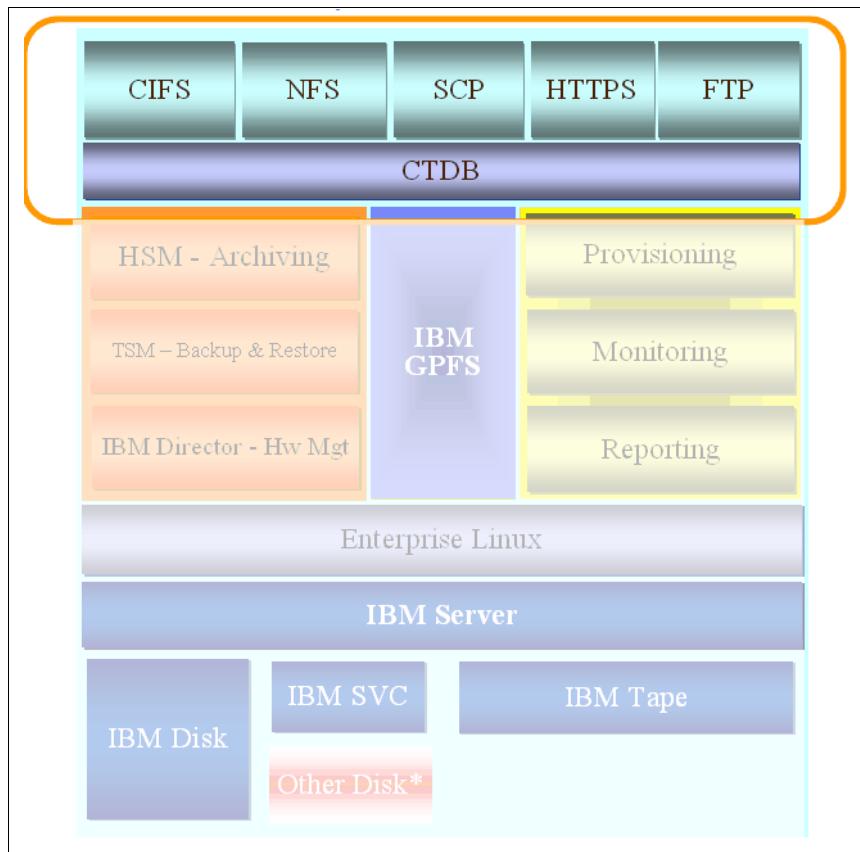


Figure 7-9 Host connectivity

### Hardware components of SBSC

The hardware components of an SBSC solution (Figure 7-10 on page 172) consist of servers, SAN switches, and disk storage. Tape storage for archiving data is an optional part of any SBSC solution.

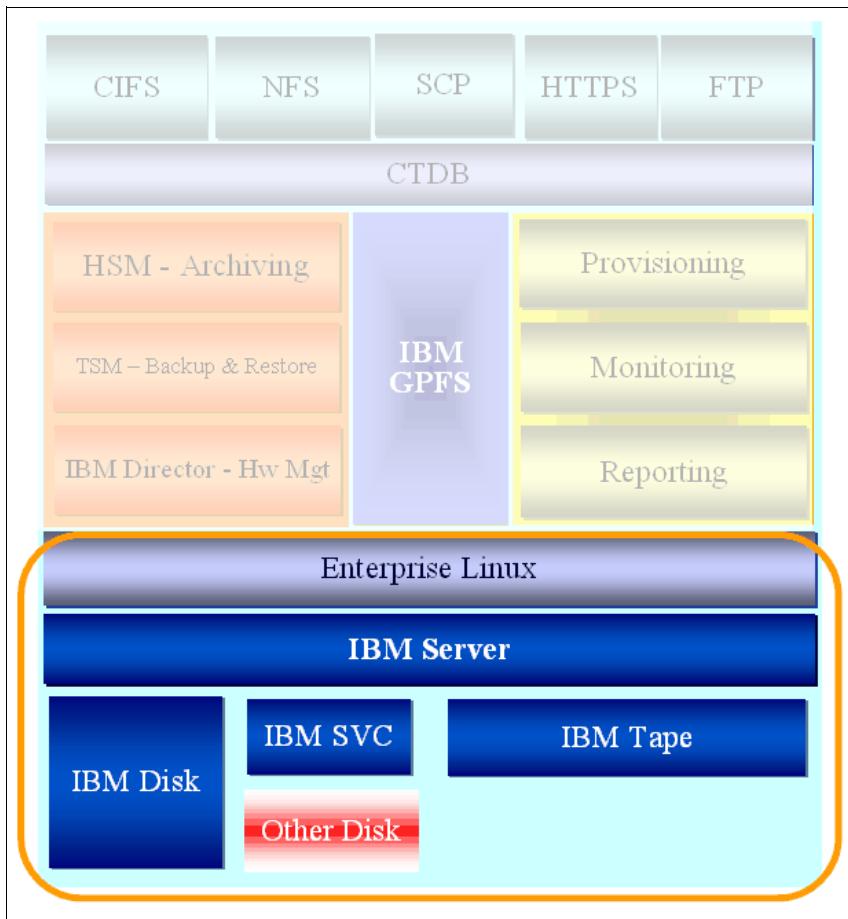


Figure 7-10 Hardware components

### **Storage Server**

The servers used in an SBSC solution are clusters of BladeCenter HS21 or HS21 XM blades or rack-mounted X3650M2 servers. Production servers may be connected via Gigabit or 10 Gigabit Ethernet. Connectivity to the switches and storage units is via fiber channel only for the blades, and fiber channel or SAS attachment for the rack-mounted servers.

As a minimum, three System x servers are required. All servers in a configuration will be the same type. A separate management console may be added or that function may be located in one of the System x servers. The BladeCenter HS21 or HS21 XM blades may be housed in a BladeCenter H with Gigabit Ethernet or a BladeCenter H with a 10 Gigabit Ethernet.

### **SAN hardware**

The SAN switch hardware currently used for SBSC systems is shown in Table 7-1. The base configuration of these switches activates less than the maximum number of fiber channel ports on the switch, but for SBSC configurations all ports will be activated.

Table 7-1 SBSC SAN switch hardware

Switch Model	Description
2005-B16	SAN16B-2, 16-port 4Gbps Fibre Channel Switch
2498-24E	SAN24B-4, 24-port 8Gbps Fibre Channel Switch
2498-40E	SAN40B-4, 40-port 8Gbps Fibre Channel Switch

### **Storage units**

Data is stored on one or more of the IBM storage system units shown in Table 7-2.

*Table 7-2 SBSC storage units*

<b>Storage Unit</b>	<b>Description</b>
XIV (2810-A14)	This large solution provides a capacity of 180 TB and uses only 1 TB SATA disk drives. The system has up to 120 GB cache and 24 FC host ports.
DS8000	SoFS supports the use of DS8100, DS8300, and DS8700 systems, but a special request must be made. Configurations will be customized to the particular solution. This large solution provides up to 512 TB using FATA disks or 307.2 TB using FC disks, up to 32 GB cache, up to 128 FC host ports
IBM SVC	SoFS supports attachment of IBM SVC managed devices, which means any devices not on the supported hardware list can be used for SoFS storage devices if they are supported by SVC.
DCS9950	SoFS supports the use of the DCS9950, but a special request must be made. Configurations are customized to the particular solution. This mid-size solution provides up to 960 TB using SATA disks or 448 TB with FC, RAID-6, 8 FC host ports, 3 GB/sec read/write speed for sequential I/O.
DS4800	This mid-size solution provides up to 168 TB using SATA disks or 67.2 TB using FC disks, up to 16 GB cache, 8 FC host ports
DS4200	This mid size solution provides up to 84 TB using SATA disks, 2 GB cache, 4 FC host ports.
DS3400	This dual controller model of the DS3400 is the only one supported in SoFS configurations. Any number of DS3400 systems that can fit into the SAN network are supported in SoFS configurations. The recommended LUN configuration with 4 enclosures is RAID 5 in a 3+P arrangement so that each drive is in a different enclosure. As a result, the system can survive the loss of a complete enclosure without losing a LUN.
DS3200	This entry level solution provides up to 14.4 TB using SAS disks, up to 1 GB cache, and 6 SAS host ports.

**Note:** Supported hardware device information supplied by Techline and current at 1st Oct. 2009. Consult your IBM or business partner sales team for updated information.

### **Software components**

The IBM GPFS 3.2 product on servers running Red Hat Enterprise Linux 5 is the heart of the SBSC system. It provides the SBSC cluster nodes with a single-system view of the file system. See Figure 7-11 for an overview of the software components of the SBSC system.

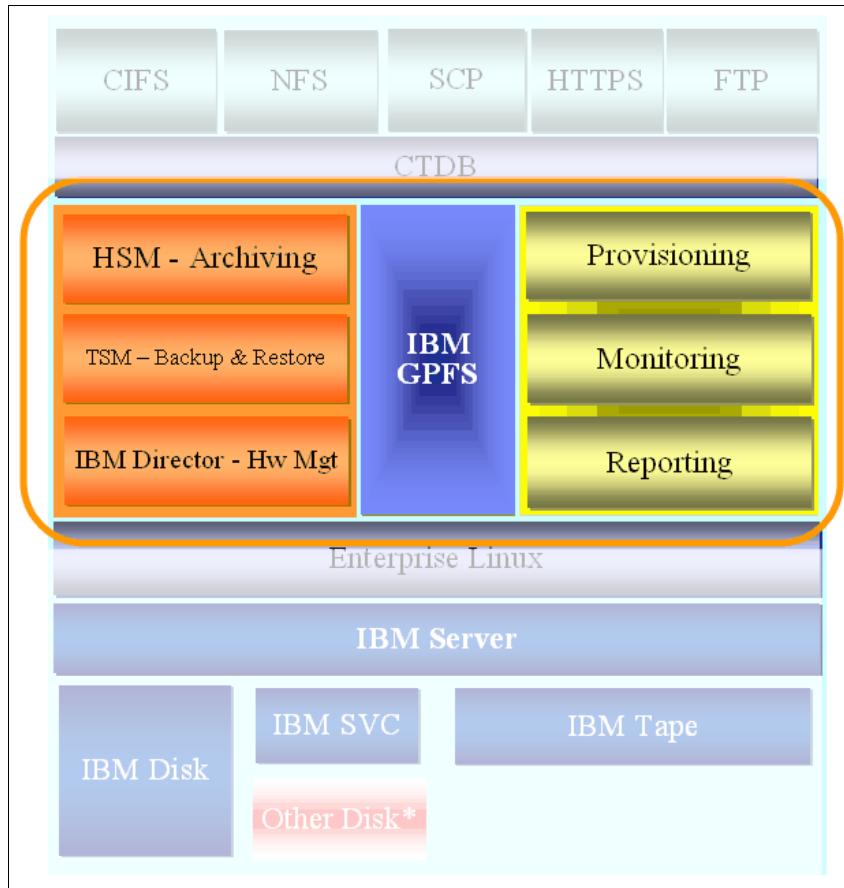


Figure 7-11 software components

Other software components included and their functions are shown in Table 7-3.

Table 7-3 SBSC software components

Component	SBSC Function
IBM Director	Hardware management
IBM Tivoli Storage Manager	Backup and restore
IBM Tivoli Hierarchical Storage manager	Archiving
DS Storage Manager SMclient	Storage device management
SBSC GUI	User interface
SBSC Toolset	Management of SBSC system

#### 7.4.10 Data protection and disaster recovery

There are a number of choices the operator can make in the area of data protection and disaster recovery. SBSC allows for different choices for different data, giving maximum flexibility to enable the right choice for each tier of data.

## Data protection

The data protection choices match the choices available on the storage system used in the SBSC solution. These typically include RAID 5, RAID 6, RAID 10, and the unique XIV data protection algorithm.

## Simple SBSC single site solution - no DR

A simple SBSC solution would allow users to access data locally using a LAN, and remotely using a WAN. While the high availability is built into a single system, there is no disaster recovery built into this solution.

## SBSC with synchronous replication on-site

The operator can set up synchronous replication of some or all of the data to other nodes within the same SBSC site, as shown in Figure 7-12.

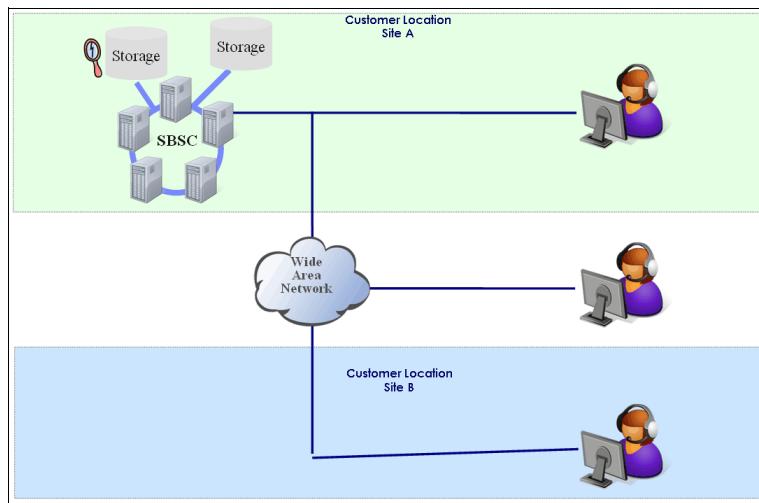


Figure 7-12 Sync replication on a single site

## SBSC with cross-site sync or async replication

The operator can set up replication of data between SBSC clusters on different sites as shown in Figure 7-13. The replication can be synchronous if the distance can be traversed by fiber channel cables. It would be asynchronous if the distance is longer.

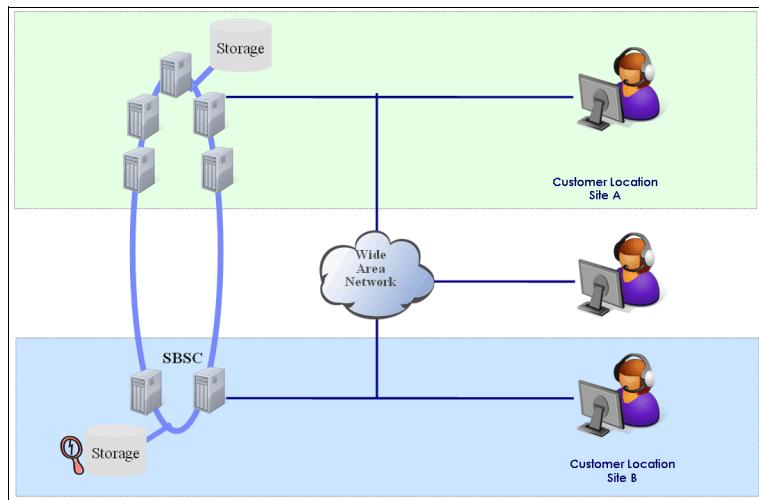


Figure 7-13 Cross-site replication

## SBSC with a cross-cluster mount

Two SBSC sites can be connected and each file system mounted on the other to provide a solution that works as one large SBSC that covers two sites, as shown in Figure 7-14. Within that complex, mirrors of data can be set up on different sites within the single SBSC solution. The cross-cluster mount requires a TCP/IP connection between the clusters. This IP connection can be used for data and metadata traffic. As an option, there is also the ability to send data traffic over a fiber channel (SAN) connection between the clusters.

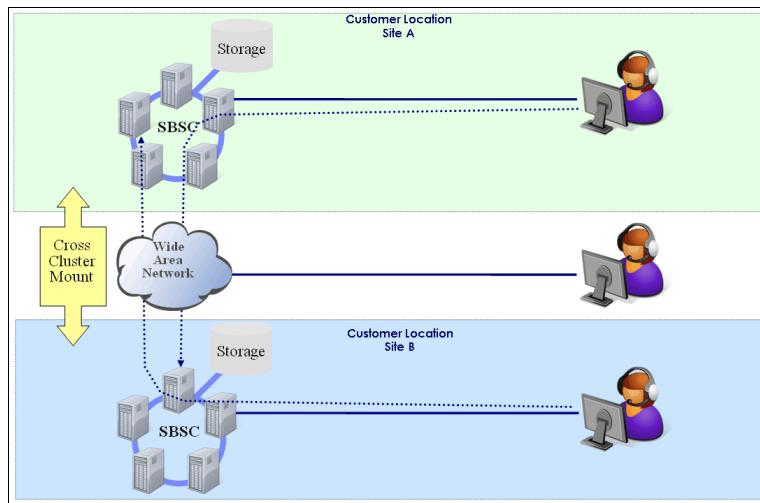


Figure 7-14 Cross-cluster mounts

## Snapshot technology

A snapshot of an entire GPFS file system (Figure 7-15) may be created to preserve the file system's contents at a single point in time. A snapshot contains a copy of only the file system data that has been changed since it was created, using a copy on write technique.

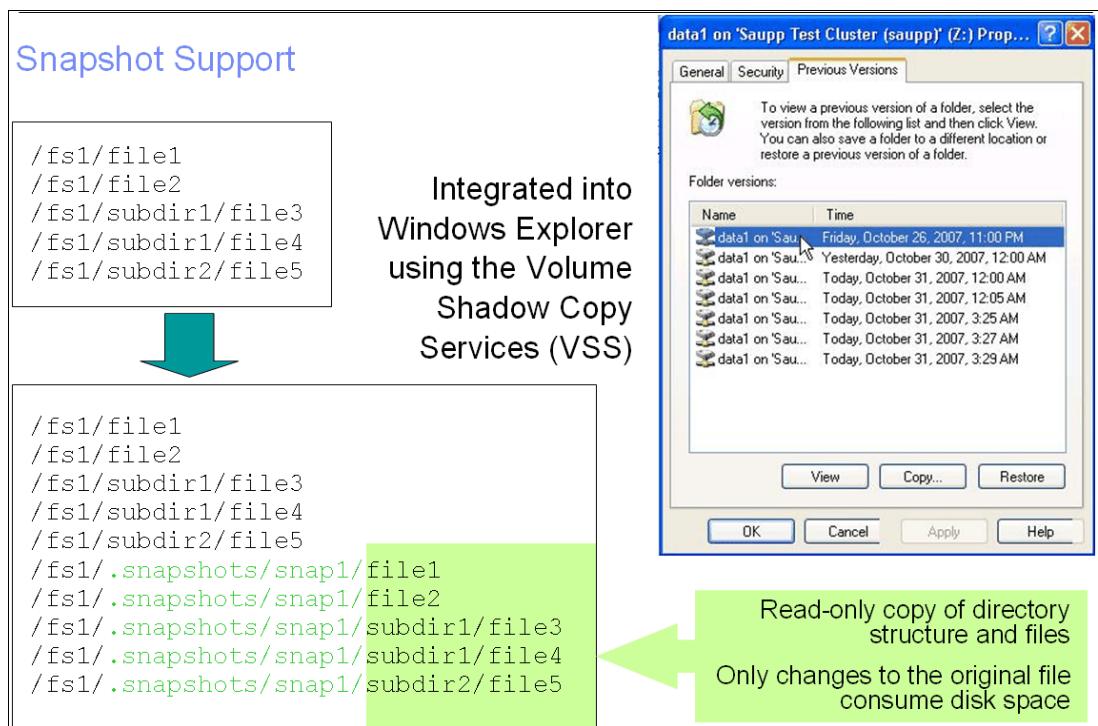


Figure 7-15 Snapshot overview

Snapshots of a file system are read-only; changes may only be made to the active (that is, normal, non-snapshot) files and directories. The snapshot function allows a backup or mirror program to run concurrently with user updates and still obtain a consistent copy of the file system as of the time the snapshot was created. Snapshots also provide an online backup capability that allows easy recovery from common problems such as accidental deletion of a file, and comparison with older versions of a file. Because snapshots are not copies of the entire file system, they should not be used as protection against media failures.

#### 7.4.11 IBM General Parallel File System (GPFS)

The IBM General Parallel File System (GPFS) is at the heart of the SBSC environment. See 9.3, “IBM General Parallel File System (GPFS)” on page 232 for a brief overview of GPFS and its functionality.

### 7.5 More information

For more information about the IBM Smart Business Storage Cloud, refer to:

[http://www.ibm.com/ibm/cloud/smart\\_business/](http://www.ibm.com/ibm/cloud/smart_business/)  
<http://www-935.ibm.com/services/us/index.wss/offerfamily/its/a1031705>

Included within SBSC is a CIFS component that is based on the Samba open source project and a newly developed, high-speed, cluster-aware version of the TDB metadata store database used by Samba. This Cluster Trivial Database (CTDB) allows Samba to scale well across multiple cluster nodes.

A more detailed explanation of this is available in the following paper: *IBM Scale out File Services: Reinventing network-attached storage* at:

<http://www-935.ibm.com/services/us/its/pdf/Sofs-am-journal-final-070108.pdf>





# Storage and Data Service

As business technology continues to evolve, the volume of information available to businesses continues to grow exponentially. Across all industries, more information needs to be stored, managed, and used by the business to drive future decisions. Main drivers for this information explosion include:

- ▶ Compliance - The requirement for legal and regulatory needs to store key information.
- ▶ Business Value - The more a business knows about its markets, customers, competition, and overall business climate, the better decisions they can make for the future.
- ▶ Customer Satisfaction - As business technology has increased, so too has consumer technology. Clients in all markets are becoming increasingly techno savvy, and demanding more from the businesses that serve them.

## 8.1 Overview

In today's environment, when thinking about Information Infrastructure, one needs to think global and have a worldwide perspective. Businesses operate 24x7x365, and there is no such thing as "real time." It is about "all the time". Access to information is critical and an imperative that most companies cannot afford to take a risk on. In the event of an outage or decreased performance, the level of intensity rises exponentially and the problem dramatically shifts to information recovery and damage control. IBM Storage and Data Services can help customers prevent such tragedies and ensure that information is securely available at any time, all the time.

### **IBM Global Technology Services offers service products**

These products can:

- ▶ Help with enabling clients to gain insight into how their LOBs are using storage assets and institutionalize storage best practices across the enterprise.
- ▶ Provide the structure for a comprehensive information archiving strategy.
- ▶ Help maximize the value of information by reducing the risks to a client's business that come as a result of poor information infrastructure management.

And since each of the four key capabilities that an Information Infrastructure must address in order to successfully manage information—information availability, retention, security, and compliance—requires to move data, IBM Data Mobility Solutions are about doing just that. We are in the business of going into the detail of migrating data to make sure that we reduce a client's risk at every task level that drives the business objectives, help organizations reduce IT complexity, and lower costs.

By proactively establishing a well-organized approach to storage and data environment, organization can gain the advantages that come from an effective storage infrastructure. Organization can provide business users with required access to data, giving key decision makers the information they need to help innovate and grow their revenue. An organization can cost-effectively deliver storage performance that meets current needs, while laying a strong foundation for the future. And an organization can better manage business risks and uphold regulatory compliance.

### **A comprehensive approach to storage and data**

IBM Global Technology Services offers services that can help businesses to address storage and data needs from end to end, including assessment, planning, design, implementation, and management. The services include:

- ▶ IBM Storage Optimization and Integration Services - helping to reduce complexity, optimize performance, and manage growth by creating a cost-effective, scalable and resilient storage infrastructure.
- ▶ IBM Information Lifecycle Management Services - helping to enable decision-making by developing and executing best practices for managing information from creation through disposal, on a cost-effective IT infrastructure.
- ▶ IBM Data Mobility Services - helping clients migrate data to more efficient storage environments without disruption, regardless of vendor hardware, operating system, or distance.

IBM Storage and Data Product Services can help to mitigate project risk and increase product value by providing assistance with planning and implementation of storage- and data-related hardware and software products or migration of data to new environments.

IBM Storage and Data Managed Services can help to leverage the expertise, scale and pre-integrated, standard capabilities of a world-class service provider that can manage the storage environment on clients' behalf.

### The anticipated benefits

IBM's storage and data services are designed to help achieve better business performance and support business customers more effectively. With the storage expertise, proven methodologies and effective tools, IBM can help support an organization's current and future storage and data requirements:

- ▶ Enable improved decision making and access to information.
- ▶ Simplify management of storage and data environment.
- ▶ Improve business ability to comply with regulations and enhance security.
- ▶ Manage storage growth more effectively, while controlling costs.

#### 8.1.1 Services offered

IBM offers the following storage and data services:

- ▶ Data migration services
- ▶ Implementation services for SAN fabric components
- ▶ Information lifecycle management services
- ▶ Migration services for data
- ▶ Storage and data managed services
- ▶ Storage and data product services
- ▶ Storage optimization and integration services
- ▶ Storage services for cloud computing

## 8.2 Data migration services

With any infrastructure change—whether any organization is moving to new hardware, consolidating, relocating, or optimizing storage—data has to be moved. But migrating data is often complex, risky, and costly and can impact application availability and performance.

Data migration with IBM Data Mobility Services can help reduce the costs and risks of these IT initiatives by accelerating data migrations, lowering labor expenses, minimizing lease and maintenance overlaps, and virtually eliminating application outages. By accelerating the data migration, IBM can help to deploy smarter and more cost-efficient technologies with minimal disruption to business.

### Highlights of IBM Data Mobility Services

- ▶ Industry-leading software designed for migration across the enterprise with support for System z, Windows, UNIX and Linux platforms and multivendor hardware: Softek TDMF®, the 10+ year, industry standard for nondisruptive volume-level migrations, and Softek zDMF, the only nondisruptive data set migration technology
- ▶ Trusted data migration technology used in more than 1,800 data migration engagements and by more than 800 organizations worldwide
- ▶ IBM's experienced technical professionals who migrate more than a petabyte of data every year and are rated as industry leaders in the ability to execute storage services

- ▶ Flexible solution choices that include IBM services, software, or managed migration services

### **Service offered under data migration services**

- ▶ Softek Data Mobility Console for z/OS
- ▶ Softek zDMF
- ▶ Softek data replication software
- ▶ Softek Transparent Data Migration Facility (TDMF)
- ▶ Implementation Services for Softek assets
- ▶ Softek asset-based services, data migration with EAV enablement
- ▶ Annuity-based data migration services
- ▶ Implementation services for system storage copy functions, global mirror

#### **8.2.1 Softek Data Mobility Console for z/OS**

Now organizations can simplify and automate nondisruptive data migration for enterprise environment. IBM Data Mobility Services: Softek Data Mobility Console for z/OS (DMCzOS) technology is designed to provide assessment, planning, activation, and validation of data movement. Its consistent and repeatable management processes can help lower costs and eliminate errors and risk while streamlining operational practices.

Designed to support the IBM z/OS mainframe environment, DMCzOS provides centralized migration management for complex storage environments such as IBM Parallel Sysplex® and IBM Geographically Dispersed Parallel Sysplex™ (GDPS®) mainframe environments. DMCzOS technology is designed to provide real-time alerts, real-time and historical data and playback, and extensive reporting, drill-down and automation capabilities. It also provides a direct interface to one of the leading migration products, Softek TDMF (Transparent Data Migration Facility) technology, featuring a user-friendly wizard to guide organizations through the key steps in a migration.

#### **8.2.2 Softek zDMF**

If an organization is procuring, consolidating or relocating mainframe storage, or is considering using Extended Address Volumes (EAVs), or has critical DB2, IBM Data Mobility Services—Softek z/OS Dataset Mobility Facility (zDMF) host-based software migrates data sets nondisruptively across virtually all major hardware vendors and between different disk capacities without disrupting applications. With Softek zDMF, now we have an alternative to time-consuming manual data set-level migrations.

Softek zDMF can help speed deployment of new storage technology by migrating data sets nondisruptively and enabling MOD consolidation of any size, including MOD 3 to MOD 92, MOD 54 and EAVs. By providing the ability to better manage unit control blocks (UCBs) as well as the ability to group data sets for easier management of large-scale migrations, Softek zDMF can help to immediately address performance issues and improve storage efficiencies while potentially lowering labor costs and reducing lease and maintenance overlap expenses. Softek zDMF is ideal for DB2 databases to help provide immediate performance improvement as well as immediate reclamation and redeployment of storage.

#### **Highlights of Softek zDMF**

- ▶ Enables flexibility to immediately migrate data sets across major hardware vendors and different disk capacities without application disruption.

- ▶ Completes DB2 data migration without application outage to reclaim and redeploy DB2 storage.
- ▶ Automatically consolidates and migrates selected data set extents of a multivolume data set, and offers a scheduled divert option.

Many IT organizations want to take advantage of the large-capacity volumes on today's more cost-effective, high-performance storage subsystems, but are faced with complex and disruptive data migrations that negatively impact their business applications. Because data conversion onto large volumes is time consuming and involves long application outages, IT specialists across organizations recognize the need for tools that can help them move data with greater flexibility, efficiency, and reliability at a lower cost while also enabling greater responsiveness to a dynamic marketplace.

IBM Data Mobility Services - Softek z/OS Dataset Mobility Facility (zDMF) host-based software is designed to move critical allocated mainframe data sets while helping to ensure that the applications remain online and available. By using data set grouping and migration control through an online Interactive System Productivity Facility (ISPF) interface, Softek zDMF provides an alternative to time-consuming manual data set-level migrations. With the capability to migrate groups of data sets across major hardware vendors and between different disk capacities, Softek zDMF helps to move away from error-prone manual data set-level migrations, avoiding downtime that can impact operations and service-level agreements (SLAs), and reducing the complexity of managing large migrations. And with an accelerated data set migration, one can reduce the cost of deploying new mainframe storage while helping to lower IT labor costs and minimizing lease and maintenance overlaps—all while virtually eliminating outages.

This host-based software migrates data sets nondisruptively across major hardware vendors and different disk capacities without disrupting applications, freeing from manual data set migration and potentially speeding deployment of new storage technology. Softek zDMF enables MOD consolidation of any size, including MOD 3, MOD 9 and MOD 54, as well as Extended Address Volumes (EAV) capability. Through streamlining of closed data set copying, Softek zDMF enables copying data for data sets that are closed when migration begins, allowing for faster migration of data sets not in use. Because Softek zDMF also helps to simplify the premigration process and provides the ability to immediately address unpredictable performance issues, one can see improved performance and potentially lower costs through improved storage efficiencies.

Moving and consolidating data sets from multiple smaller-volume subsystems to larger-volume subsystems can enhance unit control block (UCB) management. Additionally, Softek zDMF can complete an IBM DB2 data migration without application outage, making it possible to immediately reclaim hundreds of UCBs that can be used to support new business expansion initiatives. Softek zDMF software helps increase system growth by:

- ▶ Enabling immediate redeployment of source storage configuration to accommodate growth and prevent unplanned additional hardware purchases.
- ▶ Exceeding previous industry-standard storage capacity of 65K cylinders through enhanced EAV functionality.
- ▶ Reducing the number of logical volumes on a device by consolidating several small-capacity volumes onto fewer large-capacity volumes.

## **Features of Softek zDMF**

- ▶ Host-based software that migrates data sets across major hardware vendors and between different disk capacities without disrupting applications

- ▶ Nondisruptive DB2 migration completion that includes automatic completion, enables storage redeployment and enhances return on investment
- ▶ Extended Address Volume (EAV) support for large storage volumes that exceeds previous industry-standard storage capacity of 65K cylinders

### **Benefits of Softek zDMF**

- ▶ Improves storage efficiencies and total cost of ownership by reducing lease overlap and accelerating redeployment of storage, virtually eliminating outages.
- ▶ Helps speed deployment of new storage, including model (MOD) consolidation of any size, by migrating data sets nondisruptively in multivendor hardware environments.
- ▶ Offers greater flexibility to immediately address performance issues through consolidation of data extents or data placement.

### **Requirements**

Following are the hardware and software requirements of Softek zDMF.

#### ***Software requirement***

Supports all IBM MVS™ software-based operating systems that are currently supported by IBM (for example, IBM z/OS Version 1.6 software and above, including Version 1.10). For IBM Data Mobility Services, Softek TDMF is recommended but not required.

#### ***Hardware requirement***

Supports 3380 and 3390 volumes formatted with IBM z/OS technology supporting count key data/extended (CKD/E) format. To utilize EAV capabilities, z/OS Version 1.10 software must be installed.

### **8.2.3 Softek data replication software**

Data replication software provides local or remote data protection to ensure application recovery when there is a disaster or an outage. Data replication services minimize backup window issues and provide a standardized approach to enterprise replication in heterogeneous environments.

### **Highlights**

- ▶ Provides an affordable way to meet regulatory compliance or SLA requirements.
- ▶ Maintains continuous application availability.
- ▶ Replicates to/from virtually any vendor's storage, both logical volumes and physical volumes (UNIX).
- ▶ Allows data replication locally or remotely without downtime.
- ▶ Replicator is independent of applications, file systems, and volume/disk managers.
- ▶ Maintains data integrity for rapid recovery.
- ▶ Provides centralized monitoring, control and management of migrations through a common console managing Softek TDMF Windows (IP), TDMF UNIX (IP), Softek Replicator UNIX, and Softek Replicator Windows.
- ▶ Supports multiple operating systems (IBM AIX, HP-UX, Sun Solaris, Red Hat Enterprise Linux, MS Windows 2000, Windows 2003).
- ▶ No additional hardware or software required.

- Available in the form of a software license, a project service engagement, or an element of a managed service agreement.

Softek data replication software allows to replicate data over TCP/IP to remote DR sites, creates PIT copies at primary or at remote data centers for backups or compliance, and centrally manages all UNIX or Windows servers running Replicator through a common console.

#### **8.2.4 Softek Transparent Data Migration Facility (TDMF)**

If an organization needs to migrate data without disrupting business applications, regardless of platform, distance, or vendor hardware, IBM offers Softek TDMF, a host-based unified data migration solution for both open systems and mainframe environments. Softek TDMF is a proven solution for heterogeneous environments and is ideal for technology refresh, server or storage consolidation, data center relocation or consolidation, and implementing tiered storage. No additional hardware, prerequisite software or firmware is required.

With a ten-year track record of reliability and used by more than 60% of the Fortune 1000 companies since 1996, the Softek TDMF offering has become an industry leader in moving data. The products are available in the form of a software license, a project service engagement, or an element of a managed service agreement.

#### **Highlights of TDMF**

- Migrates data nondisruptively while applications are still online for business use.
- Supports heterogeneous environments, simplifying management and reducing training, licensing and maintenance costs.
- Enables easier implementation of tiered storage and provides greater flexibility to move data.
- Validates to protect against data corruption.
- Balances I/O activity to optimize application performance during data migrations.
- Enables a repeatable standardized methodology for data migration regardless of platform or storage hardware.

Under this service, IBM offers services for all platforms, such as:

- Softek TDMF UNIX
- Softek TDMF Windows
- Softek TDMF z/OS

#### **8.2.5 Implementation Services for Softek assets**

Many organizations are challenged by the need to implement storage solutions quickly and efficiently, with reduced business disruption, system downtime, or increased IT costs, all of which can reduce return on investment. IBM Implementation Services for Softek assets is designed to facilitate a rapid, reliable and effective installation of the storage software. We can provide highly skilled storage specialists to help you plan, implement, configure, and test IBM storage software products, on time and within budget.

#### **Highlights of Implementation Services for Softek assets**

- Provides predictable, effective implementation of Softek assets to promote effective and safe data migration and reduce business disruption.

- ▶ Enables increased return on investment by reducing the deployment time into a client's environment.
- ▶ Delivers storage software experience and methods to help realize the benefits of investment sooner.

To maintain an integrated, automated, and flexible storage environment, you need to reduce the costs and risks associated with storage product implementation. You need to ensure smooth and reliable IT operations, system availability, and seamless implementation of storage software without experiencing expensive downtime or business disruption.

IBM Implementation Services for Softek assets is designed to facilitate a proper, reliable and effective installation of Softek software. We can provide highly skilled storage specialists to help you plan, implement, configure, and test IBM storage software products, on time and within budget. This implementation service supports five Softek components, including zDMF, TDMF Open for UNIX, UNIX (IP), Microsoft Windows (IP), and Linux (IP), TDMF z/OS – Standard implementation, Offline Volume Access (OVA), Point in Time (PIT), Perpetual Point in Time (PPIT), Transmission Control Protocol/Internet Protocol (TCP/IP), DMCz/OS and Implementation services for Replicator Open.

## **8.2.6 Softek asset-based services - data migration with EAV enablement**

As the amount of data and information continues to increase in IT environments, so do space and performance requirements. Using a flexible, robust data migration solution that supports multiple vendors and varying disk capacities, IBM Data Mobility Services - Softek asset-based services - data migration with EAV enablement helps to quickly and efficiently migrate data to large-capacity, high-performing volumes in mainframe environments with minimal business interruption.

### **Highlights**

- ▶ Enables nondisruptive data migration without affecting application availability.
- ▶ Optimizes use of storage capacity through volume consolidation.
- ▶ Accelerates data set consolidation and return on investment.

To address the need for more data storage space and better performance, many organizations are considering migration to large-capacity disks on today's high-performance storage subsystems. But implementing a data migration is a complicated, time-consuming activity that can be disruptive to service level agreements and requires expertise that many IT organizations lack. Faced with the increased risk of business disruption and extended planned outages, organizations need help from IT experts to perform the data migration—without interrupting the ongoing business environment while maintaining data and application availability.

IBM Data Mobility Services - Softek asset-based services - data migration with EAV enablement leverages IBM's proven methodologies and best practices to provide flexible, nondisruptive data migration in mainframe environments between different disk capacities and across storage vendors. This migration solution provides the flexibility to move data online without the need for scheduling downtime while maintaining application availability. By enabling the consolidation of smaller to larger capacity, better performing storage volumes using the Extended Address Volume (EAV) functionality, organizations can make better use of organization storage capacity—reducing the number of volumes and reclaiming space. Organizations also can see a substantial reduction in downtime and greater flexibility to more easily align business continuity needs and service level agreements.

### **Features of Softek asset-based services**

- ▶ Premigration planning, project management, technical assistance, and execution of data migration with EAV enablement at a fixed price and scope
- ▶ An efficient and effective migration solution using both hardware- and software-based migration tools with minimal disruption to business operations while maintaining application availability
- ▶ Proven tools and methodologies developed from IBM's knowledge of IBM data migration and storage

### **Benefits of Softek asset-based services**

- ▶ Enables nondisruptive data migration without affecting application availability.
- ▶ Optimizes use of storage capacity through volume consolidation.
- ▶ Accelerates data set consolidation and return on investment.

## **8.2.7 Annuity-based data migration services**

Increasing amounts of data—coupled with escalating IT data center costs and a lack of skilled IT professionals—are creating a greater demand for more efficient server and storage infrastructures. With longer-term business agreements available for IBM annuity-based data migration services, an organization can simplify their multiple data migration efforts while significantly improving cost-efficiency.

### **Highlights**

- ▶ Helps to predict IT data center costs based on data movement profile.
- ▶ Enables in-house resources to focus on other key projects.
- ▶ Provides a total solution for data migration with pricing flexibility.

### **Helping to manage multiple data migrations with a single contract**

As data centers continue to grow or require new technology, companies must continue to manage and move data without disrupting business operations. At the same time, most organizations need their in-house IT professionals to stay focused on core, revenue-generating initiatives.

Annuity-based data migration services from IBM are longer-term multiple data migration event management solutions that include:

- ▶ IBM Data Mobility Services - Annuity-based data migration services for open systems
- ▶ IBM Data Mobility Services - Annuity-based data migration services for mainframes

With contracts ranging from one to three years, one can see significant cost reductions in their total data center operating costs compared with a series of traditional project-based contracts. And by entrusting IBM with specified data migration tasks, your IT staff is free to focus on business-critical tasks while gaining a more accurate and efficient data migration solution. Because these annuity-based data migration services apply to open systems and to mainframe storage environments, and align with key IBM storage hardware and software products, they offer a comprehensive data migration solution—all through a single supplier.

## **8.2.8 Implementation services for IBM System Storage copy functions - Global Mirror**

System Storage copy functions - Global Mirror can facilitate efficient, fast-moving backup of data storage at global backup locations for data retention and disaster recovery purposes.

### **Highlights of Global Mirror**

- ▶ Facilitates improved data backup and recovery capabilities.
- ▶ Provides consistent data backup at a remote site.
- ▶ Can help reduce the impact of business disruptions.
- ▶ Delivers a custom plan to implement Global Mirror functions.

Global Mirror is a powerful asynchronous, long-distance remote copy solution. It is designed to move data over great distances at high speeds, while maintaining the data integrity in transit. Implementing this solution can help reduce the time between interruption of service and full operation, and the window when transactions could be lost due to disruption. An IBM services specialist assists with a plan to implement System Storage copy functions – Global Mirror, and can:

- ▶ Conduct a planning session and present a Global Mirror overview
- ▶ Review a client's current IT environment
- ▶ Help design, implement and test the Global Mirror functions
- ▶ Review the services that will be performed at a client's location
- ▶ Review the required software and hardware prerequisites
- ▶ Outline a plan to implement and test the Global Mirror functions in a client's environment
- ▶ Provide a copy of the plan as demonstrated during the planning session

**Note:** For more information about all data migration services, visit:

<http://www-935.ibm.com/services/us/index.wss/offerfamily/its/a1029084>

## **8.3 Implementation services for SAN fabric components**

This service provides installation services to help an organization to get the SAN environment up and running quickly.

XYZ company selected data gateways and switches for Storage Area Network (SAN) environment. Because of skill or resource limitations, they may want IBM assistance with implementing IBM, Cisco Systems, INRANGE Technologies Corporation, McDATA Corporation, Pathlight Technology, Inc., Brocade Communications, Inc., or Vicom Systems products. IBM provides installation services to help get clients' SAN environments up and running quickly.

### **Highlights**

- ▶ Assistance in planning, configuration and key operator training
- ▶ Software and hardware configuration
- ▶ Testing and verification
- ▶ A SAN control book that documents clients' configurations

## 8.4 Information lifecycle management services

Information lifecycle management (ILM) could be the answer to a new approach to information management—one that optimizes storage, improves access and reduces costs. With an efficient ILM approach, one can manage information based on its business value. And, when combined with effective content management and archiving, ILM can help an organization to facilitate compliance with data-related regulations.

IBM Information Lifecycle Management Services can help to adopt best practices for data classification, tiered storage implementation, content management, and archive and retention. We can assess a client's current environment, help them to develop a roadmap and then implement a storage infrastructure that enables efficient information management and greater accessibility. IBM can help to gain:

- ▶ Easier access to important data
- ▶ Greater storage utilization
- ▶ Better governance over data growth
- ▶ Improved ability to meet regulatory requirements
- ▶ Infrastructure costs that are aligned with information value.

### 8.4.1 Healthcare and Life Sciences Grid Medical Archive Solution

Designed to provide safe, long-term storage of medical images, research data and other reference data, such as computerized tomography (CT) scans, positron-emission tomography (PET) scans and medical documents, IBM Healthcare and Life Sciences Grid Medical Archive Solution allows healthcare providers and research institutions to establish an open, multiapplication, multitier enterprise storage system across a single campus, an integrated delivery network, or an entire geographic region or regional health organization.

#### Highlights

- ▶ Collapses heterogeneous, distributed storage silos into a centrally managed, enterprise-wide, easy-to-administer enterprise storage platform.
- ▶ Automatically enables information lifecycle management (ILM) across storage tiers, manufacturers and locations.
- ▶ Protects data for its lifetime using digital signatures and advanced self-healing technologies.
- ▶ Helps ensure application uptime via real-time failover for both planned and unplanned events.
- ▶ Protects investments by leveraging existing assets and multivendor storage technologies.
- ▶ Easily scales from single terabytes to petabytes across a local area network (LAN) or wide area network (WAN).
- ▶ Optimizes access and storage of medical images and other healthcare data across multiple sites or within a single facility.

As the volume of digital images and reference data in the healthcare and pharmaceutical industries continues to explode, the need for storage is exploding right along with it. In fact, the demand for storage of fixed content-defined data, such as healthcare or research data that has to be accessed frequently, is retained for long periods of time, and cannot be changed—is growing exponentially.

The Grid Medical Archive Solution is a grid-powered ILM storage solution specifically designed to address this growth. Its advanced content addressable storage and hierarchical storage management functions help ensure the most optimal use, while its real-time failover capabilities make any planned or unplanned downtime transparent to users and their applications. Through the use of advanced virtualization and encryption technologies, Grid Medical Archive Solution can help ensure that critical patient and research data remains protected regardless of age, location, application source or storage tier. And with Grid Medical Archive Solution's centralized administration and automation functions, even large, complex, distributed archives can be managed with a fraction of the effort required today.

Grid Medical Archive Solution is sold in preconfigured, prepackaged hardware, software and services bundles designed to reduce implementation time and get archive up and running quickly. By deploying Grid Medical Archive Solution, you can:

- ▶ Improve application uptime and reliability
- ▶ Optimize storage costs across the enterprise
- ▶ Leverage existing storage assets and investments
- ▶ Deploy an open, scalable and flexible enterprise storage platform
- ▶ Automate key administration functions and hardware-related data migrations
- ▶ Lower overall storage total cost of ownership

#### **8.4.2 IBM Information Lifecycle Management Services – assessment, planning, design, and implementation**

IBM Information Lifecycle Management Services – assessment, planning, design and implementation helps to transition an organization's storage infrastructure to a cost-effective, responsive, resilient, and information-centric environment that supports business growth and innovation.

##### **Highlights**

- ▶ Helps organizations gain the maximum value from their information.
- ▶ Enables simplification of storage and data management.
- ▶ Supports regulatory risk-management and compliance.
- ▶ Provides strategies and road maps for creating best-practice storage and data infrastructures.

Increasingly, organizations have found that they can benefit by adopting information lifecycle management (ILM) principles. These concepts help turn data and insight into action, support improved decision making, align the value of information with storage costs, and facilitate compliance with regulations. ILM efforts often include classifying and prioritizing business-critical data while designing and implementing a storage infrastructure that corresponds with business requirements for information management.

IBM Information Lifecycle Management Services - assessment, planning, design and implementation is designed to enable an information-centric IT environment. These services help to:

- ▶ Define a strategy and roadmap for adopting ILM-based best practices to support client business and IT objectives
- ▶ Classify data and design and implement policy-based data management
- ▶ Optimize clients storage and data environment by adopting approaches such as virtualization and tiered storage

- ▶ Design and implement an overall archival and retention approach that helps to reduce costs and manage risk while supporting regulatory compliance
- ▶ Plan and execute an integrated ILM strategy
- ▶ Govern information management, with a focus on identifying critical information and ensuring that it is available for decision making

Whether an organization wants to acquire a full information lifecycle management solution or only require assistance, IBM can help to apply ILM-based best practices to support business growth and regulatory compliance.

### **8.4.3 Information Lifecycle Management Services - Enterprise Archive**

In today's world of increasingly complex business regulatory compliance requirements and a growing storage services market, business faces ongoing challenges about how to efficiently store and retain information. IBM Information Lifecycle Management Services – Enterprise Archive service assesses existing environments and helps design a comprehensive information archiving strategy aligned with business goals and performance needs. By helping to assess, plan and develop a more flexible and secure information archive strategy, an organization will be positioned to more quickly and cost effectively adapt to changing regulatory requirements while gaining improved service levels.

#### **Highlights**

- ▶ Uses IBM tools and experience to effectively assess storage needs for improved compliance
- ▶ Delivers a best-practices strategy to help improve security and reduce risk
- ▶ Helps to control costs and align information archiving goals with business objectives

#### **Helping assess, plan and develop a robust enterprise archive solution**

In today's environment—with its increasing amounts of information and continually changing regulatory requirements—organizations need to effectively manage, protect, and store proprietary information. To prove compliance, many organizations save nearly all their data on expensive tier one storage devices, driving IT costs and creating a tremendous information management burden. At the same time, to stay competitive, these organizations must also be highly flexible and able to quickly respond to future business and technology changes—all while controlling costs.

Using IBM assessment methodologies and tools, IBM Information Lifecycle Management Services – Enterprise Archive provides the structure for a comprehensive information archiving strategy that helps to create a highly effective information management roadmap based on unique business challenges and needs. With a comprehensive information archiving strategy in place, clients can enhance regulatory compliance capabilities and maintain greater security while allowing greater ease in searching, locating and retrieving information and reducing the financial burden of information overload.

### **8.4.4 Information lifecycle management solution**

Information lifecycle management (ILM) from IBM aligns the business value of information with the most effective IT infrastructure through each phase of the information lifecycle. ILM can help to manage different types of data in accordance with their business value to better control costs and improve efficiency.

## 8.5 Storage and Data Managed Services

For an organization looking to leverage the expertise, processes, tools and preintegrated solutions of a world-class IT provider—without significant up-front investments, IBM can help relieve the burden of maintaining an effective, efficient storage and data environment. IBM services can also help to meet security, data availability, regulatory compliance, and cost and performance objectives, while scaling to meet business demands.

IBM provides essential storage management services and on demand storage capacity—with usage-based pricing—developed and preintegrated into standard capabilities. The core activities IBM offers include provisioning, monitoring, change management, chargeback, archiving, backup and recovery.

IBM Storage and Data Managed Services allows to benefit from well-structured, high-quality operations for storage management foundation. The services can help to:

- ▶ Avoid the costs and challenges of managing IT environments
- ▶ Release strategic IT resources to focus on additional projects
- ▶ Increase security, stability, storage operational efficiencies, and scalability
- ▶ Address regulatory compliance requirements associated with storage and data
- ▶ Enhance service-level visibility and management
- ▶ Enhance effectiveness of internal chargeback mechanisms
- ▶ Reduce total cost of ownership.

IBM Managed Storage Services provides on demand storage capacity, monitoring and management services for clients' disk, backup and restore, and archive infrastructures in a security-rich environment. Combining best-in-class networking technologies with world-class service management helps enable highly available, cost-effective storage management.

### Features

- ▶ Flexible, scalable, resilient storage capacity, on demand
- ▶ Centralized, remote management
- ▶ 24x7 monitoring and management
- ▶ Allocation-based pricing

## 8.6 Storage and data product services

IBM offers implementation services for disk systems, tape systems, storage software and network-attached storage. Many of these services are offered on a fixed-scope and fixed-price basis, making them easy to understand and purchase. IBM storage and data product professionals use proven methodologies and tools—and they collaborate with IBM hardware and software experts to help an organization quickly and effectively adopt the latest technologies.

IBM also offers data migration services that allow an organization to move stored data without disrupting application availability. Using a unified approach and tool set, IBM helps to move data within mainframe or open systems environments—in client IBM-based infrastructures, across mixed-vendor environments and over distances. Engaging IBM to plan and implement storage products or solutions can help to:

- ▶ More quickly realize storage system solution benefits

- ▶ Reduce risk and improve quality when adding, upgrading or changing the storage infrastructure
- ▶ Leverage investments in IBM storage solutions
- ▶ Keep applications and data available for business users during data migration activities
- ▶ Reduce the need for internal resources who are skilled in storage implementation, increasing the ability to focus on core business IT activities

### **IBM offers the following service under storage and data product services**

- ▶ Implementation and Migration Services for Network Attached Storage systems
- ▶ Implementation and Migration Services for tape systems
- ▶ Implementation Services for disk systems
- ▶ Implementation services for storage software products

#### **8.6.1 Implementation and Migration Services for Network Attached Storage systems**

Many IT organizations do not have the time or in-house experience to implement IBM System Storage N series hardware or selected software, such as SnapManager for Microsoft Exchange, SnapMirror and SyncMirror. IBM Implementation and Migration Services for Network Attached Storage systems helps to reduce risk and speed implementation through access to a vast pool of highly skilled storage specialists to help plan for, implement, configure and test IBM System Storage N series hardware or selected software.

#### **Highlights**

- ▶ Provides fast and efficient implementation to accelerate return on investment.
- ▶ Helps minimize business disruption during implementation.
- ▶ Leverages a vast pool of skilled storage specialists to allow organizations to focus on higher priority business initiatives.

To keep up with increasing business demands, many organizations are looking to add IBM Network Attached Storage (NAS) hardware or software. But NAS implementations can require specialized skills and experience. And the infrequency of implementation means that IT organizations may lack those skills. Faced with increased risk and the prospect of a longer-than-necessary implementation, organizations need the assistance of experienced, highly skilled storage specialists to help accelerate NAS implementation so they can more quickly realize their return on investment (ROI).

IBM Implementation Services for Network Attached Storage systems is designed to help to plan for, implement, configure, and test IBM System Storage N series hardware, including both filer and gateway models, and selected software such as SnapManager for Microsoft Exchange, SnapMirror and SyncMirror. IBM proven methods and vast pool of global resources provide the technical expertise and project management skills to help reduce the inherent risks of an implementation. Experienced IBM storage specialists perform the implementation at client locations, reducing the need to maintain these skills in-house and allowing organization personnel to remain focused on higher-priority business initiatives. IBM Implementation Services for Network Attached Storage systems includes:

- ▶ Coordination of a planning and configuration session
- ▶ Assistance with the implementation of system or software components

- ▶ Configuration and verification testing of the IBM System Storage N series hardware, software, or both
- ▶ Basic skills instruction for up to two designated technical personnel on key aspects of the implementation and product features

## **8.6.2 Implementation and Migration Services for tape systems**

Increased IT efficiency, lower costs, shorter backup and recovery times, better application availability are some of the desirable features of their storage environment for any organization. But today they are being asked to do more with less while storing more data, managing growing backup and restore windows, and meeting regulatory requirements. Like most companies, the IT department may lack the skill or bandwidth to address all these storage needs—and this is not an area in which you want to cut corners.

### **IBM Implementation Services for tape systems**

This offers multiple services to help with planning, implementing, configuring and testing for tape systems products—and enables you to buy software, hardware, and services from a single vendor. These services also include basic skills instruction for the client's designated technical personnel on key aspects of the implementation and product features, helping the client to reach business goals without compromising the integrity of data.

### **IBM Migration Services for tape systems**

This is designed to help simplify the migration of data to new tape technology from IBM while helping to maximize the potential for availability and to minimize the potential for disruption and data integrity issues. IBM provides project management and tape product migration skills as well as leveraging a range of disciplines and methods, tools and skill sets to help simplify complex tape migration, and improve ROI on new tape technology purchases.

### **Tape encryption and key management**

As organizations increasingly turn to IBM tape drives to store critical data, they need to ensure that key management and encryption processes are optimized. IBM Implementation Services for tape systems, tape encryption and key management, is designed to help to take advantage of the tape encryption and key management functionality of IBM tape systems. IBM will help to develop an architecture and design for a tape encryption solution; implement, configure and test the solution; develop operational and key management procedures, and provide basic skills instruction to key personnel.

IBM is an industry leader in tape, and its highly skilled storage specialists can help ensure a smooth, efficient implementation with minimal business impact, allowing business to remain focused on other mission-critical projects and helping to speed and improve the ROI of investment in IBM tape products.

## **8.6.3 Implementation Services for disk systems**

To see a faster return on their storage investment, many organizations would like to accelerate the implementation of their IBM System Storage disk system technology. IBM Implementation Services for disk systems provides access to highly skilled storage specialists located worldwide who can provide technical expertise and project management to facilitate a more predictable, less risky implementation that minimizes business disruptions, helping to gain a faster return on investment and avoid the need for skilled in-house resources.

## **Highlights**

- ▶ Helps streamline implementation to accelerate return on investment.
- ▶ Provides access to highly skilled storage resources located worldwide.
- ▶ Helps implement a disk storage solution on schedule and within budget with minimal business disruption.

In today's fast-paced environment, as the amount of critical information continues to increase, efficiently managing and storing data is more challenging than ever. To meet business goals and compliance issues, companies must be able to easily store and access their most important asset, their proprietary data. But in a competitive marketplace, an organization cannot afford to lag behind or experience business disruptions when implementing IBM System Storage disk technology. Organizations need an efficient implementation plan that minimizes the impact to business.

## **Benefits**

- ▶ Accelerates return on investment.
- ▶ Includes basic skills instruction provided to in-house staff on key aspects of the implementation and product features.
- ▶ Implementation completed on time and within budget.
- ▶ Minimizes business disruption.

## **Implementation Services for disk systems - IBM System Storage DR550**

Now an organization can realize the full potential of their IBM System Storage DR550 system, but first they need to implement it. With the IBM Implementation Services for disk systems - IBM System Storage DR550 service, one gains access to the highly skilled storage specialists needed to plan, implement, configure and test the new DR550 system. And by using proven methodologies, a hands-on approach and a predictable timeline, IBM professionals can help:

- ▶ Achieve a quick and efficient implementation process for more rapid cutover.
- ▶ Minimize business disruption, risk and potential downtime.
- ▶ Keep an organization's core IT staff focused on key business activities and objectives.
- ▶ Provide basic skills instruction to organization staff so they can manage and maintain the DR550 system going forward.

## **Implementation Services for disk systems - IBM XIV Storage System**

To see a faster return on investment, many organizations seek to accelerate the implementation of IBM XIV Storage System technology. IBM Implementation Services for disk systems - IBM XIV Storage System provides access to highly skilled storage specialists, located worldwide, who can provide comprehensive technical expertise and project management to facilitate a more predictable, less risky implementation that minimizes business disruptions, helping to accelerate return on investment and avoid the need for skilled in-house resources.

## **Highlights**

- ▶ Helps streamline implementation to accelerate return on investment.
- ▶ Provides access to highly skilled storage resources located worldwide.
- ▶ Helps implement an IBM XIV disk storage solution on schedule and within budget with minimal business disruption.

IBM Implementation Services for disk systems - IBM XIV Storage System can help accelerate the implementation, and the value, of the storage solution. Using a comprehensive approach, IBM highly skilled storage specialists provide planning, implementation, configuration, testing and basic skills instruction. By eliminating the need to have skilled in-house resources, the IT staff is free to work on higher-priority business initiatives. And because organizations are able to more quickly take advantage of the advanced function technology of the IBM XIV Storage System while minimizing disruptions to their business operations, they can more quickly realize the return on their storage technology investment.

#### **8.6.4 Implementation services for storage software products**

IBM Implementation Services for storage products helps to plan for, install, configure, test and document storage-related hardware or software.

#### **Highlights**

- ▶ Includes services for disk and tape systems, storage software, and network-attached storage systems.
- ▶ Applies expert-level skills, methods, guidance, and project management techniques to improve the quality of implementation efforts.
- ▶ Helps organizations gain the optimal value from their storage products by confirming that the products will meet their prerequisites.
- ▶ Includes focused training on implementation products for designated personnel.

New demands for information, coupled with escalating IT management costs, are driving the need for more efficient and responsive storage and data infrastructures. Implementing new storage products, however, takes specialized skills, resources, and time that many organizations do not readily have in-house.

IBM Implementation Services for storage products can help to plan, install, configure and test storage-related hardware or software. IBM's experienced resources will provide guidance on specific products to aid with planning, technical, and training activities. IBM can help to address the challenges associated with storage system implementation, while helping to complete installation on time and on budget. This will boost the ability to get the value from storage infrastructure investments sooner than if organization had managed implementation by themselves.

IBM has fixed-price and fixed-scope installation services for key IBM storage products, such as IBM TotalStorage DS8000, Total Productivity Center Standard Edition and SAN Volume Controller. These are easy to understand and purchase when an organization procures products from IBM Systems Storage representatives or Business Partners. Or, they can obtain the services directly from IBM Global Services.

Whether clients implement storage products as part of a solution initiative, such as information lifecycle management (ILM) or infrastructure optimization, or simply adding new capabilities, IBM can help to smoothly and efficiently transition these products into the client environment.

IBM offers the following implementation services for storage software products:

- ▶ IBM Implementation Services for storage software - IBM System Storage Productivity Center (SSPC) basic integration
- ▶ IBM Implementation Services for storage software - IBM System Storage Productivity Center (SSPC) basic integration facilitating a reliable, expedited implementation of IBM System Storage Productivity Center

- ▶ Implementation Services for Tivoli Storage Resource Manager
- ▶ Implementation Services for IBM TotalStorage SAN Volume Controller
- ▶ Implementation Services for storage products - ServicePac® offerings
- ▶ Implementation Services for storage software - IBM FlashCopy SE
- ▶ Implementation Services for storage software - SAN fabric components
- ▶ Implementation Services for system storage copy functions - Global Mirror
- ▶ Implementation Services for TotalStorage copy functions
- ▶ Implementation Services for TotalStorage FAStT copy
- ▶ Implementation services for TotalStorage productivity center - standard edition
- ▶ Implementation Services for Virtual Tape Server advanced policy management

Installation Services installs 3583 Ultrium Scalable Tape Library on Host Server or Storage Area Network.

**Note:** For more information on implementation services for storage software, visit:

<http://www-935.ibm.com/services/us/index.wss/offerfamily/gts/a1028143>

For complete information on storage and data products services, visit:

<http://www-935.ibm.com/services/us/index.wss/itservice/its/a1000416>

## 8.7 Storage optimization and integration services

Today's IT organizations face increasing complexity that threatens efficiency and drives up costs. Multiple technology platforms, lack of effective tools and too little process—or too much—make it difficult to support the ever-changing needs of business applications. Add explosive data growth and increasing performance demands and a vicious cycle begins, one that makes it difficult to achieve objectives within budget.

The IBM Storage Optimization and Integration services, and the methods, tools and software IBM brings to bear, have been designed and developed around a holistic “full lifecycle” understanding of what it takes to deliver enterprise storage solutions. IBM solutions include:

- ▶ Storage Strategy and Architecture - IBM transformation strategy offering
- ▶ Best Practice Operations - IBM process excellence offering
- ▶ Storage Reporting and Analytics - IBM global insight offering
- ▶ Storage Cost Take-out - IBM storage consolidation and storage virtualization offerings
- ▶ Next-generation Networked Storage - IBM scale out file services offering

IBM's unique services model leverages hardened tools, methods and software (like those acquired from Novus Consulting Group and Softek in 2007) to provide the highest possible value to organizations. IBM adds to this its “unmatched size and worldwide scope of storage service delivery capabilities” (Gartner Magic Quadrant, 2008) to provide a truly best-in-class services team.

### IBM offers storage optimization and integration services

- ▶ Centralized Backup and Restore Solution
- ▶ Storage Optimization and Integration Services - network-attached storage

- ▶ Storage Optimization and Integration Services - process excellence
- ▶ Storage Optimization and Integration Services - storage consolidation
- ▶ Storage Optimization and Integration Services - storage virtualization
- ▶ Storage Optimization and Integration Services – global insight
- ▶ Storage Optimization and Integration Services – IBM Novus Enterprise Standardization Program
- ▶ Storage Optimization and Integration Services – storage architecture planning and design
- ▶ Storage Optimization and Integration Services – transformation strategy

### **8.7.1 Centralized Backup and Restore Solution**

IBM's centralized backup and restore solution may help organizations wrestling with the impact of uncontrolled needs for data backup and restoration, caused by accelerating data accrual rates.

#### **Highlights**

- ▶ A solution combining proven, scalable, deployable hardware and software
- ▶ Implementation of a backup and restore environment that is managed from a central point in the IT infrastructure
- ▶ Possible reduction of redundant hardware and management resources
- ▶ Tested and validated solutions help increase efficiency and lower costs

Data protection and management challenges are resulting from the explosive growth in the volume of business data. Perhaps a lack of effective data protection tools or a shortage of skilled operational resources are contributing to the impact on organizations.

### **8.7.2 Storage Optimization and Integration Services - network-attached storage**

IBM Storage Optimization and Integration Services - network-attached services (NAS) offers a multilayer, clustered storage virtualization service designed to support storage optimization efforts. It can help alleviate data storage challenges by enabling quick implementation of a scalable, global, clustered network-attached storage or scale out file system. Deployment is flexible and can take place at a client site or an IBM delivery center, with premium support services from IBM.

Network-attached file services from IBM offers:

- ▶ Virtualized, network-attached storage that can provide for enterprise wide storage and server consolidation to help eliminate fragmentation and improve utilization
- ▶ A unified management platform that helps reduce storage management labor demands and costs
- ▶ Cost-effective disaster recovery and business continuity options through advanced data replication
- ▶ Reduction of outages enabled by non-disruptive maintenance and dynamic node and storage capacity scaling
- ▶ Support for LTO-4 tape library with built-in encryption technology to secure corporate data and protect customer privacy

### **8.7.3 Storage Optimization and Integration Services - process excellence**

Most IT managers are challenged with providing consistent levels of storage and backup services that adhere to industry best practices. Each year they face varying staff skill levels, frequent employee turnover, difficulties in finding qualified candidates, the expense of comprehensive training regimens and the rapidly changing set of hardware and software products in use across organizations.

If an organization is working to control growing storage management and staffing costs, IBM GTS Storage Optimization and Integration Services - process excellence powered by IBM Novus Enterprise Standardization Program (ESP) can rapidly provide an organization with the tools needed to provide very high and consistent service levels, regardless of the underlying technology, while minimizing the level of skill needed by the IT staff. With ESP, IBM GTS consultants can quickly deploy the suite of standardized best practices for an organization's entire heterogeneous environment, thus addressing the inefficiencies that can create barriers to service delivery, result in uncontrollable growth in operational expense, reduce regulations or audit compliance, impact energy efficiency and green data center initiatives, and threaten return on investment (ROI).

### **8.7.4 Storage Optimization and Integration Services - storage consolidation**

Efficient utilization of storage can have a direct impact on a company's productivity. Getting to the right data quickly can help to be more responsive to clients. IBM Express Implementation Services - storage consolidation helps an organization to better utilize storage and share it across other servers and clients. This offering helps to achieve better utilization of storage and sharing of data across servers and clients while helping to lower the risks and costs associated with the installation of a SAN solution.

#### **Highlights**

- ▶ An end-to-end storage solution based on proven SAN technology.
- ▶ Designed to reduce the risks and costs of implementing a SAN solution.
- ▶ It can help to increase client satisfaction through data sharing.
- ▶ Designed to help enhance business resiliency through backup and recovery processes.
- ▶ It can also help increase responsiveness with data integration in applications and processes.

### **8.7.5 Storage Optimization and Integration Services - storage virtualization**

When data loads increase, so can the complexity and capacity of storage environments. But if an organization chooses to virtualize storage, they can reduce storage network complexity by aggregating multiple storage devices into a common, managed virtual storage pool. As a result, an organization can enhance their ability to:

- ▶ Improve storage capacity utilization
- ▶ Simplify management of multiple vendors and storage devices
- ▶ Enable more dynamic storage allocation
- ▶ Increase interoperability between heterogeneous storage devices
- ▶ Enable migrations and other hardware changes with virtually no disruptions or system downtime
- ▶ Share storage devices and data across the enterprise.

And with IBM Storage Optimization and Integration Services - storage virtualization, one can take advantage of the benefits of virtualization as well as gain access to the technical expertise, experience and comprehensive approach needed to design and build an integrated, virtualized storage solution.

## 8.7.6 Storage Optimization and Integration Services – global insight

Improving storage utilization can help increase productivity and enable end-to-end optimization of an organization's storage management activities. Global insight with IBM Storage Enterprise Resource Planner (SERP) software provides a holistic view of entire storage environments, making it possible to rapidly identify loopholes in storage administration, and reduce hardware, software, and resource costs. Global insight includes IBM services expertise to help with optimal planning, design, and rapid implementation of IBM SERP's capabilities to best fit needs.

### Highlights

- ▶ Offers a centralized and common view of an organization's storage environment.
- ▶ Transforms technical data across multiple storage silos into enterprise-wide actions.
- ▶ Generates numerous storage intelligence reports quickly and cost-effectively.
- ▶ Provides scalable and customizable options to suit business needs.

### Novus Storage Enterprise Resource Planner (SERP)

This service software brings business intelligence to storage infrastructure, allowing insight into how an organization is using its storage assets.

### Highlights

- ▶ A single pane of glass for reporting on storage without another set of agents
- ▶ Business context to turn reams of technical data into actionable information
- ▶ Flexibility for deeper analysis with codeless, drag-and-drop report building

SERP collects data from many instances of SRM and asset tools, and provides a view of assets with respect to geography and business infrastructure that makes the following possible:

- ▶ Capacity planning
- ▶ Configuration management
- ▶ Reclamation and utilization improvement
- ▶ ILM and right-tiering
- ▶ Deployment planning and reservation
- ▶ Topology and connectivity
- ▶ Financial transparency
- ▶ Chargeback

**Note:** For more information about Storage Optimization and Integration Services – global insight, visit:

<http://www-935.ibm.com/services/us/index.wss/offerfamily/gts/a1030334>

## **8.7.7 Storage Optimization and Integration Services – IBM Novus Enterprise Standardization Program**

How can an organization better manage their storage technologies to improve service delivery, avoid audit exposures, and address the challenge of maintaining highly skilled staff? IBM Novus Enterprise Standardization Program (ESP) provides organization staff with out-of-the-box technical and procedural documentation that can be easily used and accessed to effectively manage four common IBM storage environments.

### **Highlights**

- ▶ Enhances storage management and minimizes staffing challenges with access to an enterprise-wide knowledge library of standardized best practices.
- ▶ Facilitates audit readiness with repeatable processes and work flows that promote consistent task execution.
- ▶ Supports a dynamic storage infrastructure with easy to add wiki-based technology modules to support access, maintenance, and process enforcement.

Without a common and repeatable approach to the delivery of operational storage support activities, you risk decreased availability, outages, operational inefficiency and failed audits. Training new and existing personnel on new technologies can also lead to higher operational costs. To gain control over diverse storage technologies, an organization needs to adopt efficient processes and practices that mitigate the greatest threat to their infrastructure—human error.

IBM Novus Enterprise Standardization Program (ESP) provides a standard set of best practices for storage and backup processes. With a web-based wiki interface, ESP offers defined technical procedures and easy-to-follow steps for ongoing management. ESP can help to reduce the frequency of outages, lower costs, improve availability, capitalize on storage resources, and respond more swiftly, securely and cost-effectively to support dynamic IT environments.

Technology modules include support for four common IBM storage environments:

- ▶ IBM Tivoli Storage Manager
- ▶ IBM System Storage SAN Volume Controller
- ▶ IBM Softek Transparent Data Migration Facility (TDMF)
- ▶ IBM XIV Storage System

## **8.7.8 Storage Optimization and Integration Services - storage architecture planning and design**

As organizations experience unprecedented storage capacity growth, the complexity and costs of their storage infrastructure increase. Add to that the increasing pressures of regulatory compliance, security and disaster recovery, and many organizations can end up with a costly, inefficient mix of storage assets that are not fully utilized.

IBM Storage Optimization and Integration Services - storage architecture planning and design can help to develop an architecture designed to improve the storage environment through optimization, consolidation, virtualization, and efficient storage service management, which can help to lower storage costs, reduce management complexity, and prolong the life of hardware. By helping an organization to optimize their infrastructure, refine their business processes and improve the data organization, IBM can help increase the resiliency of an organization's storage environment.

## **8.7.9 Storage Optimization and Integration Services - transformation strategy**

Inefficiencies in storage and backup management, increased demand for storage and backups, and high hardware, software and personnel costs can directly impact a company's productivity. The IBM Management Complexity Factor, IBM Storage Optimization and Integration Services - transformation strategy full assessment, and IBM Storage Optimization and Integration Services - transformation strategy rapid assessment, are asset-based services that provide a remediation roadmap to help identify the roots of complexity and cost, recommend opportunities for capital and operational improvements across complex IT environments, and help improve service levels with available staff, at reduced costs.

### **Highlights**

- ▶ Helps address issues surrounding the ongoing management of complex storage or backup environments.
- ▶ Helps assess capital and operational costs and staffing issues associated with the IT infrastructure.
- ▶ Identifies inefficiencies and develops an actionable remediation roadmap to minimize complexity and cost.

### **Measuring the efficiency and effectiveness of IT environment**

It can be challenging to determine the impact of a complex and difficult-to-manage storage or backup environment on the core business without a clear understanding of business service priorities, how business services are configured, and how your underlying storage or backup infrastructure enables business. Plus, an organization also needs to know which portions of the storage or backup environment are most inefficient and needlessly costing money.

Powered by the IBM Management Complexity Factor (MCF), IBM Storage Optimization and Integration Services - transformation strategy uses eight key metrics to help measure the efficiency and effectiveness of an organization's IT environment. It is designed with two service delivery models:

- ▶ A transformation strategy - Full assessment engagement rates overall inefficiency and develops a detailed strategic 3-year remediation roadmap with related cost savings. Additionally, the full assessment offers follow-on evaluations where IBM experts provide progress reports, strategy updates, and refined remedial action plans.
- ▶ A transformation Strategy - Rapid assessment engagement rates overall inefficiency and develops a mixed tactical and strategic 18-month remediation roadmap with related cost savings.

IBM's expertise and extensive knowledge in storage and backup optimization and integration allows them to offer:

- ▶ Leadership in storage and backup assessment, planning, and design through proven methodology and tools
- ▶ Issue-based professional services engagements and delivery of skills on multivendor environments
- ▶ A standardized and repeatable approach for assessing storage and backup environments

IBM offers Novus Management Complexity Factor (MCF) as part of Storage Optimization and Integration Services - transformation strategy.

## **Novus Management Complexity Factor (MCF)**

Operational costs in heterogeneous, interconnected IT environments? If an organization integrates disparate environments as a result of merger and acquisition activity, it may face exponential data growth, all with fixed budgets.

### **Highlights**

- ▶ Helps to rapidly discover the roots of complexity and the cost to the business environment.
- ▶ Identifies opportunities for operational improvements across complex IT environments.
- ▶ Pinpoints infrastructure imbalances and provides optimization plans for properly aligning capital expenditures to business drivers.
- ▶ Provides the ability to quantify the complexity in the business environment.
- ▶ Is designed to initiate improvements to service levels by reducing complexity and therefore driving costs down by optimizing the environment.
- ▶ Helps limit the burden on IT management by automating and streamlining the environment.

The IBM Storage Optimization and Integration Services - transformation strategy offering, powered by the Management Complexity Factor (MCF), can be of tremendous assistance to an organization.

**Note:** For more information on MCF, visit:

<http://www-935.ibm.com/services/us/index.wss/offering/gts/a1029793>

## **8.8 Storage Services for Cloud Computing**

Information can fuel collaboration and innovation—inside and outside the organization. But where to store all this data, and how to provide secure and reliable access?

Many organizations are finding that the answer is cloud storage. Designed for affordability and security, cloud storage solutions can support explosive data growth while reigning in costs. Whether a business is considering private storage or public storage cloud technologies, IBM Storage Services for Cloud Computing can help:

- ▶ Develop a flexible cloud storage infrastructure that provides access to storage where and when an organization needs it.
- ▶ Reduce total cost of ownership by helping clients to match their investment to actual need and use.
- ▶ Optimize available storage capacity to help delay new purchases.

While there are many newcomers offering cloud computing services and solutions, IBM cloud storage capabilities leverage existing industry-leading technologies such as the IBM General Parallel File System. With years of experience, IBM is already working on next-generation capabilities. IBM can help to evaluate and implement cloud storage solutions based on an organization's current and future needs. The end result? A successful design and affordable implementation with a focus on lifecycle management, access, security, and performance.

IBM offers Smart Business Storage Cloud as part of Storage Services for Cloud Computing.

### **8.8.1 Smart Business Storage Cloud**

As data volumes grow and the ability to handle various file formats becomes more complex, supporting efficient and cost-effective access to data can be increasingly difficult, with users experiencing reduced performance and outages. IBM Smart Business Storage Cloud can help to successfully deploy a high-performance, scalable storage virtualization solution to facilitate growth and innovation at lower operational costs.

#### **Highlights**

- ▶ Enhances innovation and productivity by facilitating simplified data access and improved scalability.
- ▶ Helps reduce operating costs and total cost of ownership (TCO) through storage consolidation.
- ▶ Offers ongoing management expertise to support data storage environments.
- ▶ Provides an effective storage solution for improved data availability and performance.

Allocating the right amount of data storage to the right users at the right time is an ongoing challenge for organizations of all sizes. The explosive growth of workgroup communities and multiple data volumes demands efficient and cost-effective interdepartmental data sharing. While traditional solutions may offer simplicity, they can lack the crucial scalability to expand the storage space to serve large end-user communities.

IBM Smart Business Storage Cloud offers a storage virtualization solution designed to support storage optimization efforts. It can help alleviate data storage challenges by enabling quick implementation of a scalable, global file storage system with flexibility in deployment and management options. The solution provides virtualized storage to enable storage and server consolidation, a unified management platform to help reduce outages and storage management labor demands and costs, as well as advanced data replication for cost effective business continuity and disaster recovery.

### **8.8.2 More information**

For more information about the complete offering of storage and data services provided by IBM, visit:

<http://www-935.ibm.com/services/us/index.wss/itservice/its/a1000416>



# IBM System Storage software

IBM System Storage software products are designed with the goal of helping clients drive down the cost and complexity of storage management while providing greater flexibility to address rapidly changing storage needs.

In this section, we examine some of the key storage software offerings:

- ▶ IBM Tivoli Storage Productivity Center (TPC) Suite:
  - IBM Tivoli Storage Productivity Center Basic Edition
  - IBM Tivoli Storage Productivity Center for Data
  - IBM Tivoli Storage Productivity Center for Disk
  - IBM Tivoli Storage Productivity Center for Replication
  - IBM Tivoli Storage Productivity Center Standard Edition
  - IBM Tivoli Storage Productivity Center with Advanced Provisioning
  - IBM System Storage Productivity Center
- ▶ IBM Tivoli Storage Manager:
  - IBM Tivoli Storage Manager
  - IBM Tivoli Storage Manager Extended Edition
  - IBM Tivoli Storage Manager for Mail
  - IBM Tivoli Storage Manager for Databases
  - IBM Tivoli Storage Manager for Microsoft SharePoint
  - IBM Tivoli Storage Manager HSM for Windows
  - IBM Tivoli Storage Manager for Advanced Copy Services
  - IBM Tivoli Storage Manager for Copy Services
  - IBM Tivoli Storage Manager for SAP V6.1
  - IBM Tivoli Storage Manager for Space Management
  - IBM Tivoli Storage Manager for Storage Area Networks
  - IBM Tivoli Storage Manager for System Backup and Recovery
  - IBM Tivoli Storage Manager FastBack
  - IBM Tivoli Storage Manager FastBack for Microsoft Exchange
  - IBM Tivoli Storage Manager FastBack for Bare Machine Recovery
  - IBM Tivoli Continuous Data Protection for Files
- ▶ IBM General Parallel File System (GPFS)
- ▶ IBM System Storage Multilevel Grid Access Manager Software

- ▶ z/OS storage management tools:
  - IBM Tivoli Omegamon XE
  - IBM DB2 Cloning Tool
  - IBM Tivoli Advanced Catalog Management for z/OS
  - IBM Tivoli Advanced Backup and Recovery
  - IBM Tivoli Advanced Audit for DFSMShsm
  - IBM Tivoli Automated Tape Allocation Manager
  - IBM Tivoli Storage Optimizer for z/OS
  - IBM Tivoli Tape Optimizer for z/OS
  - DFSMS Optimizer

## 9.1 IBM Tivoli Storage Productivity Center

IBM Tivoli Storage Productivity Center (TPC) is an integrated suite that includes a single user interface to manage capacity utilization of storage systems, file systems, and databases, and to automate file-system capacity provisioning in both physical and virtual environments.

IBM Tivoli Storage Productivity Center components can be ordered as a bundled suite or ordered separately based on specific needs.

The individual components include:

- ▶ IBM Tivoli Storage Productivity Center Basic Edition
- ▶ IBM Tivoli Storage Productivity Center for Data
- ▶ IBM Tivoli Storage Productivity Center for Disk
- ▶ IBM Tivoli Storage Productivity Center for Replication.

The integrated packages include:

- ▶ IBM Tivoli Storage Productivity Center Standard Edition
- ▶ IBM Tivoli Storage Productivity Center with Advanced Provisioning
- ▶ IBM System Storage Productivity Center.

This section provides basic information about TPC components and packages. For details, refer to the documentation listed in 9.1.5, “More information” on page 218.

### 9.1.1 Tivoli Storage Productivity Center overview

IBM Tivoli Storage Productivity Center provides a set of policy-driven automated tools for managing storage capacity, availability, events, performance and assets in your enterprise environment, including NetWare, NAS, Tivoli Storage Enterprise Storage Server, and Microsoft Cluster Server technologies, as well as RDBMSs such as Oracle, Sybase SQL Server, Microsoft SQL Server, and DB2 UDB. Tivoli Storage Productivity Center provides storage management from the host and application to the target storage device. It provides disk and tape subsystem configuration and management, performance management, SAN fabric management and configuration, and usage reporting and monitoring.

Tivoli Storage Productivity Center can help you identify, evaluate, control and predict your enterprise storage management assets. Because it is policy-based, it can detect potential problems and automatically make adjustments based on the policies and actions that you define. For example, it can notify you when your system is running out of disk space or warn you of impending storage hardware failure. By alerting you to these and other issues related to your stored data, it enables you to prevent unnecessary system and application downtime.

Tivoli Storage Productivity Center is designed to:

- ▶ Simplify the management of storage infrastructures
- ▶ Manage, configure, and provision SAN-attached storage
- ▶ Monitor and track performance of SAN-attached devices
- ▶ Monitor, manage, and control (through zones) SAN fabric components
- ▶ Manage the capacity utilization and availability of file systems and databases

Figure 9-1 on page 207 shows the main window, which is displayed when you log into IBM Tivoli Storage Productivity Center.

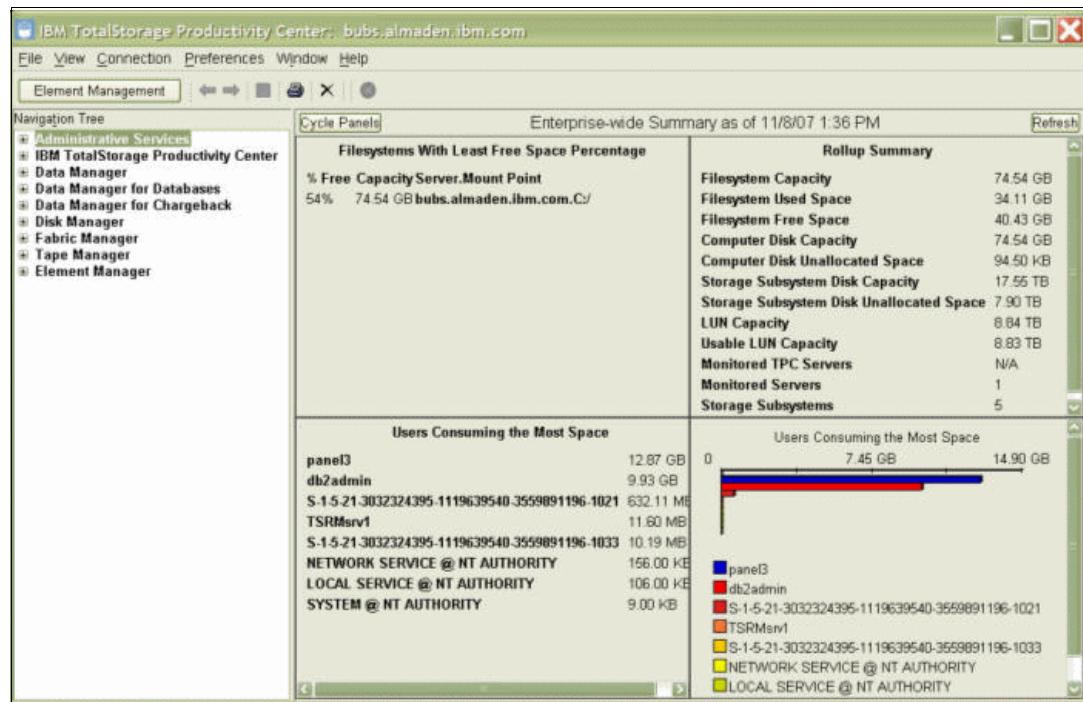


Figure 9-1 IBM Tivoli Storage Productivity Center main window

### 9.1.2 Tivoli Storage Productivity Center components and packages

This topic provides information on the IBM Tivoli Storage Productivity Center components and packages. For more information about TPC individual components and packages, see *IBM Tivoli Storage Productivity Center V4.1 Release Guide*, SG24-7725.

Use Table 9-1 to compare specific functions and data sources that are available in each license.

Table 9-1 TPC package comparison

Data Source	Functionality	Required TPC License
Hypervisor		
	Probe	Data Edition
Storage Resource Agent		
	Host Probe	Basic Edition
Storage Resource Agent / Fabric Agent		
	Fabric Probe	Basic Edition

Data Source	Functionality	Required TPC License
	Fabric Provisioning	Basic Edition
	Fabric Health Monitoring	Basic Edition
Data Agent		
	NetApp/NAS Probe	Data Edition
	Database Probe	Data Edition
	Deep Filesystem Scans	Data Edition
	Batch Reporting	Data Edition
Storage Resource Agent / Data Agent		
	Planning	Standard Edition
	Analytics	Standard Edition
FibreChannel Switch		
	Probe	Basic Edition
	Provisioning	Basic Edition
	Health Monitoring	Basic Edition
	Performance Monitoring	Standard Edition
	Planning	Standard Edition
	Analytics	Standard Edition
Storage Subsystem		
	Probe	Basic Edition
	Provisioning	Basic Edition
	Health Monitoring	Basic Edition
	Performance Monitoring	Disk Edition
	Planning	Standard Edition
	Analytics	Standard Edition

### **IBM Tivoli Storage Productivity Center Basic Edition**

IBM Tivoli Storage Productivity Center Basic Edition is focused on providing basic device management services for IBM System Storage DS3000, DS4000, DS5000, DS6000 and DS8000 products, IBM SAN Volume Controller, and heterogeneous storage environments. This is a management option available with IBM Tivoli Storage hardware acquisitions. This tool provides storage administrators a simple way to conduct device management for multiple storage arrays and SAN fabric components from a single integrated console that also is the base of operations for the IBM Tivoli Storage Productivity Center suite. Productivity Center Basic Edition also does discovery and asset management of tape libraries, specifically IBM 3494 and 3584 Tape Libraries.

Key features include:

- ▶ Discovery and configuration of supported devices
- ▶ Event gathering, error logging, and launching of device element managers

- ▶ Provisioning support, including LUN allocation and assignment
- ▶ Basic Asset and Capacity Reporting
- ▶ A Topology viewer—End to End Storage Topology View and Health Console
- ▶ A simple upgrade path to IBM Tivoli Storage Productivity Center for Disk, Data, or Fabric.

IBM Tivoli Storage Productivity Center Basic Edition enables device configuration and management of SAN-attached devices from a single console. Basic Edition simplifies the complexity of managing multiple SAN-attached storage devices. It enables you to manage SANs and heterogeneous storage from a single console.

Basic Edition enables you to manage network storage components based on SMI-S, such as:

- ▶ IBM System Storage SAN Volume Controller
- ▶ IBM System Storage disk systems (DS3000, DS4000, DS5000, DS6000, and DS8000 series)
- ▶ Other storage systems that support SMI-S standards

Device discovery is performed by Service Location Protocol (SLP), as specified by SMI-S. Configuration of the discovered devices is possible in conjunction with CIM agents associated with those devices, using the standard mechanisms defined in SMI-S. Tivoli Storage Productivity Center gathers events and can start an element manager specific to each discovered device.

For SAN fabrics, Tivoli Storage Productivity Center simplifies the management and improves the availability of the SAN environment. You can monitor and report on SAN resources and use a single location for zone control. Tivoli Storage Productivity Center discovers existing zones and zone members and allows you to modify or delete them. In addition, you can create new zones. Support for aliases is also provided.

Tivoli Storage Productivity Center gives you the ability to view events happening in your SAN environment and record state changes. Events related to topology changes or updates can be forwarded to the IBM Tivoli Enterprise Console®, to another manager that uses Simple Network Manager Protocol (SNMP), or to both.

For the SAN fabric, Tivoli Storage Productivity Center supports host bus adapters (HBAs), disk systems, tape systems, SAN switches, routers, and gateways.

**Tip:** IBM Tivoli Storage Productivity Center Basic Edition includes basic disk, fabric, tape, and data management functions, but does not include chargeback, database monitoring, and performance monitoring functions.

## IBM Tivoli Storage Productivity Center for Data

TPC for Data is an advanced Storage Resource Management (SRM) tool for storage environments that provides a set of policy-driven automated features for Data for managing storage capacity, availability, events, data assets, and green initiatives including DAS, NAS, and SAN technologies.

Key features include:

- ▶ Leverage and optimize existing storage resources and perform storage management with a high level of control
- ▶ Improve storage utilization
- ▶ Enable intelligent capacity planning
- ▶ Manage more storage with the same staff

- ▶ Support high application availability
- ▶ Detect failed backup and archive tasks
- ▶ Provide enterprise-wide reports on capacity via role-based management
- ▶ Assist customers in support of data classification, ILM assessments, and ITIL® storage practices

**Tip:** IBM Tivoli Storage Productivity Center for Data includes data management, basic tape, disk, and fabric management, database monitoring, and chargeback functions, but does not include performance monitoring functions.

## IBM Tivoli Storage Productivity Center for Disk

IBM Tivoli Storage Productivity Center for Disk is designed to enable device configuration and management of SAN-attached devices from a single console. In addition, it also includes performance capabilities to help monitor and manage the performance of the devices' disks. IBM Tivoli Storage Productivity Center for Disk is designed to help simplify the complexity of managing multiple SAN-attached storage devices.

Productivity Manager for Disk is designed to enable the IT administrator to:

- ▶ Enable proactive performance management by providing an IT administrator with a single, integrated console for the performance management of IBM System Storage devices.
- ▶ Monitor performance metrics across multiple storage subsystems from a single console.
- ▶ Designed to allow administrators to monitor metrics, such as I/O rates and cache utilization, and support optimization of storage through the identification of the best LUNs across multiple storage subsystems.
- ▶ Monitor and analyze performance statistics for storage systems to measure service levels by storing received performance statistics into database tables for later use, and analyze and generate reports on monitored devices for display in a central administrative console.
- ▶ Receive timely alerts to enable event action based on client policies by setting performance thresholds for the devices based on performance metrics and the generation of alerts when those thresholds are exceeded.
- ▶ Provide a Performance Optimization Engine that can help reduce service times of resource-constrained application by an average of 48% and up to a maximum of 90% using a heat map that provides storage I/O utilization reports that can be used to determine hot spots in the environment and generate recommendation plans for migration to distribute workload.

Key benefits include:

- ▶ Helps you potentially improve storage return on investment by keeping SANs operational reliably and dependably.
- ▶ Helps reduce storage administration costs by simplifying the management of complex SANs.
- ▶ Offers continuous real-time monitoring and fault identification to improve SAN availability.

**Tip:** IBM Tivoli Storage Productivity Center for Disk includes basic disk, fabric, tape, and data management functions and storage system performance monitoring, but does not include fabric performance monitoring, chargeback, and database monitoring functions.

## **IBM Tivoli Storage Productivity Center For Replication**

IBM Tivoli Storage Productivity Center For Replication can help simplify and automate the configuration of your replication environment. The basic functions of Tivoli Storage Productivity Center (TPC) for Replication are designed to provide management of the advanced copy services: IBM FlashCopy, Metro Mirror, and Global Mirror capabilities for the IBM System Storage DS8000, IBM System Storage DS6000, and the IBM System Storage SAN Volume Controller (SVC).

It is designed to:

- ▶ Automate the configuration of IBM DS8000, DS6000, and the IBM SAN Volume Controller advanced copy services features
- ▶ Monitor the progress of the copy services so you can verify the amount of replication that has been done as well as the amount of time needed to complete the replication
- ▶ Manage and coordinate the copy operations to ensure successful completion from your source volumes to your disaster recovery volumes:
  - Flash Copy
  - Metro Mirror
  - Global Mirror
  - Metro Global Mirror
- ▶ Execute automated failover to keep your critical data online and available to your users even if your primary site fails. When the primary site comes back on, the software manages failback to the default configuration as well.

**Attention:** With Tivoli Storage Productivity Center V4.1.1, Tivoli Storage Productivity Center and Tivoli Storage Productivity Center for Replication, previously separated products, are now integrated. You can start the IBM Tivoli Storage Productivity Center for Replication user interface from within the Tivoli Storage Productivity Center user interface.

IBM Tivoli Storage Productivity Center for Replication is still a separate, stand-alone product on z/OS.

The IBM Tivoli Storage Productivity Center (TPC) for Replication V4 includes new capabilities and enhancements:

- ▶ Metro Global Mirror with Practice Volumes
- ▶ Metro Global Mirror with HyperSwap®
- ▶ Global Mirror with Practice Volume (Both Directions)
- ▶ Global Copy—to minimize application impact when initializing Metro Mirror sessions
- ▶ Replicating session progress indicators.

### ***IBM Tivoli Storage Productivity Center for Replication Two Site Business Continuity (AIX, Linux, Windows, z/OS)***

IBM TPC for Replication Two Site Business Continuity helps to obtain continuous availability and disaster recovery solutions by using point-in-time replication, which includes FlashCopy, and continuous replication, which includes Metro Mirror and Global Mirror.

Use IBM Tivoli Storage Productivity Center for Replication Two Site Business Continuity for the following tasks:

- ▶ Perform a FlashCopy for DS6000, and DS8000
- ▶ Perform a FlashCopy for SAN Volume Controller
- ▶ Perform a Global Mirror Single Direction for DS6000, and DS8000
- ▶ Perform a Global Mirror Either Direction with Two-Site Practice for DS6000, and DS8000

- ▶ Perform a Global Mirror Single Direction for SAN Volume Controller
- ▶ Perform a Global Mirror Failover/Failback for DS6000, and DS8000
- ▶ Perform a Global Mirror Failover/Failback for SAN Volume Controller
- ▶ Perform a Global Mirror Failover/Failback with Practice for DS6000, and DS8000
- ▶ Perform a Global Mirror Failover/Failback with Practice for SAN Volume Controller
- ▶ Perform a Metro Mirror Single Direction for SAN Volume Controller
- ▶ Perform a Metro Mirror Failover/Failback for SAN Volume Controller
- ▶ Perform a Metro Mirror Failover/Failback with Practice for SAN Volume Controller
- ▶ Perform a Metro Mirror or Global Copy for DS6000, and DS8000
- ▶ Perform a Metro Mirror Failover/Failback or Global Copy for DS6000, and DS8000
- ▶ Perform a Metro Mirror Failover/Failback with HyperSwap for DS6000, and DS8000
- ▶ Practice recovery procedures while maintaining disaster recovery capability

***IBM Tivoli Storage Productivity Center for Replication Three Site Business Continuity (AIX, Linux, Windows, z/OS)***

IBM TPC for Replication Three Site Business Continuity helps to obtain continuous availability and disaster recovery solutions by using point-in-time replication, which includes FlashCopy, and continuous replication, which includes Metro Mirror, Global Mirror, and Metro Global Mirror to secondary and tertiary sites.

Use IBM Tivoli Storage Productivity Center for Replication Three Site Business Continuity for the following tasks:

- ▶ Perform a FlashCopy for DS6000, and DS8000
- ▶ Perform a FlashCopy for SAN Volume Controller
- ▶ Perform a Global Mirror Single Direction for DS6000, and DS8000
- ▶ Perform a Global Mirror Either Direction with Two-Site Practice for DS6000, and DS8000
- ▶ Perform a Global Mirror Single Direction for SAN Volume Controller
- ▶ Perform a Global Mirror Failover/Failback for DS6000, and DS8000
- ▶ Perform a Global Mirror Failover/Failback for SAN Volume Controller
- ▶ Perform a Global Mirror Failover/Failback with Practice for DS6000, and DS8000
- ▶ Perform a Global Mirror Failover/Failback with Practice for SAN Volume Controller
- ▶ Perform a Metro Mirror Single Direction for SAN Volume Controller
- ▶ Perform a Metro Mirror Failover/Failback for SAN Volume Controller
- ▶ Perform a Metro Mirror Failover/Failback with Practice for SAN Volume Controller
- ▶ Perform a Metro Mirror or Global Copy for DS6000, and DS8000
- ▶ Perform a Metro Mirror Failover/Failback or Global Copy for DS6000, and DS8000
- ▶ Perform a Metro Mirror Failover/Failback with HyperSwap for DS6000, and DS8000
- ▶ Perform a Metro Global Mirror for DS8000 (with failover and failback)
- ▶ Perform a Metro Global Mirror for DS8000 (with failover and failback)
- ▶ Perform a Metro Global Mirror with Practice for DS8000 (with failover and failback)
- ▶ Perform a Global Metro Mirror with HyperSwap for DS8000
- ▶ Practice recovery procedures while maintaining disaster recover capability.

**Important:** IBM Tivoli Storage Productivity Center for Replication Three Site Business Continuity requires a BC license key.

***IBM Tivoli Storage Productivity Center for Replication Basic Edition for System z (z/OS)***

IBM TPC for Replication Basic Edition for System z provides a disaster recovery capable solution, and helps protect from storage system failures.

Use IBM Tivoli Storage Productivity Center for Replication Basic Edition for System z with Basic HyperSwap for the following tasks:

- ▶ Monitoring for events that indicate a storage device has failed
- ▶ Determining if the failing storage device is part of a peer-to-peer remote copy (PPRC) pair
- ▶ Determining from policy, the action to be taken
- ▶ Ensuring that data consistency is not violated
- ▶ Swapping the I/O between the primary logical devices in the consistency group with the secondary logical devices in the consistency group (performing a HyperSwap for DS6000, and DS8000)
- ▶ Allowing only z/OS attached count key data (CKD) volumes to be added to the HyperSwap session.

IBM Tivoli Storage Productivity Center for Replication Basic Edition for System z provides only the HyperSwap session and not the functionality of the other IBM Tivoli Storage Productivity Center for Replication products.

**Note:** No license is required for IBM Tivoli Storage Productivity Center for Replication Basic Edition for System z. If you want to use IBM Tivoli Storage Productivity Center for Replication or IBM Tivoli Storage Productivity Center for Replication Three Site Business Continuity, a separate license for each of these products is required.

The z/OS HyperSwap license is required for running Basic HyperSwap.

### ***IBM Tivoli Storage Productivity Center for Replication for System z (z/OS)***

IBM Tivoli Storage Productivity Center for Replication for System z provides the functions as the IBM Tivoli Storage Productivity Center for Replication open systems products. It runs on System z servers, using a mixture of FICON and TCP/IP communications, to provide replication management of DS8000, and DS6000, regardless of the type of data on them (ECKD™ or FBA).

IBM Tivoli Storage Productivity Center for Replication for System z provides:

- ▶ Volume protection to exclude any volumes from being used for disaster-protection copy operations
- ▶ Command prompting to confirm storage administrator actions before running the copy services commands
- ▶ User roles for administrative levels of access
- ▶ Site awareness to indicate site locations of the storage volumes and help assure copies are done correctly
- ▶ Metro Global Mirror support for the DS8000, providing failover and fallback support, fast reestablishment of three-site mirroring, quick resynchronization of mirrored sites using incremental changes only, and data currency at the remote site.

**Note:** If you want to use IBM Tivoli Storage Productivity Center for Replication or IBM Tivoli Storage Productivity Center for Replication Three Site Business Continuity, a separate license for each of these features is required.

### ***IBM Tivoli Storage Productivity Center Standard Edition***

This is one of the industry's most comprehensive storage resource management solutions by combining the consolidated benefits of the following three components as one bundle:

- ▶ Tivoli Storage Productivity Center for Data
- ▶ Tivoli Storage Productivity Center for Disk
- ▶ Tivoli Storage Productivity Center Basic Edition

In addition to the benefits and features of Data, Disk and Basic Edition, Productivity Center Standard Edition offers additional management, control, and performance reporting for the fiber channel SAN infrastructure. These features include the following benefits:

- ▶ Provides automated device discovery, topology rendering, error detection and fault isolation, SAN error predictor, zone control, real-time monitoring and alerts, and event management for heterogeneous enterprise SAN environments.
- ▶ Helps simplify the management and improve the availability of the SAN environment.
- ▶ Provides automatic device discovery and allows multiple SAN views, including physical, logical and zone views.
- ▶ Views and analyzes multiple aspects of the storage environment, including capacity, utilization, assets and availability.
- ▶ Detects storage events and generates the appropriate alerts to the administrator.
- ▶ Provides a number of SAN availability features, including SAN error protector. An autonomic computing capability, SAN error predictor is designed to help predict SAN network problems before they become severe and impact data and application availability. This functionality incorporates predictive failure analysis into the storage network environment, designed to allow administrators to be proactive in managing SAN availability.
- ▶ Provides basic diagnostic capabilities to show which resources are impacted by an availability or performance issue in the SAN. Today, it can monitor performance at the port and switch level, and display this information in the common topology viewer for IBM Tivoli Storage Productivity Center.

**Tip:** IBM Tivoli Storage Productivity Center Standard Edition contains all the functions for data management, disk management, fabric management, and tape management, plus:

- ▶ Analytical functions
- ▶ Configuration Analysis
- ▶ Configuration History
- ▶ SAN Planner

## **IBM Tivoli Storage Productivity Center with Advanced Provisioning**

This is an integrated storage capacity provisioning solution designed to simplify and automate complex cross-discipline tasks for provisioning storage capacity in the enterprise environment and is designed to move you from just-in-case provisioning to intelligent, automated on demand provisioning.

The IBM Tivoli Storage Productivity Center with Advanced Provisioning is comprised of:

- ▶ IBM Tivoli Provisioning Manager
- ▶ IBM Tivoli Storage Productivity Center
  - IBM Tivoli Storage Productivity Center for Data
  - IBM Tivoli Storage Productivity Center for Disk
  - IBM Tivoli Storage Productivity Center for Replication

Tivoli Storage Productivity Center with Advanced Provisioning is designed to allow you to automate and execute the numerous steps necessary to provision storage in a consistent manner, helping reduce or eliminate human error. Provisioning capabilities are provided by the Tivoli Storage Productivity Center, while Tivoli Provisioning Manager facilitates the

automation of the provisioning tasks through the use of storage workflows. Tivoli Storage Productivity Center with Advanced Provisioning includes workflow building blocks designed to help you easily build and customize your own solution workflows with minimal effort. The simplicity and flexibility of workflows helps you to automate at your own pace. Through the use of automated storage capacity provisioning workflows, helps you to:

- ▶ Provision storage capacity with consistency in a repeatable and auditable manner
- ▶ Automate storage capacity provisioning at your own pace with minimal effort
- ▶ Enable staff to manage cross discipline IT projects more effectively and efficiently
- ▶ Improve responsiveness to the storage needs of applications

### **9.1.3 IBM Tivoli Storage Productivity Center licenses**

The following product licenses are available for IBM Tivoli Storage Productivity Center: Basic, Data, Disk, and Standard. Each license determines the functions that are accessible in the user interface.

For more information about licensing in the TPC, see *IBM Tivoli Storage Productivity Center V4.1 Release Guide*, SG24-7725.

Table 9-2 provides the list of functions that are included with each license to help you determine which one best meets your storage management needs.

*Table 9-2 Tivoli Storage Productivity Center packages*

Package/License	Function
IBM Tivoli Storage Productivity Center for Data	Includes data management, basic tape, disk, and fabric management, database monitoring, and chargeback functions, but does not include performance monitoring functions.
IBM Tivoli Storage Productivity Center for Disk	Includes basic disk, fabric, tape, and data management functions and storage system performance monitoring, but does not include fabric performance monitoring, chargeback, and database monitoring functions.
IBM Tivoli Storage Productivity Center for Replication (Two Site Business Continuity license and Three Site Business Continuity license)	IBM Tivoli Storage Productivity Center for Replication functions. When you install IBM Tivoli Storage Productivity Center for Replication, no licenses will be installed. You must install the Two Site or Three Site Business Continuity license after you install IBM Tivoli Storage Productivity Center for Replication.
IBM Tivoli Storage Productivity Center Basic Edition	Includes basic disk, fabric, tape, and data management functions, but does not include chargeback, database monitoring, and performance monitoring functions.
IBM Tivoli Storage Productivity Center Standard Edition	Contains all the functions for data management, disk management, fabric management, and tape management, plus: <ul style="list-style-type: none"> <li>▶ Analytical functions</li> <li>▶ Data path explorer view (or context-sensitive performance analysis)</li> <li>▶ Configuration Analysis</li> <li>▶ Configuration History</li> <li>▶ SAN Planner</li> </ul>

**Important:** Each marketing package contains the complete Tivoli Storage Productivity Center product, and all functions are installed. However, the different licenses that are shipped with each marketing package will limit the functionality available at the graphical user interface level.

**Attention:** IBM Tivoli Storage Productivity Center for Replication is still a separate, stand-alone product on z/OS.

#### 9.1.4 IBM System Storage Productivity Center

The IBM System Storage Productivity Center (SSPC) is an integrated hardware and software solution that will help you improve and centralize the management of your storage environment through the integration of products. It provides a single point from which to manage your storage systems.

The SSPC combines the power of a customized IBM System x server with preinstalled storage software that represents a significant point of centralized management. SSPC enhances several rudimentary device utilities for easier, more intuitive, context-based administration and on the whole lowers resource overhead.

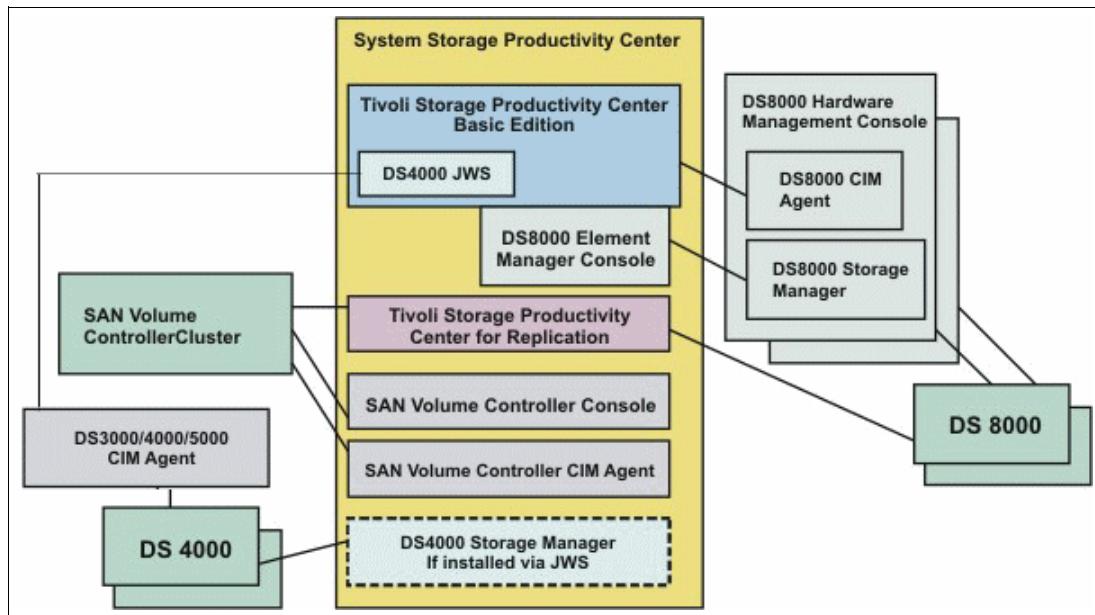
System Storage Productivity Center simplifies storage management by:

- ▶ Centralizing the management of storage network resources with IBM storage management software
- ▶ Providing greater synergy between storage management software and IBM storage devices
- ▶ Reducing the number of servers that are required to manage your software infrastructure
- ▶ Providing a simple migration path from basic device management to using storage management applications that provide higher-level functions

The System Storage Productivity Center is a 1U, rack-mounted hardware appliance that has IBM Tivoli Storage Productivity Center Basic Edition and IBM Tivoli Storage Productivity Center for Replication installed on it.

Figure 9-2 on page 217 shows an overview of how the SSPC, TPC, TPC for Replication, and the hardware and software for IBM System Storage DS8000, IBM System Storage SAN Volume Controller, IBM System Storage DS3000, IBM System Storage DS4000, and IBM System Storage D5000 all relate to each other.

**Note:** The IBM Tivoli Storage Productivity Center was formerly the IBM TotalStorage Productivity Center.



*Figure 9-2 Overview of System Storage Productivity Center*

The System Storage Productivity Center provides integration of storage management applications by providing support for the following products:

- ▶ **IBM Tivoli Storage Productivity Center Basic Edition**

IBM Tivoli Storage Productivity Center Basic Edition enables device configuration and management of SAN-attached devices from a single console. Basic Edition simplifies the complexity of managing multiple SAN-attached storage devices. It enables you to manage SANs and heterogeneous storage from a single console.

- ▶ **IBM System Storage DS8000 Storage Manager**

The IBM System Storage DS8000 Storage Manager user interface is accessible from the Tivoli Storage Productivity Center user interface. Tivoli Storage Productivity Center provides a DS8000 element manager page, which allows you to add and manage multiple DS8000 element managers from one console. You can use the DS8000 element manager page to:

- Access the IBM DS8000 Storage Manager interface that is embedded in the DS8000 Hardware Management Console (HMC).
- Use the DS8000 Storage Manager interface to configure and administer its associated IBM DS8000 storage arrays.

- ▶ **IBM System Storage SAN Volume Controller**

The IBM System Storage SAN Volume Controller Console is installed with System Storage Productivity Center. The SAN Volume Controller Console is a separate icon from the Tivoli Storage Productivity Center user interface icon on your desktop.

- ▶ **IBM Tivoli Storage Productivity Center for Replication**

Beginning with Release 4.1, IBM Tivoli Storage Productivity Center for Replication and Tivoli Storage Productivity Center, previously separated products, are integrated. This means that you can start the IBM Tivoli Storage Productivity Center for Replication user interface from within the Tivoli Storage Productivity Center user interface.

- ▶ IBM System Storage DS3000, DS4000, and DS5000 Storage Manager

You can optionally install the DS3000, DS4000, and DS5000 Storage Manager user interface on the System Storage Productivity Center server, or a remote server so that you can manage the storage systems from a single console.

To use Tivoli Storage Productivity Center to view reports and topology from the DS3000, DS4000, or DS5000, you must first install the Engenio provider (CIM agent) for the storage system (on a separate server; not the System Storage Productivity Center server). For information about the Engenio provider, contact LSI at:

[http://www.lsi.com/storage\\_home/products\\_home/external\\_raid/management\\_software/smis\\_provider/index.html](http://www.lsi.com/storage_home/products_home/external_raid/management_software/smis_provider/index.html)

- ▶ DS CIM agent management commands

The DS CIM agent management commands (DSCIMCLI) are installed on the System Storage Productivity Center system. The DSCIMCLI can manage the CIM agents for DS8000, and DS6000.

For information about the CIM agent management commands, see *DS Open Application Programming Interface Reference* at:

<http://www.ibm.com/servers/storage/support/software/cimdsapi/>

For more information about SSPC, refer to *IBM System Storage Productivity Center V1.4: Introduction and Planning Guide*, SC23-8824-06.

### 9.1.5 More information

Refer to these publications for more information about IBM Tivoli Storage Productivity Center:

- ▶ *IBM Tivoli Storage Productivity Center V4.1: Release Guide*, SG24-7725
- ▶ *IBM Tivoli Storage Productivity Center User's Guide*, SC27-2338-01
- ▶ *IBM Tivoli Storage Productivity Center Workflow User's Guide*, SC27-2341-01
- ▶ *IBM System Storage Productivity Center V1.4: Introduction and Planning Guide*, SC23-8824-06

For the latest information about IBM Tivoli Storage Productivity Center, refer to:

<http://www.ibm.com/systems/storage/software/center/index.html>

The latest documentation is available from the TPC Infocenter at:

[http://publib.boulder.ibm.com/infocenter/tivihelp/v4r1/index.jsp?topic=/com.ibm.itpc.doc\\_2.1/tpc\\_infocenter\\_home.htm](http://publib.boulder.ibm.com/infocenter/tivihelp/v4r1/index.jsp?topic=/com.ibm.itpc.doc_2.1/tpc_infocenter_home.htm)

## 9.2 IBM Tivoli Storage Manager

Tivoli Storage Manager (TSM) is the number one product of choice for an efficient and effective enterprise wide storage solution. It provides a data protection solution for backup, archiving, disaster recovery planning, space management, database and application protection, bare machine recovery, and record retention. More than 44 operating platforms are supported, using a consistent graphical user interface.

Tivoli Storage Manager provides:

- ▶ Centralized administration for data and storage management
- ▶ Fully automated data protection
- ▶ Efficient management of information growth
- ▶ High-speed automated server recovery
- ▶ Full compatibility with hundreds of storage devices, and local area network (LAN), wide area network (WAN), and storage area network (SAN) infrastructures
- ▶ Optional specifically designed backup solutions for major groupware, enterprise resource planning (ERP) applications, and database products.

Tivoli Storage Manager is the premier storage management solution for mixed platform environments.

This section provides basic information about IBM Tivoli Storage Manager. For more information about TSM, refer to the documentation listed in 9.2.4, “More information” on page 231.

### 9.2.1 IBM Tivoli Storage Manager overview

Businesses face a tidal wave of information and data that seems to increase daily. The ability to successfully manage information and data has become imperative. The IBM Tivoli Storage Manager 6.1 family of products help businesses successfully gain better control and efficiently manage the information tidal wave with significant enhancements in multiple facets of data protection.

From its inception, Tivoli Storage Manager has been a highly scalable and available data protection solution. Tivoli Storage Manager 6.1 takes data protection scalability to the next level with a new relational database, based on IBM DB2 technology, designed to store many more objects and manage more data. Greater availability is delivered through enhancements such as online, automated database reorganization. In addition, the increased scalability and the ability to leverage the latest in server technology helps deliver increased performance of backup and recovery processes.

Tivoli Storage Manager 6.1 delivers new near real-time monitoring and operational reporting capabilities.

Tivoli Storage Manager 6.1 helps decrease the rate of storage capacity required to contain data growth with a new built-in data deduplication feature that helps eliminate redundant data. This can enable significantly more backup data to be stored on disk.

For enterprise IT departments, the ability to work around the clock anywhere in the world can translate to increasingly stringent recovery point objectives and recovery time objectives, and drives the need for more effective business continuity, planning, and execution.

Tivoli Storage Manager 6.1 helps address these challenges with several new features and enhancements, including:

- ▶ Individual mailbox and item level recovery for Microsoft Exchange users
- ▶ Up to two times throughput improvement for a single Tivoli Storage Manager server for operations, such as backing up small files from multiple clients
- ▶ Enhancements designed to improve performance for IBM System Storage N series and NetApp® Network Attached Storage (NAS)
- ▶ Disaster recovery preparedness enhanced for VMware, IBM System Storage N series, NetApp NAS environments, and Microsoft Windows Active Directory environments

The IBM Tivoli Storage Manager architecture is shown in Figure 9-3.

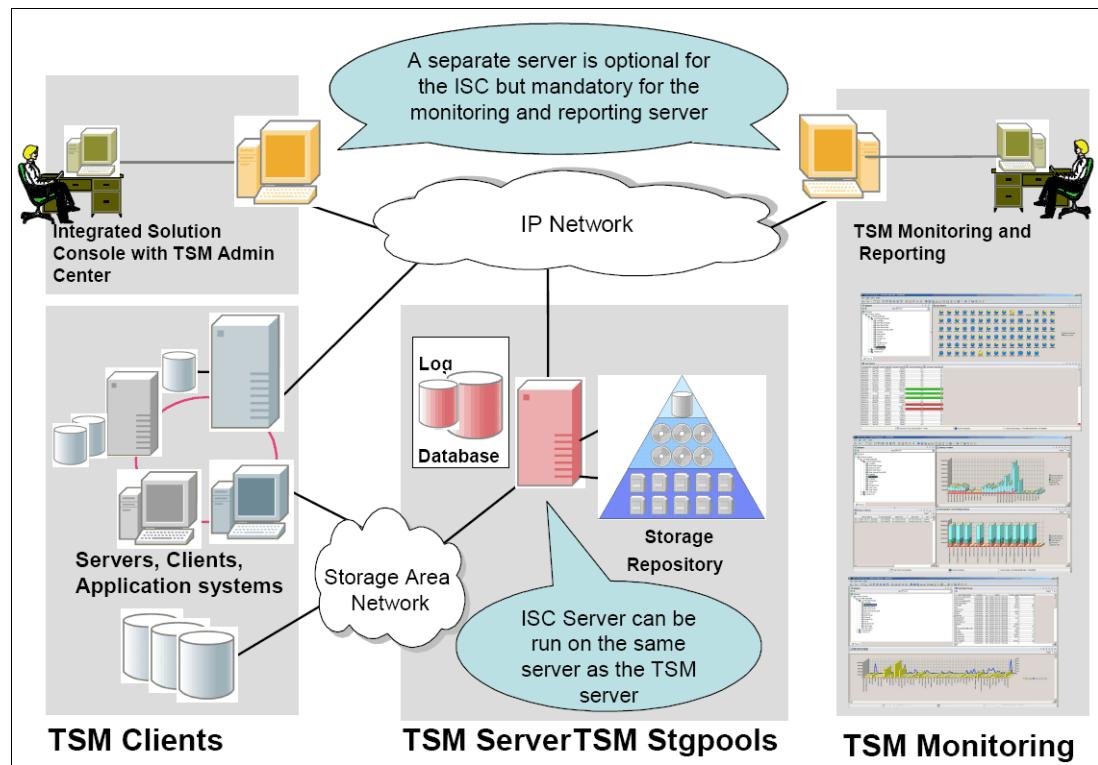


Figure 9-3 IBM Tivoli Storage Manager architecture

## 9.2.2 IBM Tivoli Storage Manager family of products

This topic provides information about the TSM family of products. For more information about the TSM family of products, refer to the documentation listed in 9.2.4, “More information” on page 231.

### IBM Tivoli Storage Manager (Basic/Standard Edition)

With the advent of Version 6.1 there is no longer an Express Edition, so there is no longer a Basic or Standard Edition. The standard version of IBM Tivoli Storage Manager contains a rich set of features and provides the core functions of backup, recovery, and archive management:

- ▶ Progressive backup methodology  
Saves time and storage space by backing up only new files and modified files. The progressive backup feature uses Tivoli Storage Manager's own relational database to

track data wherever it is stored, delivering a direct one-step file restore. Progressive backup eliminates the requirement for traditional full-plus-incremental or full-plus-differential backup and restore procedures, commonly used by other storage management products.

- ▶ Tape resource sharing

Enables multiple Tivoli Storage Manager servers to use the same tape library and drives, optimizing tape hardware asset utilization.

- ▶ Network-free rapid recovery

Supports high-speed client data recovery directly from tape or optical devices. Recovery time is minimized by eliminating the use of network and central server resources.

- ▶ Dynamic multithreaded transfer

Permits multiple clients to simultaneously transfer data to and from the same Tivoli Storage Manager server. Performance is boosted to more than three times the rate of a single-threaded session. The higher speed is achieved by transparently optimizing the number of data transfer sessions, based on available system resources.

- ▶ Adaptive differencing technology

Changes the way data is backed up from the client. Using *adaptive differencing*, data is transferred to the server either by byte, block, or file level, based on the size of the file being backed up, and the portion of the file that has changed since the last backup. Adaptive differencing technology supports all connectivity strategies, including LANs, WANs, SANs, Internet, and dial-up connections. Adaptive differencing was initially designed with mobile computer users in mind. However, other users with a requirement to minimize data transmitted over the network can also benefit from the technology.

- ▶ Enterprise administration

Simplifies centralized control across multiple Tivoli Storage Manager implementations without sacrificing network performance. Tivoli Storage Manager 6.1 employs the Integrated Solutions Console (ISC), which provides a task-based GUI interface to Tivoli Storage Manager administrative tasks.

- ▶ Clustering

Tivoli Storage Manager includes enhanced support for IBM High Availability Cluster Multi-Processing (HACMP™), Microsoft Cluster Services (MSCS), Novell Cluster Services (NCS), and VERITAS Cluster Services (VCS) on Windows.

Tivoli Storage Manager 6.1 has improved the support for Small Computer System Interface (SCSI) and fibre-attached tape device failover on Windows and UNIX, and support for Storage Agents, Library Managers, and Library Clients as cluster members.

- ▶ LAN-free data transfer

An optional module for Tivoli Storage Manager effectively exploits SAN environments by moving data transfers from the communication network to a SAN. Communication bandwidth availability is therefore improved, increasing service levels for users and clients.

- ▶ Hierarchical Storage Management

An optional module for Tivoli Storage Manager automatically and transparently moves unused data files from online disk storage to offline tape storage. In the event that a file is accessed after it has been moved to offline storage, Tivoli Storage Manager transparently recalls the file.

- ▶ Library and device support

Tivoli Storage Manager supports libraries with up to three tape drives and up to 40-cartridge capacity. Larger libraries can be accommodated, but with only three devices and 40 slots enabled.

You can find more information about IBM Tivoli Storage Manager at:

<http://www.ibm.com/software/tivoli/products/storage-mgr/>

## **IBM Tivoli Storage Manager Extended Edition**

The Extended Edition of IBM Tivoli Storage Manager expands on the features and possibilities of the standard version described in the previous section.

Tivoli Storage Manager Extended Edition adds disaster recovery planning capability for the server, Network Data Management Protocol (NDMP) control for network-attached storage (NAS) filers, and support for larger capacity tape libraries and more tape drives.

You can find more information at:

<http://www.ibm.com/software/tivoli/products/storage-mgr-extended/>

## ***Disaster Recovery Manager***

The Disaster Recovery Manager (DRM) component of Tivoli Storage Manager Extended Edition provides disaster recovery for the Tivoli Storage Manager server and assists with disaster recovery for clients.

DRM offers various options to configure, control, and automatically generate a disaster recovery plan (DRP) file. The plan contains the information, scripts, and procedures required to automate restoration and help ensure quick recovery of data after a disaster. The scripts contain the commands necessary to rebuild the Tivoli Storage Manager server.

One of the key features of Tivoli Storage Manager and DRM is the ability to track media in all possible states, such as on-site, in transit, or in a vault. The media movement features of DRM assist greatly with the daily tasks of sending disaster recovery media off-site, and receiving expired media on-site for reuse. With these features, the system administrator can quickly locate all available copies of data.

DRM functions help maintain business continuity by:

- ▶ Establishing and helping to automate a thorough server DRP; clients can then subsequently restore their data from the server if required, and can continue their daily backup procedures.
- ▶ Ensuring that vital site-specific information is available in the same plan.
- ▶ Automating vital recovery steps to return the Tivoli Storage Manager server and backup environment to normal operation.
- ▶ Managing and identifying off-site media required for recovery.
- ▶ Tracking and reporting destroyed systems in the event of a disaster.
- ▶ Storing client configuration information and assigning client recovery priorities.

With DRM, you can recover at an alternate site, on a replacement system with a different hardware configuration, and with people who are not familiar with the applications. The DRP can be periodically tested to certify the recoverability of the server. The DRP can, and must, be recreated easily every day so that it stays up to date.

During a disaster, these are some commonly encountered errors:

- ▶ A DRP does not exist.
- ▶ The DRP was not tested, or if it was, it is now out of date.
- ▶ The testing team's skills were not sufficient to perform and evaluate testing.
- ▶ The disk volume definitions for the recovery site are not known.
- ▶ The location of recovery tapes is not known.
- ▶ It is not known which tapes are to be applied first.

DRM keeps track of all the vital information required to rebuild the Tivoli Storage Manager environment, such as:

- ▶ The current server configuration information and its location
- ▶ The current Tivoli Storage Manager server database volumes (size, location, and number)
- ▶ The recovery sequence
- ▶ The currency of the DRP
- ▶ The server and client machines configurations
- ▶ The people to be contacted in the event of a disaster
- ▶ The location of the recovery media and the organization or persons responsible
- ▶ The point in time (PIT) to which the environment can be restored

During recovery from a disaster, DRM automates the following procedures to restore the Tivoli Storage Manager servers:

- ▶ Restore Tivoli Storage Manager server's key option files
- ▶ Copy files from alternate locations to production locations
- ▶ Initialize the Tivoli Storage Manager database and log volumes
- ▶ Match sizes and locations of the Tivoli Storage Manager database and log volumes
- ▶ Automatically launch restoration of the Tivoli Storage Manager database
- ▶ Track media required and availability
- ▶ Register installed Tivoli Storage Manager server features and return the server state to a valid license configuration
- ▶ Update Tivoli Storage Manager volume catalog information, including whether volumes have been destroyed during the disaster
- ▶ Rebuild Tivoli Storage Manager hierarchical storage configuration
- ▶ Restore destroyed volumes from those available where possible
- ▶ Recreate customer backup environment

A detailed description, recovery scenario, and recovery plan built with DRM can be found in *Disaster Recovery Strategies with Tivoli Storage Management*, SG24-6844. Also, recommendations and examples of using DRM to store client machine information in the DRM plan file for use during a client disaster recovery are given in the same book.

In summary, DRM will systematically rebuild the Tivoli Storage Manager server environment and ensure that current application data for the entire enterprise is available for recovery. This can all be done automatically from a single scripted command.

### ***NDMP support for network-attached storage***

For NAS devices, Tivoli Storage Manager Extended Edition uses NDMP to perform high-performance, scalable backups and restores. NDMP-based backups and restores minimize network traffic and transfer data outboard of the Tivoli Storage Manager client and server. NDMP enables a full and differential file system image backup and restore of Network Appliance™ file servers with OS Data ONTAP V7.1 or higher, and EMC Celerra systems. Multiple backup and restore operations can be performed simultaneously. General NDMP support also allows other NAS vendors to certify integration with Tivoli Storage Manager.

The NDMP backup and restore features are fully integrated with Tivoli Storage Manager Extended Edition server and client. No extra software is required on the server, client, or NAS

appliance. When doing backups and restores, the NAS device and the Tivoli Storage Manager server and client all have specific roles, as shown in Figure 9-4.

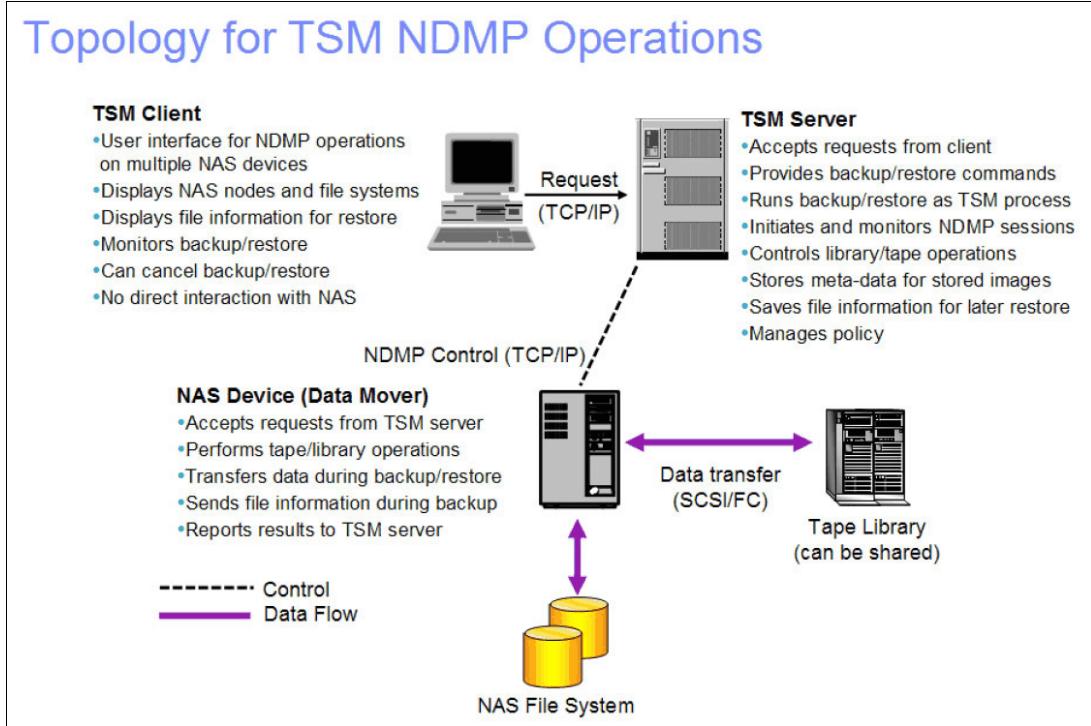


Figure 9-4 Topology for NDMP using IBM Tivoli Storage Manager

Tivoli Storage Manager Extended Edition offers the ability to do file-level and full or differential file system image backups and restore of servers that support the NDMP protocol. Now you can back up directly to the Tivoli Storage Manager hierarchy and also implement DRM, as it now supports NAS storage. Multiple backup and restore operations can be performed in parallel.

During backup and restore operations, data flows directly between the tape drive and the NAS appliance. NDMP for NAS backup uses either an SCSI-attached tape device local to the NAS appliance, or a SAN-attached SCSI or Automated Cartridge System Library Software (ACSLS) device that can be shared with the Tivoli Storage Manager server. Library robotics can be controlled directly by the Tivoli Storage Manager server or by passing SCSI commands through an NAS file server.

Drives must be supported by both the NAS appliance and the NAS OS. Drives can be dedicated to NDMP operations from a single NAS file server or can be shared. Multiple NAS appliances can share SAN-attached shared tape resources if backups are performed through the same Tivoli Storage Manager server. Drives can also be shared with LAN-free backup/restore operations, provided that the library is controlled directly by the Tivoli Storage Manager server.

### ***Extended library and drive support***

Tivoli Storage Manager Extended Edition supports larger tape libraries, thus removing the 48-cartridge limit for library capacity, and allowing more than four tape drives within a single library.

### ***Database and application online protection***

This feature protects a wide range of application data through the protection of the underlying databases and application management systems holding that data. This module automates data protection tasks and allows database and application servers to continue running their primary applications while they back up and restore data to and from offline storage.

### ***Data retention***

IBM System Storage Archive Manager, previously known as Tivoli Storage Manager for Data Retention, helps manage and simplify the retrieval of the ever-increasing amount of data that organizations must retain for strict records retention regulations. Many regulations demand archiving of records, emails, design documents, and other data for many years, in addition to requiring that the data is not changed or deleted.

### ***Bare Machine Recovery***

This feature backs up and automatically restores the operating system structures required to rebuild the operating system, as well as data files. It schedules regular operating system backups so that a recovery brings back the latest information.

## **9.2.3 IBM Tivoli Storage Manager complementary products**

This section provides basic information about TSM complementary products. For details, refer to the documentation listed in 9.2.4, “More information” on page 231.

IBM Tivoli Storage Manager can be integrated with several optional applications that together form a powerful integrated storage management solution. These include:

- ▶ IBM Tivoli Storage Manager for Mail
- ▶ IBM Tivoli Storage Manager for Databases
- ▶ IBM Tivoli Storage Manager for Microsoft SharePoint
- ▶ IBM Tivoli Storage Manager HSM for Windows
- ▶ IBM Tivoli Storage Manager for Advanced Copy Services
- ▶ IBM Tivoli Storage Manager for Copy Services
- ▶ IBM Tivoli Storage Manager for Enterprise Resource Planning
- ▶ IBM Tivoli Storage Manager for Space Management
- ▶ IBM Tivoli Storage Manager for Storage Area Networks
- ▶ IBM Tivoli Storage Manager for System Backup and Recovery
- ▶ IBM Tivoli Storage Manager FastBack
- ▶ IBM Tivoli Storage Manager FastBack for Microsoft Exchange
- ▶ IBM Tivoli Storage Manager FastBack for Bare Machine Recovery
- ▶ IBM Tivoli Continuous Data Protection for Files.

### **IBM Tivoli Storage Manager for Mail**

IBM Tivoli Storage Manager for Mail is a software module for IBM Tivoli Storage Manager that automates the data protection of email servers running either Lotus Domino or Microsoft Exchange. This module utilizes the application programming interfaces (API) provided by email application vendors to perform online backups without shutting down the email server and improve data-restore performance. As a result, it can help protect the growing amount of new and changing data that should be securely backed up to help maintain mail server application availability 24x7, 365 days a year. The two products available are:

- ▶ IBM Tivoli Storage Manager for Mail: Data Protection for Microsoft Exchange Server 6.1
- ▶ IBM Tivoli Storage Manager for Mail: Data Protection for Lotus Domino 5.5

For details, see *Tivoli Storage Manager for Mail - Data Protection for Microsoft Exchange Server, Installation and User's Guide*, SC23-9796.

## **IBM Tivoli Storage Manager for Databases**

IBM Tivoli Storage Manager for Databases is a software module designed to work with IBM Tivoli Storage Manager to protect a wide range of application data through the protection of the underlying database management systems holding that data. IBM Tivoli Storage Manager for Databases exploits the various backup-certified utilities and interfaces provided for Oracle using RMAN functionality and Microsoft SQL Server (with or without VSS.)

This same functionality is included in the IBM DB2 Universal Database™ package and Informix® Dynamic Server, using ONBAR enabling them to work directly with IBM Tivoli Storage Manager without the need to buy any additional modules.

For more information, refer to:

<http://www.ibm.com/software/tivoli/products/storage-mgr-db/>

## **IBM Tivoli Storage Manager for Microsoft SharePoint**

IBM Tivoli Storage Manager 6 for Microsoft SharePoint is a policy-based backup and recovery solution. It allows you to restore your Microsoft SharePoint business data and content after almost any kind of business interruption.

It provides the following functionality:

- ▶ Backup and recovery of Microsoft SharePoint Portal 2003 and Microsoft Office SharePoint Server 2007 environments.
- ▶ Restores portals, top-level sites, subsites and individual document libraries, attachments, lists, folders, areas, and subareas.
- ▶ Schedules full, incremental or differential backup at the site level, subsite level and item level.
- ▶ Preserves all meta-data versions.
- ▶ Integrates with the Tivoli Storage Manager server so that you can create synchronous or asynchronous copies of SharePoint data for off-site protection.
- ▶ Includes an easy-to-use browser-based graphical user interface (GUI).

For details, see:

<http://www.ibm.com/software/tivoli/products/storage-mgr-sharepoint/>

## **IBM Tivoli Storage Manager HSM for Windows**

IBM Tivoli Storage Manager for HSM for Windows provides hierarchical storage management functionality to the Windows platform. As with IBM Tivoli Storage Manager for Space Management, HSM for Windows automatically migrates rarely-accessed files to alternative storage, without disrupting the most frequently used files in local Windows file systems. Similarly, migrated files are automatically and transparently recalled to their original location when required by applications or users.

HSM for Windows allows various levels of granularity for migration of files. Files can be migrated individually, and file systems can be partially or fully migrated, based on a comprehensive set of policy options.

IBM Tivoli Storage Manager for Space Management complements both IBM Tivoli Storage Manager and IBM Tivoli Storage Manager Extended Edition.

For more information, see:

<http://www.ibm.com/software/tivoli/products/storage-mgr-hsm/>

## **IBM Tivoli Storage Manager for Advanced Copy Services**

IBM Tivoli Storage Manager for Advanced Copy Services (formerly known as IBM Tivoli Storage Manager for Hardware) is an optional software module for AIX that integrates with Tivoli Storage Manager Extended Edition. Tivoli Storage Manager for Advanced Copy Services protects mission-critical data that must be available 24x7, and integrates hardware- and software-based snapshot capabilities with Tivoli Storage Manager and its Data Protection components for DB2 UDB, Oracle, and mySAP.

Tivoli Storage Manager for Advanced Copy Services supports a wide range of hardware:

- ▶ IBM Enterprise Storage Server (ESS)
- ▶ IBM DS6000
- ▶ IBM DS8000
- ▶ SAN Volume Controller (SVC) and all IBM and non-IBM devices supported by the SVC.  
For a complete list, see:  
<http://www.ibm.com/systems/storage/software/virtualization/svc/interop.html>

Tivoli Storage Manager for Advanced Copy Services also provides the following functionality:

- ▶ IBM FlashCopy support for ESS for Oracle
- ▶ FlashCopy support for ESS for DB2
- ▶ FlashCopy support for ESS for mySAP on DB2 UDB
- ▶ FlashCopy support for ESS for mySAP on Oracle
- ▶ Snapshot support for DS8000, DS6000, and SVC for DB2 UDB
- ▶ Snapshot support for DS8000, DS6000, and SVC for Oracle
- ▶ Snapshot support for DS8000, DS6000, and SVC for mySAP on DB2 UDB
- ▶ Snapshot support for DS8000, DS6000, and SVC for mySAP on Oracle
- ▶ Multiple snapshot versions managed by Tivoli Storage Manager policy
- ▶ Coordinated FlashCopy backup of multi-partition DB2 UDB databases distributed across multiple host systems

Support of FlashCopy and snapshot functionality allows for “Zero Impact” backups and instant recovery. Data transfer to the Tivoli Storage Manager server is handled from a separate storage server, allowing the primary production data to remain online and undisturbed.

For details, refer to *Tivoli Storage Manager for Advanced Copy Services - Data Protection for Snapshot Devices Installation and User's Guide*, SC33-8331.

## **IBM Tivoli Storage Manager for Copy Services**

IBM Tivoli Storage Manager for Copy Services is a new optional module for Windows that integrates with Tivoli Storage Manager or Tivoli Storage Manager Extended Edition. It is designed to leverage Microsoft’s Volume Snapshot Services (VSS) on Windows 2003. Tivoli Storage Manager for Copy Services provides similar functionality to Tivoli Storage Manager for Advanced Copy Services, but supports Windows VSS and Microsoft Exchange Server 2003 only.

The features of Tivoli Storage Manager for Copy Services are:

- ▶ Single command-line interface (CLI) for performing earlier and VSS snapshot backup, restore, and query operations
- ▶ Single GUI for performing earlier and VSS snapshot backup, restore, and query operations
- ▶ Support for both hardware and software VSS providers that strictly adhere to Microsoft VSS provider requirements
- ▶ Support for a clustered Exchange environment

Full and Copy backup types are supported, with granularity at the Exchange Storage Group level. Backups are managed by Tivoli Storage Manager policies and can be stored on the Tivoli Storage Manager server, local disks or both. Different policies can be assigned for the different storage locations and backup types (Full or Copy). As with Tivoli Storage Manager for Advanced Copy Services, zero impact backups and instant recovery allow the primary production data to remain online and undisturbed. Data movement to Tivoli Storage Manager storage can be off-loaded to a secondary machine through a VSS hardware provider that supports transportable shadow copy volumes.

For more information, see:

<http://www.ibm.com/software/tivoli/products/storage-mgr-copy-services/>

### **IBM Tivoli Storage Manager for SAP V6.1**

Previously known as IBM Tivoli Storage Manager for Enterprise Resource Planning, Data Protection for SAP for V6.1 is a software module that works with IBM Tivoli Storage Manager to better protect infrastructure and application data and improve the availability of SAP R/3 servers.

For more details, refer to the following publications:

- ▶ *Tivoli Storage Manager for Enterprise Resource Planning - Data Protection for SAP, Installation and User's Guide for DB2*, SC33-6341-10
- ▶ *Tivoli Storage Manager for Enterprise Resource Planning - Data Protection for SAP, Installation and User's Guide for Oracle*, SC33-6340-10

### **IBM Tivoli Storage Manager for Space Management**

IBM Tivoli Storage Manager for Space Management provides hierarchical storage management (HSM) to automatically migrate rarely-accessed files to alternative storage, without disrupting the most frequently used files in local storage. Migrated files are automatically and transparently recalled to primary storage when required by applications or users. Administrators and users are freed from manual file system maintenance tasks, and more online disk space is available for more important active data. Tivoli Storage Manager for Space Management can also help defer the requirement to purchase additional disk storage for clients, by making optimal use of available client storage.

Tivoli Storage Manager for Space Management offers increased scalability and performance through parallel migrations, improved candidate search, and optimized synchronization between the IBM Tivoli Storage Manager server and the HSM client.

IBM Tivoli Storage Manager for Space Management complements both IBM Tivoli Storage Manager and IBM Tivoli Storage Manager Extended Edition, and is supported on AIX, HP/UX, Solaris, and Linux.

For details, see *Tivoli Storage Manager for Space Management for UNIX and Linux - User's Guide*, SC23-9794.

### **IBM Tivoli Storage Manager for Storage Area Networks**

IBM Tivoli Storage Manager for Storage Area Networks enables your SAN-connected Tivoli Storage Manager servers and client computers to make maximum use of their direct network connection to storage. This software extension enables both servers and client computers to make the bulk of their backup/restore and archive/retrieve data transfers over the SAN instead of the LAN, either directly to tape or to the Tivoli Storage Manager disk storage pool. This ability greatly reduces the impact of data protection on the LAN while also reducing CPU utilization on both client and server.

Some SAN configurations allow specific SAN devices to perform data movements directly to and from some tape devices, further reducing client and server CPU utilization.

Tivoli Storage Manager for Storage Area Networks complements and coexists with the standard library-sharing functionality of both standard version and Extended editions of the Tivoli Storage Manager server.

The core functions of IBM Tivoli Storage Manager for Storage Area Network are:

- ▶ LAN-free backup/restore
- ▶ SAN-connected tape library

This Tivoli Storage Manager component is also commonly referred to as a Storage Agent.

For more information, refer to the following publications:

- ▶ *Tivoli Storage Manager for SAN for AIX - Storage Agent User's Guide*, SC23-9797
- ▶ *Tivoli Storage Manager for SAN for HP-UX - Storage Agent User's Guide*, SC23-9798
- ▶ *Tivoli Storage Manager for SAN for Linux - Storage Agent User's Guide*, SC23-9799
- ▶ *Tivoli Storage Manager for SAN for Sun Solaris - Storage Agent User's Guide*, SC23-9800
- ▶ *Tivoli Storage Manager for SAN for Windows - Storage Agent User's Guide*, SC23-9553.

## **IBM Tivoli Storage Manager for System Backup and Recovery**

IBM Tivoli Storage Manager for System Backup and Recovery (SysBack®) provides a flexible backup method for AIX systems to help protect data and provide bare machine recovery capabilities. It offers a comprehensive system backup, restore, and reinstallation tool.

SysBack is a simple-to-use and highly effective tool. Any feature may be executed from either the AIX command line or by using the SMIT menu interface.

For Windows platforms, bare machine recovery can be achieved with the TSM Backup/Archive client's Automated System Recovery capability.

In addition, Windows, Sun, and Linux bare machine recovery can be done with Cristie Bare Machine Recovery. This integrates directly with Tivoli Storage Manager to provide operating system recovery for these platforms.

Tivoli Storage Manager for FastBack products also provide similar recovery capabilities for the Windows environment only.

For details, refer to *Tivoli Storage Manager Backup-Archive Clients - Installation and User's Guide*.

## **IBM Tivoli Storage Manager FastBack**

Tivoli Storage Manager FastBack is recovery software - a specific kind of storage management that ensures that applications and users are back up and running within minutes following any data loss while performing full data recovery in the background:

- ▶ Protect and recover data for critical Windows applications.
- ▶ Reduce the need for traditional backup windows with storage management software that captures data changes at the block level while providing extremely low systems overhead.
- ▶ Schedule automated data transfers based on flexible, policy-based settings, helping administrators meet data protection and retention requirements on a per-application basis.
- ▶ Enable data asset recovery from any Windows application, including Microsoft Exchange, Microsoft SQL Server, Oracle, IBM DB2, and SAP.

- ▶ Make the most effective use of available bandwidth with strategies such as multi-threading, bundling of small files and industry-standard compression.
- ▶ Operating systems supported: Windows.

For more information about Tivoli Storage Manager FastBack, see:

<http://www.ibm.com/software/tivoli/products/storage-mgr-fastback/>

## **IBM Tivoli Storage Manager FastBack for Microsoft Exchange**

IBM Tivoli Storage Manager FastBack for Microsoft Exchange provides the ability to recover Microsoft Exchange data such as email, attachments, calendar entries, contacts and tasks.

It helps to:

- ▶ Minimize business risk with the ability to recover Microsoft Exchange data objects from virtually any Microsoft Exchange database—even corrupt databases.
- ▶ Optimize Microsoft Exchange recovery by applying it at a granular level to any individual data object or group of objects, such as individual email messages, contact lists, tasks, or calendar entries.
- ▶ Increase operational efficiency and user productivity by helping reduce recovery time from hours or days to minutes.
- ▶ Improve service levels by helping to minimize the downtime associated with data recovery.
- ▶ Enable recovery of objects that were previously considered unrecoverable—such as deleted email messages, or address books lost due to synchronization errors.
- ▶ Restore objects directly to an Exchange Server or to send objects to a user-defined destination via SMTP.
- ▶ Integrate with Active Directory and Exchange Server security to help limit unauthorized access to backup and restore systems.

For details, see:

<http://www.ibm.com/software/tivoli/products/storage-mgr-fastback-exchange/>

## **IBM Tivoli Storage Manager FastBack for Bare Machine Recovery**

IBM Tivoli Storage Manager FastBack for Bare Machine Recovery provides recovery following a disaster or catastrophic server failure, restoring systems within an hour:

- ▶ Enables systems recovery following a disaster or catastrophic server failure.
- ▶ Provides the flexibility of recovering to comparable hardware, to dissimilar hardware or to a virtual machine using VMware or Microsoft Virtual Server.
- ▶ Helps protect remote or branch offices with a cost-effective disaster recovery and business resiliency strategy that requires a minimum of standby hardware.
- ▶ Leverages IBM Tivoli Storage Manager FastBack to provide near-instant access to applications and data while full recovery takes place in the background.
- ▶ Facilitates the migration of workloads to new hardware platforms, making it fast and easy to move workloads from old hardware or standalone servers to new hardware or blade servers.
- ▶ Enables organizations to perform bare machine recovery in a local office, in a data center or in a central recovery site.
- ▶ Operating systems supported: Windows.

For more information, refer to:

<http://www.ibm.com/software/tivoli/products/storage-mgr-fastback-bmr/>

### **IBM Tivoli Continuous Data Protection for Files**

According to industry surveys, almost 70% of corporate data exists on notebooks (mobile computers) or desktop machines, and less than 8% of it is backed up regularly. For notebook, desktop, and file server machines that contain important, critical, or sensitive data that is constantly being updated, a typical 24-hour backup cycle may not be sufficient to provide adequate data protection. The addition of Tivoli Continuous Data Protection for Files provides a client machine with the capability of being able, transparently in real time, to back up a file to a Tivoli Storage Manager server as soon as the file is saved. Files that are backed up by this method are managed in the same way as other corporate data by the Tivoli Storage Manager server.

Tivoli Continuous Data Protection for Files was developed with notebook (mobile computer) and desktop users in mind, but can be applied to any client with a high rate of change of data on its file systems.

Tivoli Continuous Data Protection for Files provides clients with true point-in-time recoverability. It is supported on AIX, Solaris, Linux, and Windows platforms.

For more information, see:

<http://www.ibm.com/software/tivoli/products/continuous-data-protection/>

#### **9.2.4 More information**

- ▶ More information about Tivoli Storage Manager can be found on the following Web site:  
<http://www.ibm.com/software/tivoli/products/storage-mgr/>
- ▶ Product manuals for API and Backup-Archive Clients are:
  - *Using the Application Programming Interface*, SC23-9793
  - *Tivoli Storage Manager for UNIX and Linux Backup-Archive Clients Version 6.1 - Installation and User's Guide*, SC23-9791
  - *Tivoli Storage Manager for Windows Backup-Archive Clients*, SC23-9792
- ▶ Product manuals for Storage Manager for AIX are:
  - *Tivoli Storage Manager for AIX - Administrator's Guide*, SC23-9769
  - *Tivoli Storage Manager for AIX - Administrator's Reference*, SC23-9775
  - *Tivoli Storage Manager for AIX - Installation Guide*, GC23-9781
  - *Tivoli Storage Manager for SAN for AIX - Storage Agent User's Guide*, SC23-9797
- ▶ Product manuals for Storage Manager for HP-UX are:
  - *Tivoli Storage Manager for HP-UX - Administrator's Guide*, SC23-9770
  - *Tivoli Storage Manager for HP-UX - Administrator's Reference*, SC23-9776
  - *Tivoli Storage Manager for HP-UX - Installation Guide*, GC23-9782
  - *Tivoli Storage Manager for SAN for HP-UX - Storage Agent User's Guide*, SC23-9798
- ▶ Product manuals for Storage Manager for Linux are:
  - *Tivoli Storage Manager for Linux - Administrator's Guide*, SC23-9771
  - *Tivoli Storage Manager for Linux - Administrator's Reference*, SC23-9777
  - *Tivoli Storage Manager for Linux - Installation Guide*, GC23-9783
  - *Tivoli Storage Manager for SAN for Linux - Storage Agent User's Guide*, SC23-9799

- ▶ Product manuals for Storage Manager for Sun Solaris are:
  - *Tivoli Storage Manager for Sun Solaris - Administrator's Guide*, SC23-9772
  - *Tivoli Storage Manager for Sun Solaris - Administrator's Reference*, SC23-9778
  - *Tivoli Storage Manager for Sun Solaris - Installation Guide*, GC23-9784
  - *Tivoli Storage Manager for SAN for Sun Solaris - Storage Agent User's Guide*, SC23-9800
- ▶ Product manuals for Storage Manager for Windows are:
  - *Tivoli Storage Manager for Windows - Administrator's Guide*, SC23-9773
  - *Tivoli Storage Manager for Windows - Administrator's Reference*, SC23-9779
  - *Tivoli Storage Manager for Windows - Installation Guide*, GC23-9785
  - *Tivoli Storage Manager for SAN for Windows - Storage Agent User's Guide*, SC23-9553
- ▶ Product manual for Space Management:  
*Tivoli Storage Manager for Space Management for UNIX and Linux - User's Guide*, SC23-9794
- ▶ Product manual for ACS:  
*Tivoli Storage Manager for Advanced Copy Services - Data Protection for Snapshot Devices Installation and User's Guide*, SC33-8331
- ▶ Product manuals for SAP are:
  - *Tivoli Storage Manager for Enterprise Resource Planning - Data Protection for SAP, Installation and User's Guide for DB2*, SC33-6341-10
  - *Tivoli Storage Manager for Enterprise Resource Planning - Data Protection for SAP, Installation and User's Guide for Oracle*, SC33-6340-10
- ▶ Product manual for Mail:  
*Tivoli Storage Manager for Mail - Data Protection for Microsoft Exchange Server, Installation and User's Guide*, SC23-9796.

## 9.3 IBM General Parallel File System (GPFS)

The IBM General Parallel File System (GPFS) is a high-performance file management solution that provides fast, reliable access to a common set of file data from two computers or concurrently from hundreds of systems. GPFS integrates into your environment by bringing together mixed server and storage components to provide a common view to enterprise file data. GPFS provides online storage management, scalable access, and integrated information lifecycle tools capable of managing petabytes of data and billions of files. The proven GPFS file management infrastructure provides the foundation for optimizing the use of your computing resources.

This section provides basic information about GPFS. For details, refer to the documentation in 9.3.3, “More information” on page 236.

### 9.3.1 IBM General Parallel File System overview

The IBM General Parallel File System (GPFS) provides file system services to parallel and serial applications. GPFS allows parallel applications simultaneous access to the same files, or different files, from any node that has the GPFS file system mounted while managing a high level of control over all file system operations.

GPFS is particularly appropriate in an environment where the aggregate peak need for data bandwidth exceeds the capability of a distributed file system server. GPFS allows users shared file access within a single GPFS cluster and across multiple GPFS clusters.

A GPFS cluster consists of:

- ▶ AIX nodes, Linux nodes, Windows nodes, or a combination thereof

A node can be:

- An individual operating system image on a single computer within a cluster.
- A system partition that contains an operating system. Some IBM System p5 and IBM System p machines allow multiple system partitions, each of which is considered to be a node within a GPFS cluster.
- ▶ Network shared disks (NSDs) created and maintained by the NSD component of GPFS
  - All disks used by GPFS must first be given a globally-accessible NSD name.
  - The GPFS NSD component provides a method for cluster-wide disk naming and access.
  - On Linux machines running GPFS, you may give an NSD name to:
    - Physical disks
    - Logical partitions of a disk
    - Representations of physical disks (such as LUNs)
  - On AIX machines running GPFS, you may give an NSD name to:
    - Physical disks
    - Virtual shared disks

**Note:** Beginning with GPFS 3.3, new file systems must be created using Network Shared Disks only. Virtual shared disks will not be supported on new file systems. GPFS will continue to support existing file systems with virtual shared disks until that function is no longer available with AIX.

- Representations of physical disks (such as LUNs)
- ▶ A shared network for GPFS communications allowing a single network view of the configuration. A single network, a LAN or a switch, is used for GPFS communication, including the NSD communication.

### 9.3.2 The strengths of GPFS

GPFS is a powerful file system that provides global namespace, shared file system access among GPFS clusters, simultaneous file access from multiple nodes, high recoverability and data availability due to replication, the ability to make certain changes while a file system is mounted, and simplified administration that is similar to existing UNIX systems.

This topic provides basic information about key features of GPFS.

#### Shared file system access among GPFS clusters

GPFS allows users shared access to files in either the cluster where the file system was created or other GPFS clusters. Each site in the network is managed as a separate cluster, while allowing shared file system access. When multiple clusters are configured to access the same GPFS file system, Open Secure Sockets Layer (OpenSSL) is used to authenticate and check authorization for all network connections.

GPFS shared file system access provides for:

- ▶ The ability of the cluster granting access to specify multiple security levels, up to one for each authorized cluster
- ▶ A highly available service as the local cluster may remain active prior to changing security keys. Periodic changing of keys is necessary for a variety of reasons, including:
  - In order to make connection rate performance acceptable in large clusters, the size of the security keys used for authentication cannot be very large. As a result, it may be necessary to change security keys in order to prevent a given key from being compromised while it is still in use.
  - As a matter of policy, some institutions may require that security keys be changed periodically.

## **Improved system performance**

Using GPFS to store and retrieve your files can improve system performance by:

- ▶ Allowing multiple processes or applications on all nodes in the cluster simultaneous access to the same file using standard file system calls.
- ▶ Increasing aggregate bandwidth of your file system by spreading reads and writes across multiple disks.
- ▶ Balancing the load evenly across all disks to maximize their combined throughput. One disk is no more active than another.
- ▶ Supporting very large file and file system sizes.
- ▶ Allowing concurrent reads and writes from multiple nodes.
- ▶ Allowing for distributed token (lock) management. Distributing token management reduces system delays associated with a lockable object waiting to obtain a token.
- ▶ Allowing for the specification of different networks for GPFS daemon communication and for GPFS administration command usage within your cluster.

## **File consistency**

GPFS uses a sophisticated token management system to provide data consistency while allowing multiple independent paths to the same file by the same name from anywhere in the cluster.

## **High recoverability and increased data availability**

GPFS failover support allows you to organize your hardware into *failure groups*. A failure group is a set of disks that share a common point of failure that could cause them all to become simultaneously unavailable. When used in conjunction with the *replication* feature of GPFS, the creation of multiple failure groups provides for increased file availability should a group of disks fail. GPFS maintains each instance of replicated data and metadata on disks in different failure groups. Should a set of disks become unavailable, GPFS fails over to the replicated copies in another failure group.

During configuration, you assign a replication factor to indicate the total number of copies of data and metadata you wish to store. Replication allows you to set different levels of protection for each file or one level for an entire file system. Since replication uses additional disk space and requires extra write time, you might want to consider replicating only file systems that are frequently read from but seldom written to. To reduce the overhead involved with the replication of data, you may also choose to replicate only metadata as a means of providing additional file system protection.

GPFS is a logging file system that creates separate logs for each node. These logs record the allocation and modification of metadata aiding in fast recovery and the restoration of data consistency in the event of node failure. Even if you do not specify replication when creating a

file system, GPFS automatically replicates recovery logs in separate failure groups, if multiple failure groups have been specified. This replication feature can be used in conjunction with other GPFS capabilities to maintain one replica in a geographically separate location which provides some capability for surviving disasters at the other location.

## Enhanced system flexibility

With GPFS, your system resources are not frozen. You can add or delete disks while the file system is mounted. When the time is right and system demand is low, you can rebalance the file system across all currently configured disks. In addition, you can also add or delete nodes without having to stop and restart the GPFS daemon on all nodes.

**Note:** In the node quorum with tiebreaker disk configuration, GPFS has a limit of eight quorum nodes. If you add quorum nodes and exceed that limit, the GPFS daemon must be shut down. Before you restart the daemon, switch quorum semantics to node quorum.

In a SAN configuration where you have also defined NSD servers, if the physical connection to the disk is broken, GPFS dynamically switches disk access to the server nodes and continues to provide data through NSD server nodes. GPFS falls back to local disk access when it has discovered that the path has been repaired.

After GPFS has been configured for your system, depending on your applications, hardware, and workload, you can reconfigure GPFS to increase throughput. You can set up your GPFS environment for your current applications and users, secure in the knowledge that you can expand in the future without jeopardizing your data. GPFS capacity can grow as your hardware expands.

## Simplified storage management

GPFS provides storage management based on the definition and use of:

- ▶ Storage pools

A storage pool is a collection of disks or RAIDs with similar properties that are managed together as a group. Storage pools provide a method to partition storage on the file system. While you plan how to configure your storage, consider factors such as:

- Improved price-performance by matching the cost of storage to the value of the data
- Improved performance by:
  - Reducing the contention for premium storage.
  - Reducing the impact of slower devices.
- Improved reliability by providing for:
  - Replication based on need
  - Better failure containment

- ▶ Policies

Files are assigned to a storage pool based on defined *policies*. Policies provide for:

- Placing files in a specific storage pool when the files are created.
- Migrating files from one storage pool to another.
- File deletion based on file characteristics.
- Snapshot metadata scans and file list creation.

- ▶ Filesets

Filesets provide a method for partitioning a file system, and allow administrative operations at a finer granularity than the entire file system. For example, filesets allow you to:

- Define data block and inode quotas at the fileset level.

- Apply policy rules to specific filesets.

### Simplified administration

GPFS offers many of the standard UNIX file system interfaces allowing most applications to execute without modification or recompiling. UNIX file system utilities are also supported by GPFS. That is, users can continue to use the UNIX commands they have always used for ordinary file operations. The only unique commands are those for administering the GPFS file system.

GPFS administration commands are similar in name and function to UNIX file system commands, with one important difference: the GPFS commands *operate on multiple nodes*. A single GPFS command performs a file system function across the entire cluster.

GPFS commands save configuration and file system information in one or more files, collectively known as GPFS cluster configuration data files. The GPFS administration commands are designed to keep these files synchronized with each other and with the GPFS system files on each node in the cluster, thereby providing for accurate configuration data.

#### 9.3.3 More information

Refer to these publications for more information about IBM General Parallel File System:

- ▶ *GPFS V3.3 Advanced Administration Guide*, SC23-5182-03
- ▶ *GPFS V3.3 Administration and Programming Reference*, SA23-2221-03
- ▶ *GPFS V3.3 Concepts, Planning, and Installation Guide*, GA76-0413-03
- ▶ *GPFS V3.3 Problem Determination Guide*, GA76-0415-03
- ▶ *GPFS V3.3 Data Management API Guide*, GA76-0414-03

## 9.4 IBM System Storage Multilevel Grid Access Manager Software

IBM System Storage Multilevel Grid Access Manager Software (Grid Access Manager Software) is built on an open, high-performance grid architecture that delivers data protection, information life-cycle management, simplified storage management, and multi-site data access based on open standards. The potential benefits derived from these features can help deliver important cost savings and operational efficiencies, including:

- ▶ Simplified management and improved storage utilization, with excellent performance
- ▶ Data protection and improved business continuity
- ▶ Support for global access, multisite operation

This topic provides a basic overview of Grid Access Manager Software. For details, refer to the documentation listed in 9.4.5, “More information” on page 239.

### 9.4.1 Grid Access Manager Software overview

Grid Access Manager Software enables customers with single or multiple sites and with fixed content and reference data storage requirements to improve storage utilization and investment across sites by way of an enterprise-wide, fault-tolerant storage grid with real-time failover capabilities. Grid Access Manager Software can help protect enterprise data through automated replication, lifecycle management, and digital signature functionality.

The need to retain massive volumes of business-critical fixed-content data for long periods of time presents new data and storage management challenges for IT. Users continue to

demand fast performance and higher and broader availability of enterprise data. Massive data volumes combined with long retention periods require storage administrators to deliver a cost-effective storage strategy that meets the user's needs, protects valuable data, scales on demand, simplifies data migration, and automates recovery from both planned and unplanned downtime.

Grid Access Manager Software can help customers address these critical challenges by delivering an automated and virtualized storage and data management layer that can be deployed locally or across multiple facilities and even on heterogeneous storage hardware. Grid Access Manager Software achieves this by presenting itself to enterprise applications as a single storage system that can aggregate underlying storage silos into a single enterprise storage pool—even if these silos are spread across multiple facilities and consist of heterogeneous storage media. This highly automated system enables IT administrators to focus on storage planning and infrastructure improvements and eliminate many manual administration tasks.

Grid Access Manager Software works to improve the core capabilities of a traditional storage system for fixed content in several areas including:

- ▶ Storing and protecting data
- ▶ Data retrieval
- ▶ Business continuity and disaster recovery
- ▶ Capacity expansion and hardware upgrades
- ▶ Simplified management through task automation, proactive notification, and centralization

Figure 9-5 illustrates Grid Access Manager Software.

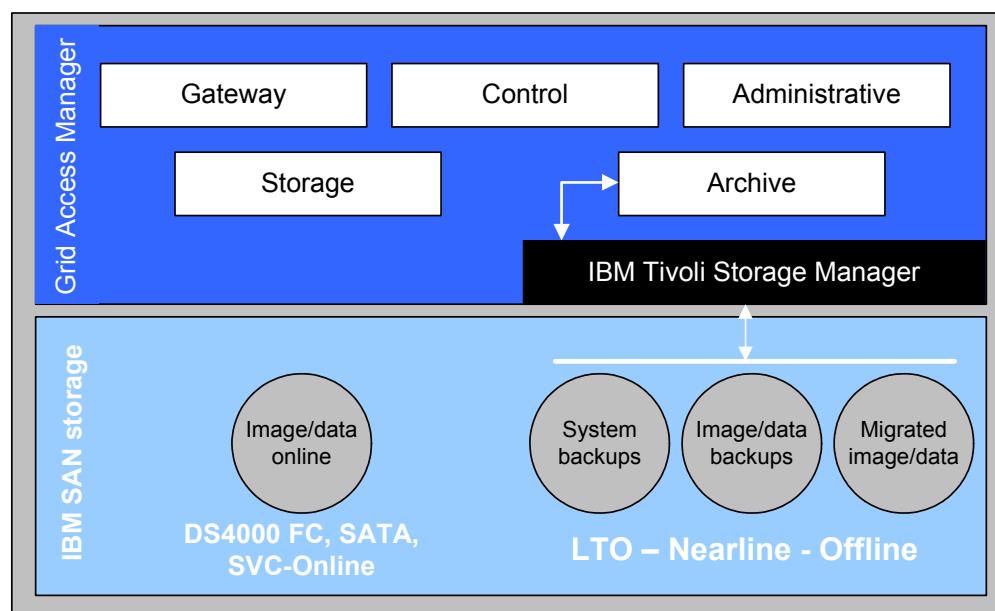


Figure 9-5 Grid Access Manager Software

#### 9.4.2 Simplified Management and Optimized Storage Utilization

Grid Access Manager Software helps clients implement a virtualized, shared storage pool for reference data and fixed content. By operating across locations, multiple storage tiers and storage hardware brands, Grid Access Manager Software offers storage flexibility and easy extensibility to customers, and supports tiered storage architectures so organizations can

have greater flexibility to implement the most cost-effective storage according to their defined policies while continuing to use existing investments.

Key features include:

► Intelligent information lifecycle management

Grid Access Manager Software enables the creation of information lifecycle management (ILM) policies that govern the geographic location and placement of data in a multilayer, multifacility storage system. Intelligent ILM can help deploy the right storage in the right place, on the right media, at the right time, based on its relevance and value to the organization.

► Operation across facilities and tiers

Capacity, performance and geographic scope of Grid Access Manager Software may be increased by adding new nodes. As nodes are added, typically in a nondisruptive manner, Grid Access Manager Software can continue to present itself as one large scalable computing system. Grid Access Manager Software automatically reconfigures the environment to take advantage of the new resources.

► Flexible hardware configurations

Grid Access Manager Software utilizes industry-standard servers and storage, empowering administrators to deliver a “best of breed” enterprise storage strategy with the flexibility to adapt over time. A Grid Access Manager Software solution can be composed of multiple storage tiers leveraging online and nearline storage media (such as SCSI, SATA and tape).

► Automated data migration

Grid Access Manager Software can automate the movement of data from obsolete resources to new resources—reducing or eliminating manual, disruptive data migration projects.

► Open, standards-based access

With support for industry-standard interfaces (including CIFS and NFS) and protocols (such as HTTP), Grid Access Manager Software enables organizations to implement an enterprise fixed-content-storage strategy.

► Proactive monitoring and management

Grid Access Manager Software is designed to reduce the cost of management by continuously monitoring the health of the system, including storage, servers and network, and proactively alerts administrators if issues arise. Administrators can monitor and manage the grid from across the network using the single-pane, web-based management console. Administrators can track CPU, network, storage resources and digital data assets using the 120 customizable alerts and more than 500 on demand reports.

– Exceptional performance

Grid Access Manager Software employs data streaming, caching and the power of grid architecture to deliver a fast, responsive storage system. Grid Access Manager Software implements a fast data-streaming mechanism to deliver data. To improve performance, Grid Access Manager Software load-balances requests based on storage tier, CPU and network bandwidth.

– The Distributed Gateway (optional) based on IBM GPFS increases the scalability and performance of the file system front end for the Grid, allowing NAS capability for transactional as well as archive data.

### **9.4.3 Data protection and business continuity**

Grid Access Manager Software supports business continuity by creating multiple copies of data and automatically replicating them geographically or to different storage tiers based on customer rules so they are no longer vulnerable to potential issues. By supporting continuous operations even in the event of failure, Grid Access Manager Software provides automated recovery to help maintain business resiliency. The solution also supports continuous operation during hardware refreshes, capacity upgrades and data migration.

- ▶ Data integrity protection

Grid Access Manager Software helps protect the integrity and authenticity of stored data using digital fingerprints. Data integrity is proactively monitored and verified when data is stored, replicated, restored and retrieved. Integrity checks can be performed on demand and when errors are encountered, Grid Access Manager Software can automatically create another replica from a known good copy.

- ▶ High availability

Grid Access Manager Software provides a fault-tolerant, resilient, and self-healing solution. Storage services can remain available even after hardware, storage and network failures occur or where entire sites are completely destroyed.

- ▶ Automated recovery

In the event of site, storage, or system failure, Grid Access Manager Software automates data recovery to fully restore the storage system to the original state. During this period, storage services continue to be available.

### **9.4.4 Multisite operation**

Fast, enterprise-wide availability can be a challenge for traditional storage systems when transporting petabytes of data across sites that are linked by varying bandwidth networks. Grid Access Manager Software enables formation of archives that can scale to petabytes of data across hundreds of sites. Key enabling features include:

- ▶ Object store with global name space

Grid Access Manager Software provides an object-based storage system that can scale to petabytes (capacity) and billions of objects (object count) in a single unified system that can span multiple sites and tiers. A global name space gives access to stored objects using globally unique object identifiers, which can be accessed from any grid resource—regardless of location or storage tier. This eliminates storage silos to enable efficient and effective multisite access.

- ▶ WAN-optimized replication

Grid Access Manager Software provides policy-based N-way data replication among sites and heterogeneous storage hardware. The replication semantics are highly optimized for WAN operation and designed to recover from congestion or link failure.

### **9.4.5 More information**

For more information about Grid Access Manager Software, visit:

<http://www.ibm.com/systems/storage/software/gam/index.html>

## 9.5 z/OS storage management tools

The z/OS storage management tools are a collection of products designed to provide a comprehensive menu of solutions in order to meet the storage management requirements of z/OS clients. The tools are positioned to complement and extend the storage management capabilities of DFSMS.

These products allow IBM to provide a more complete suite of storage management solutions:

- ▶ Ability to predict results of alternative actions with minimum risk
- ▶ Overall ability to optimize the responsiveness of storage assets
- ▶ Better response time and throughput by elimination of easily identified bottlenecks
- ▶ Providing storage administrators a more simple, straightforward environment, increasing their productivity while reducing mistakes as well as potential outages
- ▶ An increased system availability from simpler, faster, and more reliable recovery operations for storage structures

The following tools can be used to manage storage on z/OS:

- ▶ IBM Tivoli Omegamon XE
- ▶ IBM DB2 Cloning Tool
- ▶ IBM Tivoli Advanced Catalog Management for z/OS
- ▶ IBM Tivoli Advanced Backup and Recovery
- ▶ IBM Tivoli Advanced Audit for DFSSMSHSM
- ▶ IBM Tivoli Automated Tape Allocation Manager
- ▶ IBM Tivoli Storage Optimizer for z/OS
- ▶ IBM Tivoli Tape Optimizer for z/OS
- ▶ DFSSMS Optimizer

For details about all z/OS storage management tools, refer to the publications listed in 9.5.11, “More information” on page 245.

### 9.5.1 IBM Tivoli Omegamon XE

IBM Tivoli OMEGAMON® XE for Storage on z/OS enables you to monitor and manage mainframe-attached storage. It combines comprehensive storage monitoring for z/OS I/O subsystem performance and storage availability.

IBM Tivoli Omegamon XE provides the following features:

- ▶ Enables you to monitor and manage storage (including DASD and tape devices), and the analysis of two important IBM storage software components: Data Facility Systems Managed Storage and Data Facility Hierarchical Storage Manager (DFHSM).
- ▶ Provides the capability to quickly create commands or schedule actions that maintain and administer DASD storage with a new storage toolkit for DFHSM and DFDSS functions.
- ▶ Offers more versatile and granular reporting capabilities using the storage toolkit.
- ▶ Improves problem resolution with Dynamic Workspace Linking (DWL) to OMEGAMON XE on z/OS, which enables you to easily navigate between Tivoli Enterprise Portal workspaces.
- ▶ Adds enhanced problem determination capabilities with new problem-solving workspaces in the Tivoli Enterprise Portal (TEP).
- ▶ V4.1.0 is fully globalized and translated into Group 1 languages<sup>1</sup>.

## 9.5.2 IBM DB2 Cloning Tool

IBM DB2 Cloning Tool for z/OS is a vendor-independent tool that provides access to data sets on replicated volumes created with point-in-time copies of Fast Data Replication tools (FlashCopy and SnapShot) or Splits of Continuous Mirrors tools (EMC TimeFinder, IBM PPRC, HDS ShadowImage, Softek TDMF, and Fujitsu Equivalent Copy).

The clones these tools create are not accessible due to an inherent replication problem: the target volume label, internal data, and data set names all reflect the source volume name. DB2 Cloning Tool solves these issues so that the replicated data can be utilized quickly and accessed on the same system.

DB2 Cloning Tool supports the replication of DB2 subsystems with intelligent features that condition the target environment, enabling the replicated data to be made available for use within minutes.

DB2 Cloning Tool provides a way for clients to meet the demand for increased online access to databases while continuing to meet business requirements for batch and backup processing. Using the tool, clients can run processes in parallel. In addition, they can easily create test and QA environments and refresh the data on a regular basis.

IBM DB2 Cloning Tool provides the following features:

- ▶ IBM DB2 Cloning Tool is an innovative tool that solves the cloned data access dilemma, giving users access to data sets on target volumes created with FlashCopy or Snapshot by renaming and cataloging them.
- ▶ Resolves catalog conflicts of like-named data sets that are created by cloning a volume. It also solves internal conflicts that are created when copying a volume to a different VOLSER.
- ▶ Fixes volume conflicts (VTOC, VTOCIX, and VVDS) and then renames and recatalogs the data sets.
- ▶ Rename capability allows users to change any qualifier or add or delete qualifiers.
- ▶ Track the behind-the-scenes FlashCopy, enabling users to know when they can start another cloning operation or withdraw from the current copy.
- ▶ Provide automatic pairing of volume characteristics.
- ▶ Provide the capability to FlashCopy or Snapshot by Storage Groups.

## 9.5.3 IBM Tivoli Advanced Catalog Management for z/OS

IBM Tivoli Advanced Catalog Management for z/OS offers vital data protection while helping to increase data availability. With effective auditing tools, secure recovery, and improved day-to-day management, you can access your data, even in the event of problems in the IT environment ranging from simple human errors to natural disasters. Effective catalog management requires the best tools available to ensure that key data assets are protected and can be recovered in any event.

Advanced Catalog Management for z/OS is designed to provide backup and restore facilities that provide high integrity and fast processing.

IBM Tivoli Advanced Catalog Management for z/OS provides the following infrastructure benefits:

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<sup>1</sup> Group 1 refers to English, Simplified Chinese, Traditional Chinese, French, German, Italian, Japanese, Korean, Portuguese (Brazilian), and Spanish.

- ▶ Backup and restore facilities that provide high integrity and fast processing
- ▶ A forward recovery facility for BCS and VVDS catalog structures that use SMF data, merged with backup records, to update the BCS and VVDS from the time of the backup to the current time
- ▶ A full-function backup and restore facility for VSAM files that allows attribute changes during recovery and can back up damaged KSDS data sets
- ▶ An expanded diagnostic facility that enables frequent health checks of the BCS, VVDS, VTOC, and tape management catalog structures. This facility contains an audit check and “fix” capability to resynchronize entries that are in error
- ▶ A fast and safe MERGECAT facility that enables moving or copying of individual BCS entries, alias groups of BCS entries, or entire catalogs
- ▶ A fast and safe split/merge facility that enables moving or copying of individual BCS entries, alias groups of BCS entries, or entire catalogs
- ▶ The Reorg While Open and Repair While Open features reorganize and repair ICF catalogs while applications are still active. These high-availability features can save hours of application downtime over traditional tools.
- ▶ The feature to allow reorganization and repair of, and attribute changes for, ICF catalogs while applications are still active. These high-availability features can save hours of application downtime over traditional tools.

#### **9.5.4 IBM Tivoli Advanced Backup and Recovery**

IBM Tivoli Advanced Backup and Recovery solution provides powerful functions for reliable, accurate backups, and even helps to identify data that is not already backed up. It can reduce costs associated with remote DASD replication.

Advanced Backup and Recovery can centralize and track all backups, including ICF catalogs. This enables client environments to bounce back quickly and fully from unplanned local outages, saving crucial time and money.

IBM Tivoli Advanced Backup and Recovery provides the following infrastructure benefits:

- ▶ ABARS Manager enhances the value of DFSMShsm ABARS:
  - All backup information and backup status is accessible through one central point.
  - Backup status and details can be viewed online.
  - Online access to the full activity log and all error messages, as well as condensed status summary, makes ABARS management simple.
  - Detail data set inventory provides recovery capacity requirements, recovery tape VOLSER, and other key planning and operational details.
- ▶ Incremental ABARS allows users to combine their disaster recovery backup strategy with an incremental backup capability. The benefits of this are reduced backup size, improved backup and recovery performance, and reduced resources to vault and maintain the backup.
- ▶ With ABARS Manager, the value of ABARS is expanded to provide a local recovery solution that allows searching and recovering selected data sets from ABARS or DFSMShsm backups.
- ▶ Automated Critical Data Identification interfaces directly into ABARS Manager to ensure that all critical assets are included in the backup.

- ▶ Critical Backup Tracking and Inventory ensures that all critical non-ABARS-managed assets have a backup, tracks and inventories all other backups in the environment, and identifies duplicate backups.

### **9.5.5 IBM Tivoli Advanced Audit for DFSMShsm**

IBM Tivoli Advanced Audit for DFSMShsm offers comprehensive and extremely fast audit support in the following areas: DFSMShsm Migration, Backup, Offline Control DataSets (MCDS, BCDS, and OCDS), and DFSMShsm-owned tape.

Advanced Audit for DFSMShsm evaluates the Migration, Backup, and Offline Control DataSets (MCDS, BCDS, and OCDS) to resolve structural and logical discrepancies that could have prevented migrated data from being recalled, or backup data from being restored. Advanced Audit for DFSMShsm checks the ICF catalog relationships to assure that migrated data is cataloged, and that data cataloged as “migrated” is actually migrated. This function duplicates the DFSMShsm audit and enhanced audit commands with improved performance and flexibility.

The IBM Data Facility System Managed Storage Hierarchical Storage Manager (DFSMShsm) manages hundreds of thousands to millions of data assets, both critical and non-critical, in licensed IT environments. As businesses grow, the sheer quantity of data assets stored on z/OS increases commensurately. This growth is mitigated using DFSMShsm to manage the life cycle of data assets, from creation to expiration. DFSMShsm is a complex environment requiring audit and reporting solutions that reduce resource consumption and help bridge the learning curve for new or inexperienced DFSMShsm administrators.

Advanced Audit for DFSMShsm enables clients to manage DFSMShsm environments using less time and fewer resources and provides powerful enhancements over the base DFSMShsm offering. The solution provides proactive DFSMShsm management capabilities that permit clients to create a truly resilient DFSMShsm environment.

#### **Infrastructure benefits**

Advanced Audit for DFSMShsm provides an easy-to-use, high performance method for auditing the DFSMShsm environment, including migration and backup tapes. It can easily and automatically identify problems and implement corrective actions to predefined scenarios. It makes frequent auditing feasible, and makes it easy to keep the DFSMShsm environment accurate.

### **9.5.6 IBM Tivoli Automated Tape Allocation Manager**

IBM Tivoli Automated Tape Allocation Manager for z/OS addresses tape device availability, providing automatic, unattended sharing of tape resources across multiple images. Tivoli Automated Tape Allocation Manager helps ensure that existing tape drives are available on demand for requests from multiple images. Its tape sharing capabilities and commands can help manage tape devices across your System z environment, reducing tape-related bottlenecks and job request backlogs.

IBM Tivoli Automated Tape Allocation Manager provides the following features:

- ▶ Maximizes use of existing tape resources before you invest in additional hardware. Minimizes batch processing delays and operational overhead by sharing tape storage devices across a multisystem environment without the need for a shared control file.
- ▶ Automates tape resource management and minimizes the need for operator intervention.
- ▶ Enables you to migrate from alternative vendor products to an IBM solution.

- ▶ New in V3.1 Integration with Tivoli Enterprise Portal (TEP).
- ▶ Configuration T1 parameter can be adjusted to specify different timing intervals for different device types.
- ▶ A new E command shows a map of tape esoteric names and associated devices.
- ▶ Option to use the SAF security interface to help control your ability to manage tape availability via Automated Tape Allocation Manager for z/OS, V3.1.
- ▶ Enhanced ability to employ preferential tape device assignment.

### **9.5.7 IBM Tivoli Advanced Allocation Management on z/OS**

IBM Tivoli Advanced Allocation Management helps businesses increase productivity and maximize data availability by preventing and recovering from X37 abends, using a single solution.

IBM Tivoli Automated Tape Allocation Manager provides the following features:

- ▶ Proactively intercepts, resolves, and recovers from X37-type abends using a single, integrated solution.
- ▶ Minimizes out-of-space conditions that can hamper productivity.
- ▶ Provides comprehensive activity reporting to view total abends and errors avoided or recovered.
- ▶ Centrally controls DASD usage both at initial allocation and end-of-volume processing.
- ▶ Supports both SMS and non-SMS data sets, using flexible rule definitions to specify criteria.
- ▶ Leverages IBM Tivoli Enterprise Portal as a common user interface for managing information and tasks for a wide variety of solutions.
- ▶ Shares information with Tivoli OMEGAMON XE for Storage for more effective problem discovery, investigation and resolution.

### **9.5.8 IBM Tivoli Storage Optimizer for z/OS**

IBM Tivoli Storage Optimizer for z/OS provides a single focal point for the discovery, monitoring, and managing of z/OS storage devices across the enterprise. IBM Tivoli Storage Optimizer for z/OS tracks capacity and usage changes over time enabling you to stay ahead of storage demand.

IBM Tivoli Storage Optimizer for z/OS provides the following features:

- ▶ Provides high-availability and fault-tolerant architecture.
- ▶ Offers optimized monitoring.
- ▶ Helps you identify root cause for more in-depth analysis and problem resolution.
- ▶ Provides strategic planning that enables you to analyze space, size, and growth rates.

### **9.5.9 IBM Tivoli Tape Optimizer for z/OS**

IBM Tivoli Tape Optimizer for z/OS maximizes the efficiency of tape-copy processes and optimizes utilization of tapes.

IBM Tivoli Tape Optimizer for z/OS is a tape copy and stacking solution for data residing on tape storage devices that are managed by Data Facility Storage Management Subsystem

removable media manager (DFSMSrmm). You can copy a single tape or data set, or potentially your entire tape library.

IBM Tivoli Tape Optimizer for z/OS provides the following features:

- ▶ V2.1 can copy tape volumes to other tapes or tape-compatible storage.
- ▶ Renames tape data sets.
- ▶ Preserves DFSMSrmm tape library information.
- ▶ Updates the system catalog for the copied tapes.

### 9.5.10 DFSMS Optimizer

The DFSMS Optimizer solution contains two features: The Performance Analyzer uses historical and real-time data to provide an overall data usage picture, and the Management Class Analyzer provides cost benefit analyses and what-if simulations of DFSMS Management Class policies. The Optimizer supports both System-Managed Storage (SMS) and non-SMS environments. The Performance Analyzer uses historical and real-time data to provide an overall data usage picture, and the Management Class Analyzer provides cost benefit analyses and what-if simulations of DFSMS Management Class policies. The Optimizer supports both System-Managed Storage (SMS) and non-SMS environments.

It maximizes the use of your storage resources while helping to minimize your overall storage costs. DFSMS Optimizer helps you make informed, timely data management decisions for your storage system environment.

DFSMS Optimizer provides the following features:

- ▶ Graphical User Interface running on Windows or OS/2.
- ▶ Includes a Performance Analyzer that uses historical and real-time data to provide an overall data usage picture.
- ▶ Powerful SMS filtering controls.
- ▶ High compression (80-90%) of collected SMF, RMF™, CRR, and HSM data.
- ▶ Reporting and analysis for both SMS and non-SMS data.

### 9.5.11 More information

For more information about z/OS storage management tools, visit:

<http://www-03.ibm.com/systems/storage/software/toolkit/>





10

## IBM Smart Analytics System

The IBM Smart Analytics System is a complete, off the shelf, ready to use analytics solution designed to accelerate your business's ability to quickly deliver insight where and when it is needed, and to adjust and grow based on your company's ever-changing business needs. Powered by InfoSphere™ software, the system leverages a modular component-based approach of pre-tuned and pre-integrated IBM hardware, software, and storage capabilities designed to accelerate the deployment, the efficiency, and ROI delivered from IBM's comprehensive portfolio of business analytic solutions.

## 10.1 IBM Smart Analytics System overview

IBM Smart Analytics System offers faster business value at lower cost by combining the simplicity and rapid deployment characteristics of an appliance while retaining the flexibility of a custom integration approach to take advantage of ongoing hardware and software enhancements without full system replacement.

IBM Smart Analytics System was developed based on your data analysis needs while maintaining the high availability and mission-critical reliability that are essential for today's environment. It is designed to simplify the delivery of information to the people in the business that need it the most while helping to minimize the cost of building a complex architecture to support analytical applications.

Some key features of IBM Smart Analytics System include:

- ▶ Powerful and flexible analytics in a package that simplifies deployment and speeds business results, meeting a broad spectrum of line-of-business analytic needs while lowering the IT costs to do so.
- ▶ Modular and scalable approach based on an integrated solution combining IBM's leading database management software, Power Systems, and IBM storage.
- ▶ Comprehensive, integrated solution consisting of a platform with optional modules depending on client requirements. All systems are optimized and pretested and packaged in several preconfigured sizes to simplify ordering and delivery.
- ▶ Highly available and reliable system with built-in failover and near zero planned downtime incorporated from the beginning.

IBM Smart Analytics System offers the IBM hardware, software, and services infrastructure to support additional application modules that provide a single end-to-end analytics solution from a single vendor. This powerful and flexible system provides:

- ▶ Modular analytics capacity
- ▶ Modular data warehouse processing capacity
- ▶ Modular storage capacity
- ▶ Modular user and administration capacity
- ▶ Advanced workload management and monitoring

IBM Smart Analytics System offers a wide range of analytics capabilities, enabling you to consume information in the most digestible format, gain insight, and make smarter decisions today and in the future.

At the core of IBM Smart Analytics System you will find powerful warehouse and storage optimization capabilities. This foundation not only manages the data store, but it is essential for speeding system deployment and enabling advanced analytics.

### ***Business intelligence (BI) - Fast answers to key business questions***

IBM Smart Analytics System BI capability offers a full range of reporting, analysis, and dashboarding to enable you to quickly gain new insights and take actions to drive better business outcomes. Providing a turnkey analytic solution, the system uniquely delivers leading BI software comprehensively optimized for its high performance server and storage hardware that can help you be business ready in days, not months. Drive better business outcomes with:

- ▶ A single consistent view of the business
- ▶ A full range of decision-making capabilities

- ▶ Easily accessible information
- ▶ Deeply optimized solutions for unparalleled performance
- ▶ Rapid time to value and potential return on investment (ROI), including the flexibility to grow with the business

IBM Smart Analytics System puts the power of industry-leading business intelligence software into the hands of business leaders who demand an easy-to-use solution with fast time to value. With the system, decision makers can access a consistent view of information throughout the business and multiple data sources; uncover and share new insights; and make better decisions to drive the business forward.

### ***Multidimensional cubing services - Gain insight from unseen data relationships***

IBM Smart Analytics System provides high performance cubing services to give decision makers a fast, multidimensional view of data stored in a relational database for such analysis as how to improve product profitability or customer satisfaction. Your organization can create, edit, import, export, and deploy cube models over the relational warehouse schema to perform these deeper multidimensional analyses across multiple business variables and large data sets.

Cubing services also provide optimization techniques to dramatically improve the performance of online analytical processing (OLAP) queries. In doing so, it simplifies the delivery of business analytics and optimization results and puts more power into more decision-makers' hands to analyze data and generate business insight.

### ***Data mining and text analytics - Predictive analytics to uncover opportunity***

Powerful yet simple, the data mining capabilities available with IBM Smart Analytics System enables integrated analytics of both structured and unstructured data. Standard data mining models (clustering, associations, classification, and prediction) are supported and can be developed easily via drag-and-drop in the Design Studio. The data mining models are executed in the production environment to provide real-time scoring of data records. Additionally, rich presentation components are provided to enable visual analysis of data mining results. With the system, decision makers can now organize and mine all your valuable information to uncover new opportunities, perform customer behavioral analysis, or assess potential risk.

### ***IBM Smart Analytics System - seamless growth***

The system leverages a modular component-based approach of integrated and optimized IBM hardware, software, and services designed to accelerate the deployment, the efficiency, and ROI delivered from IBM's growing portfolio of business analytic solutions.

- ▶ A foundation of components based on IBM hardware, software, and storage capabilities and an expanding portfolio of easy to deploy modular business analytic applications that combine to give IBM clients the industry's most reliable, high performance and comprehensive analytic capability to extract business insight from information assets and provide the right answers to the right questions at the right time.
- ▶ Designed so that each system component is able to leverage the strength of the others, creating a combined system that uniquely delivers high performance and can easily scale at the pace of business.
- ▶ Software included in IBM Smart Analytics System takes full advantage of the POWER and AIX technology. Hardware and software modules can be added anytime to existing installations, resulting in the most reliable, scalable, available, and highly performing alternative in the market, outside of the mainframe world.

- Capabilities include business intelligence reporting, analysis, dashboards, and scorecards, data mining, cubing services, text analytics, data warehouse management, storage and server platform.

Each configuration can be augmented (Figure 10-1) at anytime to meet new requirements by simply adding new analytic capability or data and user capacity building block components. And because all of these components leverage the same foundation, the system is easy to maintain, preserves existing investments, and delivers results in days rather than months.

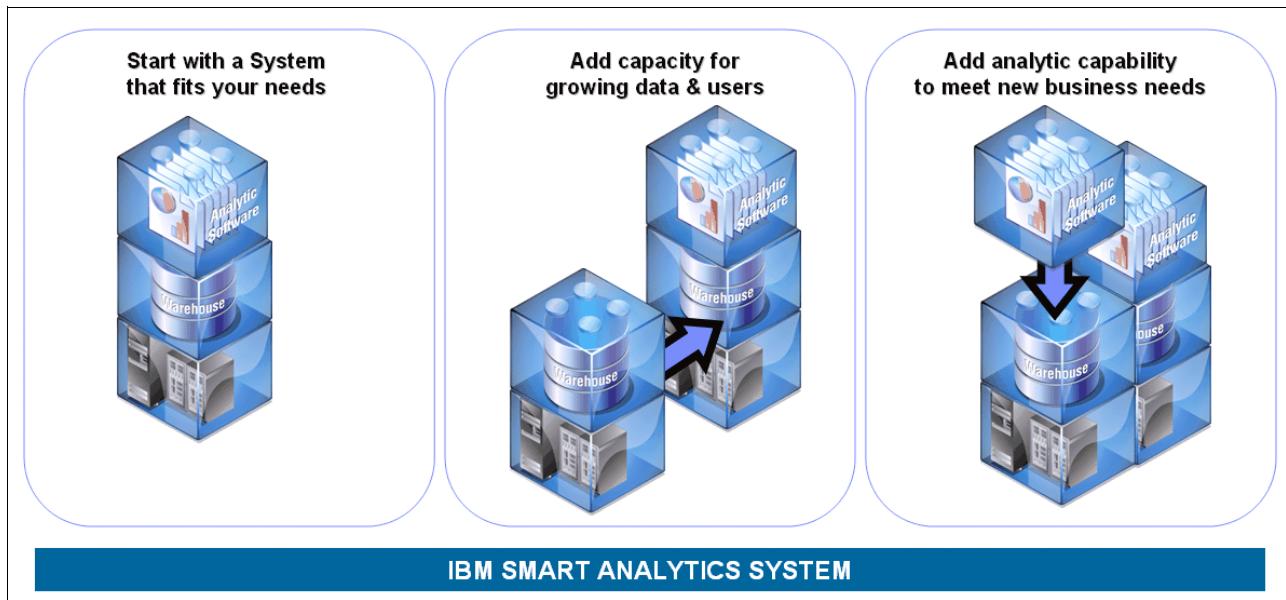


Figure 10-1 IBM Smart Analytics System

### Some important Smart Analytics System features

- An analytics platform providing cubing services, data mining, text analytics, intuitive business intelligence reporting, analysis, dashboards, and scorecards
- A trusted information platform offering high performance data warehouse management and storage optimization
- A highly reliable system platform with scalable server and storage
- Installation services and single point of support.

And with this system, your organization can be sure you are utilizing the industry's most comprehensive, strategic, and flexible analytics system available in the market today.

## 10.2 IBM Smart Analytics System module construction

IBM Smart Analytics System is comprised of the following components.

### Analytics software options

- Cognos® 8 Business Intelligence
- InfoSphere Warehouse Cubing Services
- InfoSphere Warehouse Text Analytics & Data Mining

## **Data warehouse software**

- ▶ InfoSphere Warehouse
- ▶ InfoSphere Warehouse Advanced Workload Management
- ▶ Tivoli System Automation

## **Hardware and OS**

- ▶ IBM Power 550
- ▶ IBM System Storage DS5300
- ▶ AIX 6.1

Refer to Figure 10-2 for a graphical representation of IBM Smart Analytics System modular construction.



Figure 10-2 IBM Smart Analytics System modular construction

### **10.2.1 IBM Smart Analytics software stack**

All IBM Smart Analytics System modules contain the following software:

#### **General server stack**

General server stack of IBM Smart Analytics Systems contains the following software:

- ▶ IBM AIX 6.1 TL 2 SP3 (64-bit)
- ▶ IBM General Parallel File System v3.2.1 (64-bit)
- ▶ IBM Tivoli System Automation v3.1.0.3 (64-bit) with RSCT 2.5.3.0

#### **InfoSphere stack**

InfoSphere stack of IBM Smart Analytics Systems contains the following software:

- ▶ InfoSphere Warehouse 9.5.1 Refresh
- ▶ DB2 9.5 FP4

### ***Some important features of InfoSphere software***

- ▶ A powerful, unified data warehouse platform for Business Intelligence with embedded analytics, integrated data transformations and movement, and integrated development and management interfaces
- ▶ Embedded analytics infrastructure to support high performance and high value business intelligence solutions
- ▶ Robust and scalable multidimensional analytics (OLAP) with cubing services
- ▶ Data discovery, detection and prediction with data mining
- ▶ Unlock the value of the text content with unstructured analytics
- ▶ Deliver analytic function and insights through industry standard interfaces
- ▶ Lower cost of solution development and maintenance through integrated tooling
- ▶ Design Studio for common solution design and development in a collaborative Eclipse-based environment
- ▶ Web-based remote control and management for DBAs and administrators through the Administration Console
- ▶ Built on the highly scalable, high performance and highly available DB2 data server with powerful data warehousing features

### ***Some important features of DB2 enterprise software***

- ▶ Powerful engine for the business intelligence solution
- ▶ Highly scalable shared nothing architecture
- ▶ Database partitioning (DPF) for predictable growth costs and performance
- ▶ Accelerates BI with high performance features
- ▶ Table partitioning and multidimensional clustering for rapid data access and management
- ▶ Faster query responses with materialized query tables
- ▶ Faster query response and reduced storage requirements with deep compression
- ▶ Effective resource management and high ROI
- ▶ Advanced workload management and monitoring

### **Cognos required stack**

Cognos stack of IBM Smart Analytics System contains the following software:

- ▶ IBM Cognos 8 BI Server v8.4 FP2
- ▶ IBM Cognos 8 Go! Dashboard v8.4 FP2
- ▶ IBM Cognos 8 BI Samples 8.4 FP2
- ▶ IBM Cognos 8 Supplementary Languages Documentation 8.4

### ***Some important features of Cognos stack***

- ▶ Delivers a complete range of business intelligence capabilities with reporting analysis, dashboarding and scorecards with a single, service-oriented architecture.
- ▶ Reporting.
- ▶ Author once, consume anywhere; intuitive, self-service reporting.
- ▶ Provides full breadth of report types (personalized, transactional, management, statutory, and production).
- ▶ Analysis.

- ▶ Compare and contrast to reveal symptoms and causes behind trends (for example, sales trend analysis); summary level to detail with ease.
- ▶ Flexible analysis using web or Excel interfaces.
- ▶ Dashboards.
- ▶ Full range of dashboard styles, including personalized, self-assembly views with Flash graphics.
- ▶ Highly visual and intuitive.

### 10.2.2 Configuration overview

This section discusses the foundation of IBM Smart Analytics System and includes the details about hardware and other components of the system.

IBM Smart Analytics System has many components, which makes it a robust device. Table 10-1 provides the details.

*Table 10-1 Configuration overview*

Component	Configuration
Server	IBM Power 550 Express servers <ul style="list-style-type: none"> <li>▶ 5.0 GHz POWER6 processors</li> <li>▶ 32 GB RAM</li> <li>▶ Internal 300 GB 15K RPM SAS disk drives</li> </ul>
Storage	DS5300 mid-range storage <ul style="list-style-type: none"> <li>▶ 146 GB 15K RPM DDM</li> <li>▶ EXP5000 Expansion Units</li> </ul>
Software	<ul style="list-style-type: none"> <li>▶ IBM DB2 Server V9.5 FP4 (64 bit)</li> <li>▶ IBM Tivoli System Automation V3.1.0.3 (64 bit)</li> <li>▶ IBM WebSphere® Application Server V6.1 FP17 (32 bit)</li> <li>▶ IBM HTTP Server V6.1 FP17 (32 bit)</li> <li>▶ IBM Java SDK V1.5 SR7 (32 bit)</li> <li>▶ IBM General Parallel File System V3.2.1 (64 bit)</li> <li>▶ IBM AIX V6.1 TL 2 SP3 (64 bit)</li> </ul>
Other software	<ul style="list-style-type: none"> <li>▶ IBM InfoSphere Warehouse Enterprise Edition V9.5.2 (64 bit)</li> <li>▶ IBM DB2 Performance Expert for Linux, UNIX, and Windows (LUW) V3.2.2</li> </ul>

### 10.3 More informational links

Refer to these links to get more information about IBM Smart Analytics System.

- ▶ [http://download.boulder.ibm.com/ibmdl/pub/software/data/sw-library/infosphere/brochures/analytics\\_IMB14052-USEN-00.pdf](http://download.boulder.ibm.com/ibmdl/pub/software/data/sw-library/infosphere/brochures/analytics_IMB14052-USEN-00.pdf)
- ▶ <http://www-01.ibm.com/software/data/infosphere/support/smart-analytics-system/>
- ▶ [www.ibm.com/smart-analytics-system](http://www.ibm.com/smart-analytics-system)



# Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

## IBM Redbooks

For information about ordering these publications, see “How to get Redbooks” on page 256. Note that some of the documents referenced here may be available in softcopy only.

- ▶ *IBM Tivoli Storage Manager Implementation Guide*, SG24-5416
- ▶ *Introduction to Storage Area Networks*, SG24-5470
- ▶ *Designing an IBM Storage Area Network*, SG24-5758
- ▶ *IBM System Storage Tape Library Guide for Open Systems*, SG24-5946
- ▶ *IBM TotalStorage 3494 Tape Library: A Practical Guide to Tape Drives and Tape Automation*, SG24-4632
- ▶ *Implementing the IBM System Storage SAN Volume Controller V5.1*, SG24-6423
- ▶ *Implementing an IBM/Brocade SAN with 8 Gbps Directors and Switches*, SG24-6116
- ▶ *IBM SAN Survival Guide*, SG24-6143
- ▶ *IP Storage Networking: IBM NAS and iSCSI Solutions*, SG24-6240
- ▶ *IBM Midrange System Storage Implementation and Best Practices Guide*, SG24-6363
- ▶ *The IBM TotalStorage NAS Integration Guide*, SG24-6505
- ▶ *IBM System Storage DS8700: Architecture and Implementation*, SG24-8786
- ▶ *IBM Midrange System Storage Copy Services Guide*, SG24-7822
- ▶ *IBM Tivoli Storage Productivity Center V4.1: Release Guide*, SG24-7725
- ▶ *IBM Midrange System Storage Hardware Guide*, SG24-7676
- ▶ *IBM XIV Storage System: Architecture, Implementation, and Usage*, SG24-7659
- ▶ *IBM System Storage TS7650 and TS7650G with ProtecTIER*, SG24-7652
- ▶ *Introducing the IBM Grid Access Manager*, SG24-7612
- ▶ *Implementing an IBM/Cisco SAN*, SG24-7545
- ▶ *IBM/Cisco Multiprotocol Routing: An Introduction and Implementation*, SG24-7543
- ▶ *IBM Virtualization Engine TS7500: Planning, Implementation, and Usage Guide*, SG24-7520
- ▶ *The IBM Virtualization Engine TS7510: Getting Started with i5/OS and Backup Recovery and Media Services*, SG24-7510
- ▶ *IBM Virtualization Engine TS7510: Tape Virtualization for Open Systems Servers*, SG24-7189
- ▶ *IBM System Storage N series*, SG24-7129
- ▶ *IBM System Storage DS3000: Introduction and Implementation Guide*, SG24-7065
- ▶ *IBM System Storage DS4000 and Storage Manager V10.30*, SG24-7010

- ▶ *Deployment Guide Series: IBM TotalStorage Productivity Center for Data*, SG24-7140
- ▶ *IBM TotalStorage Virtual Tape Server: Planning, Implementing, and Monitoring*, SG24-2229
- ▶ *IBM System Storage DS8000 Series: IBM FlashCopy SE*, REDP-4368
- ▶ *IBM DS8000 and z/OS Basic HyperSwap*, REDP-4441
- ▶ *IBM System Storage DS8700 Disk Encryption Implementation and Usage Guidelines*, REDP-4500
- ▶ *IBM System Storage DS8000: Remote Pair FlashCopy (Preserve Mirror)*, REDP-4504
- ▶ *IBM System Storage DS8000: LDAP Authentication*, REDP-4505
- ▶ *DS8000: Introducing Solid State Drives*, REDP-4522
- ▶ *DS8000 Thin Provisioning*, REDP-4554

## Other publications

These publications are also relevant as further information sources:

- ▶ *IBM System Storage Productivity Center V1.4: Introduction and Planning Guide*, SC23-8824
- ▶ *IBM Tivoli Storage Productivity Center and IBM Tivoli Storage Productivity Center for Replication Installation and Configuration Guide*, SC27-2337

## Online resources

This web site is also relevant as further information source:

<http://www.ibm.com/systems/storage/>

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(0.5" spine)  
0.475" <-> 0.875"  
250 <-> 459 pages







# IBM Information Infrastructure Solutions Handbook



## Information compliance, availability, retention, and security

An information infrastructure is comprised of software, servers, storage, and networks, integrated and optimized to deliver timely, secure, and trusted information throughout the organization and to its clients and partners.

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