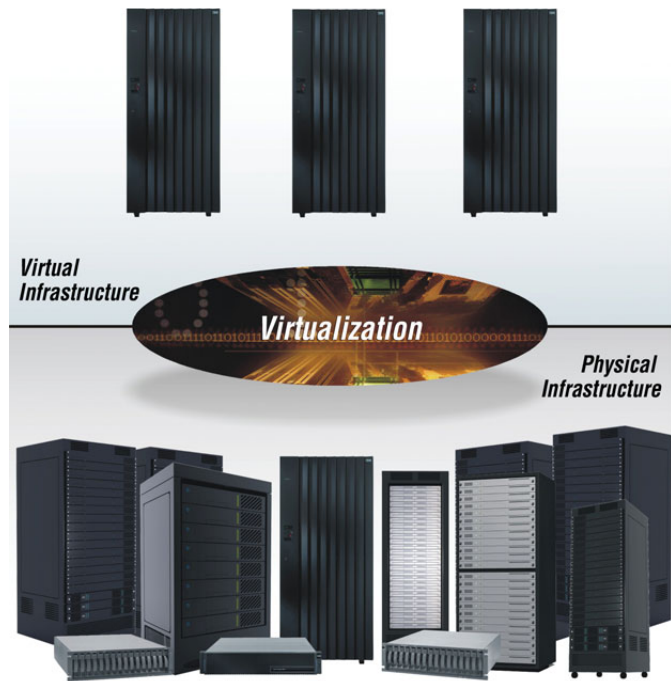




Manage storage more effectively with virtualization capabilities from IBM

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. 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 don’t 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 hides the true complexity of the storage environment from the servers and applications in the data center.

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

- *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*
- *Flexibly meet rapidly changing demands by dynamically adjusting storage resources across the information infrastructure*

- *Reduce data center complexity and improve IT productivity by managing multiple physical resources as fewer virtual resources*
- *Deploy tiers of different storage types to help optimize storage capability while controlling cost and power and cooling requirements*

Reducing costs while improving flexibility

At a time when businesses are searching for ways to reduce IT costs and to make the best use of every asset, deploying storage virtualization is an important tool to deploy. By pooling storage capacity, virtualization can improve the utilization of existing storage assets, which helps delay new storage purchases. Improvements of as much as 30 percent in disk storage utilization have been seen,¹ while tape virtualization including IBM ProtecTIER® technology can reduce storage requirements by up to 25 times. Virtualization can also deliver advanced technologies such as thin provisioning, snapshots, solid-state devices, and deduplication that can help you more effectively control the use of storage, thereby helping you make better use of new storage or the storage you already have.

Storage virtualization also helps companies respond quickly to the changing business environment. Simplified user interfaces and standardized provisioning procedures help enable rapid deployment of virtual storage resources to support virtual server resources.

The natural evolution from server virtualization to storage virtualization

Organizations have relied on server virtualization to extend server resources in the data center by consolidating workloads from multiple servers onto fewer, larger servers. But having only one part of the information infrastructure virtualized, while useful, has its limitations. For example, the absence of storage virtualization may limit what can be achieved with server virtualization. Server virtualization can help enable applications to be moved from one server to another, but if storage is not accessible to all servers in the environment, it will impose limits on where those applications can be moved.

Similarly, server virtualization helps speed deployment of applications by enabling the creation of new “virtual machines,” but without storage virtualization, deployment of the needed storage could take much longer. A recent report on server and storage virtualization by Enterprise Strategy Group (ESG) concurs, concluding that the combination of both types of virtualization “makes sense and over time should become requisite in the data center, in one form or another.”² In another study, ESG learned that an increasing number of organizations are deploying server and storage virtualization together. Twenty-four percent have already deployed storage virtualization in conjunction with server virtualization and 33 percent plan on doing so within the next 24 months.³

Many organizations run mixed environments with a variety of virtualized and non-virtualized servers and expect to do so for years to come. Storage virtualization delivers functions that operate in a consistent manner and provide common services

for all attached servers, regardless of whether those servers are virtualized. In contrast, server-based storage virtualization techniques differ from server to server and can make mixed environments more complex.

Virtualization of servers and storage at The University of Auckland, New Zealand's leading university and research facility, demonstrates the value of virtualizing more than just one part of the information infrastructure. The university's Information Technology Services (ITS), in an effort to improve administrative effectiveness, increase information availability, and reduce the total cost of storage, consolidated and virtualized all layers of the infrastructure—including storage and servers—using IBM System Storage™ technology. The initiative dramatically simplified the information infrastructure by eliminating the overly complex one-to-one relationships between applications and physical servers and by enabling centralized administration of the storage area network.

Improving information availability and simplifying IT management

Storage virtualization delivers better information and application availability in several ways. It makes it possible to move data without disrupting operations, since it helps eliminate the downtime frequently caused by data movement in non-virtualized environments. For organizations planning to use tiered storage to control costs, virtualization makes deployment easier by enabling data to move between tiers without disruption while also providing common management capabilities for all tiers.

When storage is virtualized, access to information does not require knowledge of the physical location of the information. Virtualization separates the logical view of information from its

physical location, enabling administrators to focus on information itself and how it can be used, rather than where information is stored. And because changes can be made to the virtual infrastructure so much more quickly and easily than to the physical infrastructure, IT organizations can respond faster to changes in business requirements that affect storage. Overall, storage virtualization technologies help practically eliminate storage-related causes of application downtime.

The simplified storage environment enabled by virtualization also makes administrators more productive by making it easier for them to manage the storage infrastructure. Virtualization creates the appearance of fewer resources in the environment (even though, physically, the infrastructure is unchanged), and fewer resources are easier to manage. While enabling centralized management, virtualization also hides the differences among multi-vendor products, facilitating management of heterogeneous environments. And virtualization contributes to simplification of physical infrastructure administration by reducing the number of devices needed to meet growing storage requirements. Companies deploying storage virtualization have experienced productivity improvements of up to twice their previous rate.¹

Comprehensive storage virtualization solutions

IBM offers a comprehensive portfolio of solutions for storage virtualization. To meet the broadest range of storage requirements, IBM's family of offerings for storage virtualization includes solutions for both network attached storage (NAS) and storage area network (SAN) approaches to shared data storage. IBM storage

virtualization offerings are all designed to operate with server virtualization systems such as VMware to help organizations enjoy the benefits of operating a fully virtualized information infrastructure.

File virtualization: IBM Scale-out File Services

In NAS environments, file virtualization using IBM Scale-out File Services 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 utilize scaling architectures and technologies borrowed from server environments and apply 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 end 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.

Tape storage virtualization: IBM System Storage TS7650 ProtecTIER Deduplication systems

IBM System Storage TS7650 ProtecTIER Deduplication systems combine a virtual tape library solution with inline data deduplication powered by IBM's patented HyperFactor® technology. The solution meets the data protection needs of the data center while potentially enabling significant savings in disk requirements and costs. It offers high-performance inline data deduplication and leading capacity scalability. TS7650 systems are an enterprise-class data protection platform designed to quickly and safely protect business information while reducing the amount of space required for storage. Customers can experience up to 25 times or more storage capacity reduction.

Disk system virtualization: IBM XIV Storage System

The IBM XIV® Storage System is a next-generation high-end open disk storage system, architected from the ground up to meet today's information infrastructure challenges. Its highly virtualized system software greatly simplifies IT operations and optimizes performance and availability through automatic distribution of data across the XIV system resources. This enables exceptional performance, and self healing without manual tuning. It also offers an amazingly intuitive user interface, and the system virtualization greatly simplifies storage configuration and management. Additionally, space-saving functions such as snapshot and thin provisioning are built in to the system. These XIV functions 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.

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 application 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 Tivoli Storage Productivity Center Suite

The IBM Tivoli® Storage 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 Tivoli Storage 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.

IBM Tivoli Storage Productivity Center supports management of virtual and physical resources from a single screen, helping administrators understand the relationships between these resources. Tivoli Storage Productivity Center also manages how these resources are used by virtual server environments and virtual SANs, supporting fully virtualized storage infrastructures.

Enhancing your virtualized infrastructure with IBM Global Services

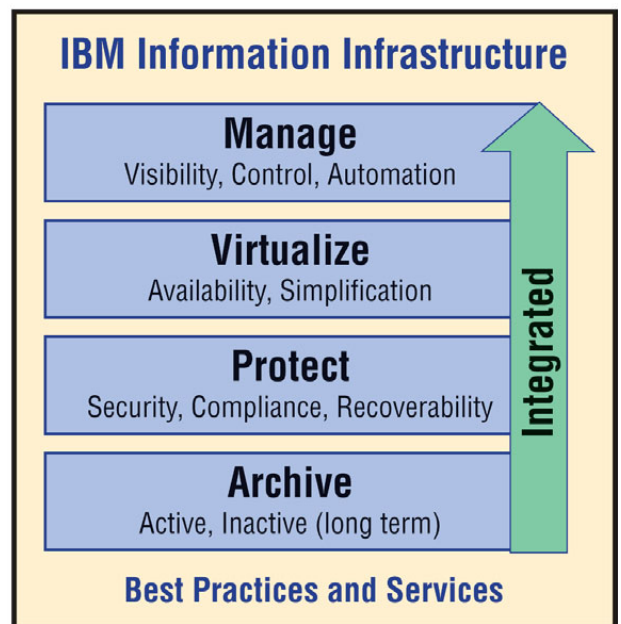
In today's environment, organizations are quickly overwhelmed with maintaining the right skills and keeping up with rapid changes occurring in technology, growth of information, and regulations. IBM Global Services can help you realize value more quickly and design an information infrastructure built for today and prepared for tomorrow. In partnership with specialists in storage virtualization and management, IBM Global Services delivers complete enterprise storage management services and solutions for today's businesses. IBM brings to the infrastructure development and deployment process:

- *Global reach and scale.*
- *Technology- and industry-focused IT innovation.*
- *A full storage services portfolio including consulting, product services, data migration, implementation, and managed services to complement your existing capabilities.*

Part of the comprehensive IBM Information Infrastructure

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. IBM Information Infrastructure solutions:

- *Offer a comprehensive approach that covers all aspects of an information infrastructure.*
- *Deliver unified 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.*



IBM Information Infrastructure represents a comprehensive approach that covers all aspects of an information infrastructure.



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. 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.

For more information

To learn more about how IBM's storage virtualization solutions can help your organization meet your storage challenges, contact your IBM representative or IBM Business Partner, or visit

ibm.com/storage/virtualization

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U.S.A.

Produced in the United States of America
July 2009

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¹ Forrester Consulting, "The Total Economic Impact of IBM System Storage SAN Volume Controller," Multicompany Analysis, September 2006

² Enterprise Strategy Group, "IBM: Server and Storage Virtualization," Server and Storage Virtualization Brief, February 2008

³ Enterprise Strategy Group, "The Impact of Server Virtualization on Storage," Research Report, December 2007



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