

June 2003



Tivoli software
IBM TotalStorage™

IBM storage solutions: Managing growth

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Executive summary

Today’s IT managers are faced with a daunting environment. The percentage of IT spending on storage and storage management is being driven upward by data growth while at the same time, global economic conditions are resulting in reduced or flat budgets.

The result is a storage infrastructure-management challenge that has been described by some as being so costly that total cost of ownership (TCO) has replaced initial purchase price as the relevant metric when evaluating storage solutions.

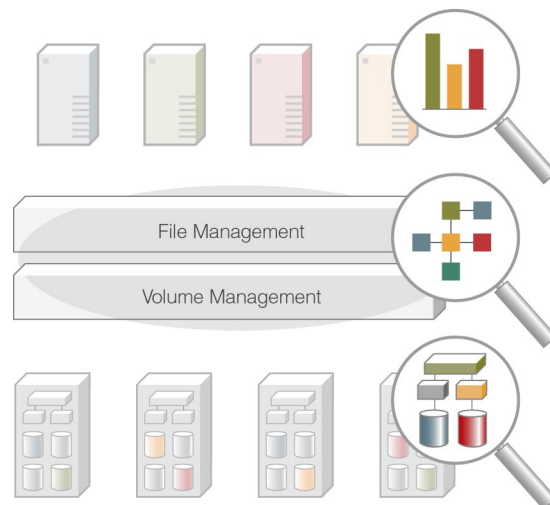


Figure 1. IBM storage solutions help IT managers reduce their TCO by delivering better information, eliminating administrator work and automating storage operations.

To help IT managers reduce their cost of ownership, IBM is delivering solutions that:

- *Integrate to provide better information for administrators – leading to better decisions*
- *Reduce, and in some cases, eliminate administrator work items through virtualization*
- *Enable policy-based automation tools that allow the storage environment to manage itself*

Organized under both the IBM Tivoli® software and IBM TotalStorage™ brands, IBM is working to deliver comprehensive storage software and hardware solutions that help IT managers evolve to an on demand operating environment¹ (see Figure 1). This paper focuses on the following current and upcoming members

Highlights

- *IBM Tivoli Storage Area Network Manager*
- *IBM Tivoli Storage Resource Manager*
- *IBM TotalStorage Virtualization Family*
 - *IBM TotalStorage SAN Volume Controller*
 - *IBM TotalStorage SAN File System*
 - *IBM TotalStorage SAN Integration Server*

IBM storage solutions can help IT managers reduce their TCO by significantly reducing, or in some cases, eliminating administrator work items associated with managing growth in the storage environment.

of IBM's comprehensive storage portfolio and a selected list of their integrated capabilities for managing growth.

“Growth” —driving change in IT environments

He arrived at work early that day to begin planning for changes to the storage infrastructure driven by low free space on one of his storage arrays. As he stopped for coffee, the operations manager told him that there had been two application outages during the night due to unexpected out-of-space conditions in another area of the storage environment. “Something needs to change,” the operations manager said. When he got to his office, there was an e-mail in his in-box from the head of a business unit. She was informing him that a change in business forecasts would likely mean a new application would be coming online and the existing applications would have expanded capacity requirements. He leaned back in his chair, looked at the ceiling and...

If you are an IT manager, you can probably finish the story quite easily. The key drivers of this situation are:

- *Rapid growth in the amount of data used by applications*
- *Constant change driven by the coming and going of applications and technology*
- *Highly complex storage environments requiring a great deal of administrator activity and attention*

And all this is resulting in ... change.

“Change” requires storage network administrators to create and maintain spreadsheets with serial numbers, firmware levels and connection information for Fibre Channel host bus adapters (HBAs), switches and storage devices.

“Change” requires application owners to spend time tracking their storage utilization, forecasting future data growth and planning for the necessary application downtime when storage hardware is added or refreshed.

“Change” requires storage administrators to track overall hardware utilization and plan upgrade activities with an eye toward minimizing application downtime.



Highlights

“Change” requires system administrators on each operating platform to map storage devices to logical volume groups, format file systems and use software to move data.

In the storage environment, the costs involved in managing change contribute directly to an overall TCO that has been described as being so significant, that the initial purchase price is no longer important.

Managing growth with IBM storage solutions

IBM is working to deliver solutions to help IT managers reduce their cost of ownership by giving them the information and tools to manage the change associated with growth more effectively. Organized under both the IBM TotalStorage and IBM Tivoli software brands, these integrated solutions are modular in design – each component with well-defined functions and open interfaces – making it possible for IT managers to construct, upgrade or enhance their on demand operating environment one component at a time.

Better information

In a shared storage environment with high growth and frequent change, one of the more difficult tasks can be simply maintaining a complete and current picture of what the environment looks like.

A good picture of the environment that you are working with is essential when planning for or reacting to change. However, manually maintaining that picture, on a spreadsheet for example, can consume a great deal of administrator time, is error prone and is difficult to keep current.

IBM storage solutions offer better information to IT managers. As a first step, IBM offers infrastructure components that adhere to industry standard open interfaces for registering with management software and communicating connection and configuration information. As the second step, IBM offers automated management software components that integrate with these interfaces to collect, organize and present information about the storage environment.

IBM Tivoli SAN Manager is designed to automatically build and maintain a complete, current picture of your storage network.

Building the picture—One of the modular storage components that can help enhance your integrated on demand operating environment, the *IBM Tivoli Storage Area Network (SAN) Manager*, is designed to build and maintain a complete, current map of your storage network.² SAN Manager can automatically

determine both the physical and logical connections in your storage network and display the information in both a topological format and a hierarchical format. Looking outward from the SAN switch, SAN Manager can answer questions that help administrators validate proper configuration of your open storage network (see Figure 2):

- *What hosts are attached to my storage network and how many HBAs does each host have?*
- *What firmware levels are loaded on all my HBAs?*
- *What firmware levels are loaded on all my SAN switches?*
- *How are the logical zones configured?*

Looking downward from the host, SAN Manager answers administrator questions that arise when changes occur in the storage network that could affect host access to storage:

- *Does a given host have alternate paths through the storage network?*
- *Do those alternate paths use alternate switches?*
- *If available, are those alternate paths connected to alternate controllers on the storage device?*

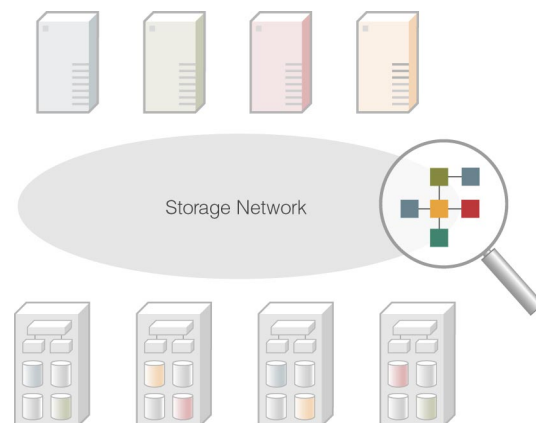


Figure 2. IBM Tivoli SAN Manager answers key questions about the configuration and operation of the storage network.

Looking upward from the storage device, SAN Manager answers administrator questions that arise when changes happen in the storage network that could affect the availability of stored data:

- *What hosts are connected to a given storage device?*
- *What hosts have access to a given storage logical unit (LUN)?*

Highlights

IBM Tivoli Storage Resource Manager provides detailed information about the configuration and capacity of storage devices, file systems and databases.

Another key function of the SAN Manager is “change validation”—SAN Manager detects changes in the storage network, both planned and unplanned, and can highlight those changes for administrators giving them an easy way to validate that a change action achieved the desired result.

Improving the resolution—With the center of the picture—the storage network infrastructure—displayed by SAN Manager, you can now improve the resolution on the edges of the picture with *IBM Tivoli Storage Resource Manager*—another modular storage component that will enhance your on demand operating environment.

First, focusing on the hosts, file systems and databases that are attached to the top of the storage network, Storage Resource Manager answers the following detailed capacity questions (see Figure 3):

- *How full are the file systems on my hosts and which ones are approaching an out-of-space condition?*
- *Which files, users or groups are leading to out-of-space conditions?*
- *How full are the databases on my hosts and which ones are more likely to have space-allocation problems soon?*
- *Which user or tablespace is leading to database space-allocation problems?*
- *How am I using up my allocated file system and database space over time?*

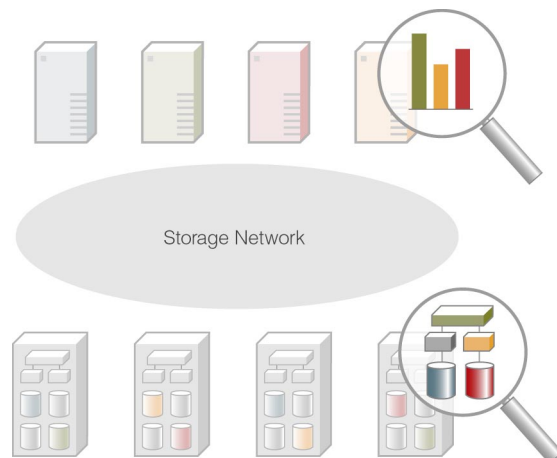


Figure 3. IBM Tivoli Storage Resource Manager answers key questions about the configuration and capacity of storage devices, file systems and databases.

Next, focusing on the storage devices at the bottom of the storage network, Storage Resource Manager answers detailed device configuration and capacity questions:

- *How are the LUNs that hosts see mapped to the actual physical disks in the storage device?*
- *What hosts have access to a given physical disk?*
- *What LUNs have been created but are not in use?*
- *How much physical storage capacity and free space do I have in my storage network?*
- *How am I using up my storage capacity over time?*

Eliminating work

Providing IT managers with better information is one step that can be taken to improve the efficiency with which they do their work. As a second step, new architectures in virtualized file system and volume management are now allowing IT managers to eliminate certain work items all together.

In traditional environments, a host system owns storage and has its own unique volume manager and file system. This model creates a management stovepipe. Individual system administrators are forced to manage storage resources on a host-by-host basis.

One of the more time-consuming and frequent changes in the storage environment is the process of growing, shrinking or moving storage capacity. To illustrate the significant work currently required to manage such changes, consider the example case of replacing a storage device whose lease has expired. With the old device going out, a new device is brought in, connected to the storage network and its physical storage configured into LUNs. Then, the bulk of the work falls to system administrators operating on each of the host machines that use the storage capacity who have to perform the following tasks:

1. *Using volume management software, they add the new LUNs to an appropriate volume group.*
2. *Using file system software, they format the new volumes with the appropriate file system.*
3. *Using volume replication software, file-copy software or some other manual method, they move data from the old device to the new device.*
4. *Finally, they might have to interrupt operations because an application outage is often required to complete the move process.*

Because traditional volume manager and file system software is host-based, this list of administrator tasks is replicated on every host. As storage systems get larger and more hosts are attached to storage networks, it is easy to see how the processes of growing, shrinking or moving storage capacity can become unmanageable and costly.

Evolving to an on demand operating environment can eliminate much of the work associated with changing physical storage. This is accomplished by consolidating the variety of host-based volume management and file system functions into single points of control in the storage network. Instead of each host owning its storage, a virtualized storage utility is created that host machines “plug in” to. As a result, administrators do not need to interact with individual host systems to get disks assigned; logical volumes created, striped or mirrored; file systems formatted and mounted or data copied.

The *IBM TotalStorage SAN Volume Controller*, planned for availability in mid-2003, has been designed to provide the volume management functions for all hosts from a single point in the storage network. With SAN Volume Controller, volume management functions that administrators once performed on each individual host are no longer required (see Figure 4).

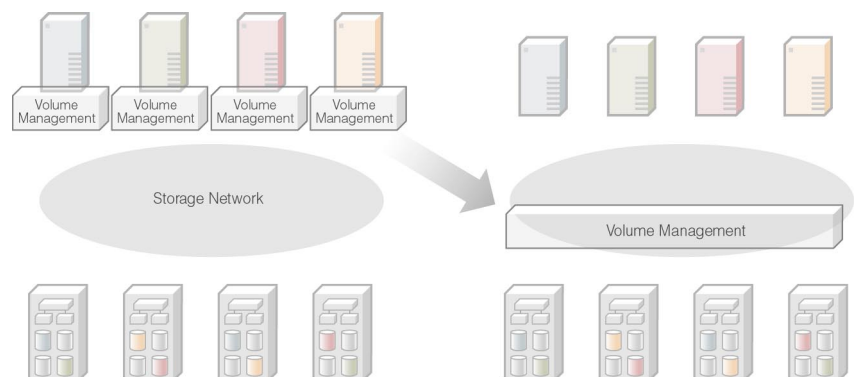


Figure 4. IBM TotalStorage SAN Volume Controller will help consolidate traditional host-based volume management functions into a single point of control in the storage network.

Logical volumes can be created, moved from one storage device to another and replicated – all from a central location and without interrupting the operation of the host system. Additionally, because all volume management functions are



Highlights

IBM TotalStorage SAN Volume Controller has been designed to provide the volume management functions for all hosts from a single point of control in the storage network.

centralized, storage utilization efficiency is improved. The waste associated with pre-allocating storage LUNs to individual host-based volume managers can be eliminated.

Another variation on volume management virtualization offerings from IBM is the *IBM TotalStorage SAN Integration Server*—also planned for availability in mid-2003. This solution will integrate, at manufacturing time, the SAN Volume Controller together with other components (IBM TotalStorage SAN switch, IBM TotalStorage FASStT storage, IBM Tivoli SAN Manager, rack, and cabling) into a complete SAN environment. The goal is to make it easier for IT administrators to install new SANs that offer the benefits of virtualization.

Next, turning to virtualized file management, the *IBM TotalStorage SAN File System*—planned for availability in late 2003, has been designed to provide the file management functions for all hosts from a single point in the storage network (see Figure 5). With SAN File System, host machines will “plug in” to a common file structure giving them “visibility” to all data. “Access” and “usage” are then controlled by policies governing security and quotas. Storage utilization efficiency is again enhanced as the storage is shared between all hosts and allocated only as files are created.

The ability to plug host systems into a virtualized storage utility will help free administrators from another key source of storage complexity and work—upgrading or changing host machines. The same dynamics that drive change in the storage infrastructure can drive change in the hosts attached to that storage. Processors that go off lease, applications that need more processing capacity and strategic shifts from one operating system to another all contribute to this change. The existing model of host systems owning storage makes managing these changes time consuming and difficult.

Highlights

IBM TotalStorage SAN File System has been designed to provide the file management functions for all hosts from a single point of control in the storage network.

With an on demand operating environment built with SAN File System, applications may be moved from one host system to another or even from one operating system to another independently from the data that the application uses. When the application move is complete, the new host is simply “plugged in” to the storage utility, giving the application access to the same data it had on the old host. No time-consuming data move operations will be required.

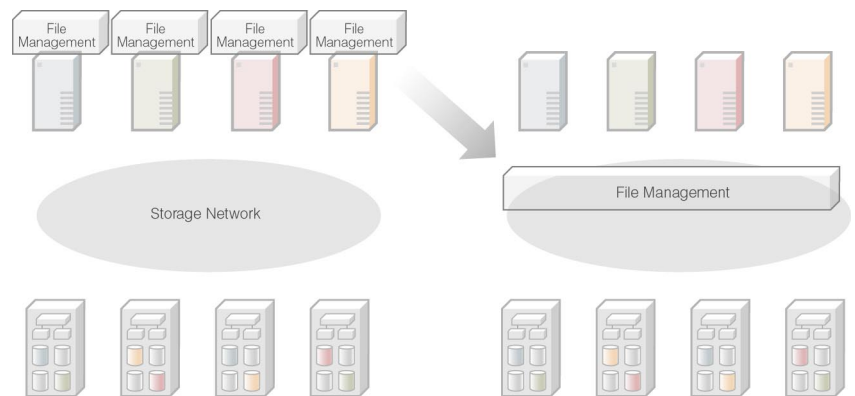


Figure 5. IBM TotalStorage SAN File System has been designed to consolidate traditional host-based file system management functions into a single point of control in the storage network.

The SAN Volume Controller, the SAN Integration Server and the SAN File System are part of the new *IBM TotalStorage Virtualization Family*.

Automating operations

An on demand operating environment has the potential not only to deliver better information and eliminate work; it can also provide IT managers with policy-based, autonomic tools that allow the storage environment to manage itself.

Proactive file management—Storage capacity intended to support business operations can often be slowly consumed by files that are totally unrelated to the business. In some cases, these non business files can also represent a business liability—downloaded illicit audio, video or graphic files for example. Company policies governing the retention of system files—such as core dumps and log files—and the storage of large, personal files are difficult to enforce without *autonomics*. Tivoli Storage Resource Manager includes autonomic functions that can take company policies and automate their implementation. For example,



Highlights

IBM storage solutions combine through industry standard interfaces to deliver unique value in automating storage operations.

with Tivoli Storage Resource Manager, IT managers can automate the process of routinely identifying unwanted or obsolete files, such as those mentioned before. Then, through integration with Tivoli Storage Manager, these files can be automatically archived and deleted from primary storage – returning the freed capacity to business operations.

Optimized storage provisioning—One of the most-rapidly changing attributes of a storage system is its capacity utilization. Managing that utilization on a minute-by-minute basis without automation is very difficult – if not impossible. Mismanaging storage capacity utilization can result in application outages.

With an on demand operating environment, IT managers have the ability to set policies that govern storage capacity utilization. If a host file system exceeds a predefined utilization threshold, IBM Tivoli Storage Resource Manager combines with IBM TotalStorage Enterprise Storage Server™ to automatically identify unused capacity in the storage network, create a new LUN from that storage, allocate the LUN to the host and extend the file system across the new LUN. Informational alerts are then generated informing IT managers of the automated action.

Policy-driven quality of service—IT managers choosing to virtualize file system functions in the storage network with IBM TotalStorage SAN File System have the ability to create pools of storage that deliver different quality of service. Examples of the kinds of storage pools that they might create include:

- *Online transaction processing data – real-time mirroring and disaster recovery*
- *Reference Data – appropriate data protection and archival policies*
- *Temporary Data – disaster recovery and data protection is not critical*

IT managers then define a set of policies that govern which files get allocated into each storage pool. As files are created, information about the file is interrogated by the policies and the files are automatically placed. This helps to free administrators from manual file placement and helps ensure that existing storage assets are efficiently and correctly utilized.



Conclusion

Managing growth in the storage environment is a significant challenge that directly contributes to a rapidly rising TCO. To help IT managers reduce their cost of ownership, IBM is delivering open storage solutions that provide better information to administrators, eliminate certain administrator work items through virtualization and provide IT managers with autonomic tools that allow the storage environment to manage itself better. These integrated solutions are offered in modular components so IT managers can construct, upgrade or enhance their on demand operating environment one component at a time

For more information about IBM e-business on demand™ and storage, go to ibm.com/ondemand, ibm.com/totalstorage and ibm.com/tivoli

***IBM storage solutions:
Managing growth***



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¹ For a more complete discussion of the value of an on demand operating environment, see the IBM white paper *IBM Storage Solutions: Evolving to an on demand operating environment*.

² For a complete list of supported infrastructure components, go to ibm.com/software/sysmgmt/products/support/IBM_TSANM_Device_Compatibility.html

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06/03

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