Demartek

Simple SAN &
Storage Resource Management in
Microsoft® Windows Server™ 2003 R2

May 2006

Can SANs really be simple? What new storage management functions are available in Windows Server 2003 R2?

This Demartek report, commissioned by Microsoft®, is designed for IT managers and system administrators who work in small and medium-sized organizations and who are exploring ways to take advantage of newer, simpler SAN technology, both Fibre Channel and iSCSI. This paper describes new SAN management and storage resource management functions that are provided with Windows Server™ 2003 R2 without having to purchase an expensive management application.

Legal Notices

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Executive Summary

Can Storage Area Networks (SANs) be simple to install and use for the small and medium-sized business? Is it possible to provide basic storage resource management functions for administrators to use without having to purchase an expensive management application?

With the new storage management functions included with Microsoft® Windows Server™ 2003 R2 and the work done by various storage vendors, the goal of achieving a "Simple SAN" has been met, including the use of fibre channel and iSCSI storage technologies. This paper describes the goals and accomplishments of the Simple SAN program including actual deployment steps taken by Demartek to install and use a simple SAN. This paper also describes the use of basic storage resource management functions provided by Windows Server™ 2003 R2 including quota management and storage resource utilization.

This paper is divided into the following sections:
♦ Management Perspective on Fibre Channel and iSCSI SANs
♦ Simple SAN
  ▪ Installation on one server
  ▪ Using Storage Manager for SANs across multiple servers
♦ Storage Resource Management

Management Perspective on Fibre Channel and iSCSI SANs

Storage Area Networks (SANs) provide several advantages over direct-attached storage (DAS) including:

♦ The ability to plan for storage growth without regard to the number of I/O slots, power connections, or drive bays in a particular server
♦ The ability to add storage to an IT environment without rebooting servers
♦ The ability to upgrade application servers to more powerful platforms without having to migrate application data off the server
♦ The ability to share storage resources across several servers, including devices such as tape libraries
♦ The ability to place the storage miles away from the server cabinet

However, SANs have traditionally been non-trivial to implement, requiring a fair degree of technical expertise. While adoption of SANs has been slow in small and medium-sized businesses, SAN adoption has been very strong in large enterprises. Large enterprises have full-time storage professionals and larger budgets available for storage equipment.

Fibre Channel

Fibre Channel SANs have been deployed in large enterprise datacenters since the mid-1990's because they meet the performance and reliability requirements of those environments. The Fibre Channel interface provides high-speed connections between servers and storage, using 1, 2, or 4 gigabit connections, resulting in throughput of 100, 200, and 400 megabytes per second over distance. Fibre Channel networks also currently provide for 10 gigabit connections between Fibre Channel switches to provide additional bandwidth within the infrastructure. Fibre Channel solutions provide reliable and efficient data transfer between host servers and storage devices with relatively little host server overhead because there are no packets to be assembled and re-ordered by host software – this work is performed at the hardware layers.

The Fibre Channel interface supports several protocols, including SCSI, ESCON, IP, VI and others. The same SCSI command set that is used for direct-attached storage devices is used for Fibre Channel storage devices, except that the number of devices that can be addressed in a Fibre Channel fabric is in the millions, and the cable lengths can be much longer than traditional SCSI cables.

However, Fibre Channel infrastructure equipment can be expensive and complex. New Fibre Channel host bus adapters are typically priced in the neighborhood of one thousand dollars, and Fibre Channel switches are typically several thousand dollars. Implementing a Fibre Channel infrastructure requires knowledge of fabric technologies such as zoning, binding, and other concepts. In addition, there has typically been a large compatibility matrix associated with host bus adapters, switches, disk arrays, tape devices, and the supported firmware levels of each. In a large environment, planning and deployment of a

complete, traditional Fibre Channel SAN can take many hours or sometimes days. While this type of technology deployment is perfectly acceptable in a large enterprise environment, the level of expertise required, the cost, and the time for deployment put a typical Fibre Channel solution out of reach for many small and medium-sized businesses.

iSCSI

iSCSI is a newer technology that provides for some of the same benefits as Fibre Channel SAN technology but at a reduced cost. iSCSI uses the SCSI command protocol over TCP/IP networks. This approach provides the same type of storage interface from an application viewpoint as traditional SCSI or Fibre Channel connections, but uses less expensive hardware and can run over potentially very long distances. Ethernet and TCP/IP infrastructure and technology are usually present in most IT environments and are well understood.

Because iSCSI is a software emulation layer typically running above the TCP/IP stack, the end-to-end throughput of iSCSI is typically lower than Fibre Channel, but for the small and medium-sized business environment, iSCSI provides acceptable performance for many applications. In addition, some iSCSI solutions provide accelerator hardware in the form of TCP/IP Offload Engines (TOEs) where the TCP/IP processing is performed in a separate adapter, similar in concept to a SCSI or Fibre Channel host bus adapter.

Because iSCSI uses TCP/IP protocol and runs over well-understood networks, the same security and error risks that are present in normal network environments are also present with iSCSI configurations. IP security protocol (IPSEC) is typically implemented to provide the additional security that is required.

Similar to traditional SCSI solutions, iSCSI solutions require an iSCSI initiator and one or more iSCSI targets. Microsoft provides a free iSCSI initiator with Windows client and server environments. Version 2.0 of the Microsoft iSCSI initiator, released in early 2006, supports 32-bit and 64-bit processors, multi-path I/O (Microsoft MPIO), and IPv6. In March 2006, Microsoft acquired the WinTarget technology from String Bean Software. The WinTarget technology provides iSCSI target technology that will be used in Microsoft Windows Server solutions.

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Simple SAN

One of the obstacles to deploying Storage Area Networks (SANs) in the small and medium-sized business environment has been the complexity of the technology. Microsoft and its storage partners have been working to deliver "Simple SAN" complete solutions and the first of these solutions are now available.

To understand the goals of the Simple SAN program, consider the deployment of a simple Ethernet network. When a user connects a computer to an unmanaged Ethernet switch using an Ethernet cable, there is a light on the switch and on the computer indicating connectivity, and assuming DHCP in a router or server, basic configuration is complete. This level of simplicity is the underlying strategy for the "Simple SAN" solutions.

To test the simplicity and ease of use of the first Simple SAN solutions, Demartek deployed two different Simple SAN solutions. Demartek noted the amount of effort to deploy each of the SANs, and noted the time from the beginning of the process until the servers were writing data on the SAN storage devices. The solutions installed and tested were:

♦ *Fibre Channel:* Hitachi SimpleSAN v1.0 Simple SAN solution
♦ *iSCSI:* EqualLogic PS 100/200/300 Series Simple SAN solution

The basic installation process consisted of the following steps:
♦ Hardware steps:
  o Install the hardware, connect the cables, etc.
  o Install the HBA for the Fibre Channel solution
♦ Software steps:
  o Run the installation software from the CD
  o Initialize the disk array
  o Configure and allocate the LUNs by running Storage Manager for SANs
  o Format the new volumes and write data to the new volumes

One requirement for the Simple SAN solutions is that they require either zero or at most one reboot for the entire installation process. The two solutions tested here meet that requirement.

The installation instructions included with Simple SAN solutions are generally found on a poster-sized sheet that includes a small number of clear steps, very similar to the installation instructions found with other computing equipment such as a printer. Even though some of the components of the Simple SAN solution may come from different manufacturers, there is one installation poster for the entire solution.

All the SAN hardware components, including the fiber-optic cables, were included in the box with each Simple SAN solution.

Test Environment

The iSCSI and Fiber Channel complete Simple SAN solutions were installed and deployed on identical but separate rack mount systems containing four servers and the appropriate switch and storage units provided with the complete Simple SAN solution. The servers were HP ProLiant DL360 G3 servers, with Dual Intel Xeon 2.8 GHz processors and 1 GB RAM memory.

The complete Simple SAN solutions included the Microsoft VDS 1.1 provider, which supports both Fibre Channel and iSCSI. The Hitachi solution was tested using a pre-release VDS 1.1 hardware provider.

The File Server Resource Manager (FSRM) was tested on a Dell PowerEdge 1600SC server with dual Intel Xeon 2.8 GHz processors and 1 GB RAM.

Simple SAN Solution Number 1 – iSCSI EqualLogic solution

The first Simple SAN solution we installed was the EqualLogic PS 100 iSCSI solution. We followed the simple installation instructions that were included in the installation poster. Our goal was to create a "FileandPrint" volume of 25 GB capacity from a pool of storage on the disk array.

After installing the EqualLogic-supplied components into the rack, we inserted the drive units into the drive enclosure and connected the various cables, as directed by the instructions.
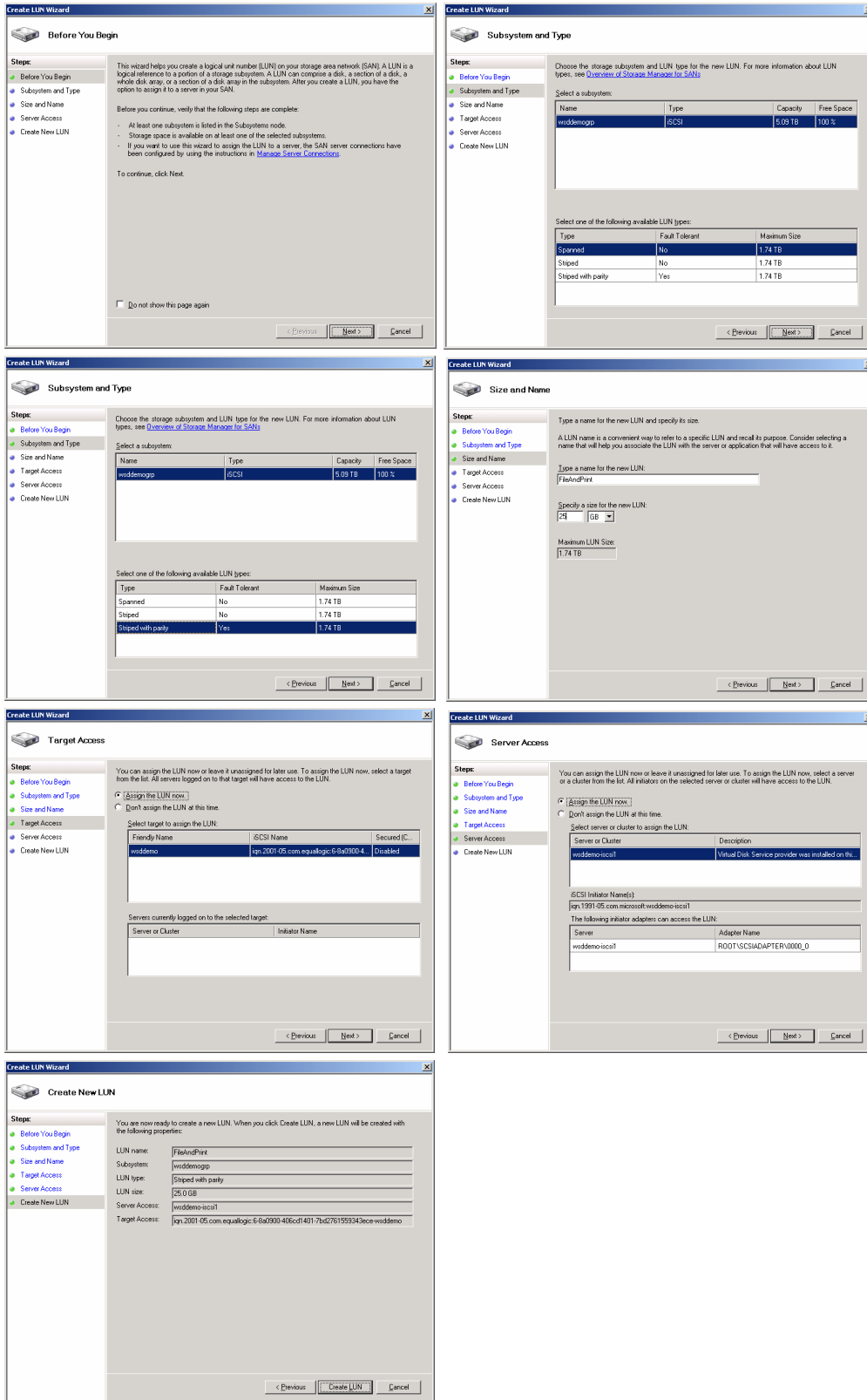
The software driver installation process was very straightforward using the CD that came with the solution. The following screen shots taken during the installation process show the simplicity of the installation of the software. The software license screen shot lists the EqualLogic and Microsoft software components that were installed. At the completion of this phase of the installation, the software gave us the option to launch the next step in the process, initializing the disk array, which we accepted.

Following the installation of the EqualLogic software, we proceeded directly to the initialization of the PS series disk array, using the EqualLogic Remote Setup Wizard, following the prompts as shown by the screen shots below. We used the IP address of 192.168.162.190 as the local address for this iSCSI array. Since this was our first iSCSI disk array, we created a new group with this array. As with the previous section, the software gave us the option of proceeding with the next phase immediately after finishing this phase, running Storage Manager for SANs (SMfS), which we accepted.

The only remaining function was to create volumes on our 5 TB disk array and assign them to our host servers. This is accomplished by using Storage Manager for SANs, a component of Windows Server 2003 R2.

Storage Management for SANs presents the appropriate menu choices for the disk array technology. In this case, we can select "Manage iSCSI Targets" to configure the volumes in the iSCSI disk array. The basic iSCSI configuration consisted of selecting the subsystem, assigning it a friendly name, and enabling the portal – all wizard-driven.

The next step in iSCSI configuration performed by Storage Manager for SANs is to create one or more LUNs. This task is also wizard-driven and follows the "cookbook" steps on the left side of the screen. The selections that are shown are appropriate for the type of device, in this case iSCSI, and particular to the vendor solution.

Once the LUNs are created, the wizard led us through the assigning of the LUNs to a server. Once the LUNs are created and assigned to a host server, Storage Manager for SANs allows the administrator to log onto the iSCSI target. At this point, the LUNs are ready for use by the user or application.

We formatted the volumes using the standard Windows Disk Management tools, and began to write data on the volumes.

The total time to deploy the iSCSI SAN, from the beginning of the installation process to writing user data on the LUNs, was 53 minutes, including the time required to capture and save the screen shots used for this report. No reboot was required.

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Simple SAN Solution Number 2 – Fibre Channel Hitachi solution

The installation of the Fibre Channel solution was very similar to the iSCSI solution, except for the installation of the fibre channel HBA into the server. Our goal was to create a "File&Print" volume of 25 GB capacity from a pool of storage on the disk array.

After installing the Hitachi Simple SAN components into the rack, and installing the HBA into the server, we began the software installation. The HBA installation requires the server to be powered down, followed by a power-up and normal boot sequence. The Hitachi Simple SAN solution provides an installation tool known as *SANsurfer Express*, provided by Qlogic. This is an example of two vendors, Qlogic and Hitachi in this case, collaborating on the complete solution. SANsurfer performs disk array, switch and HBA management, and renders a graphical version of the Simple SAN topology. This is different from Storage Manager for SANs, which provides only the basic disk array management.

The basic software installation from the CD-ROM was very similar to the iSCSI solution, with the exception of requiring a reboot before continuing on to the creation of the logical disks.

After the reboot, SANsurfer provided us with the following screen, showing us the progress we had made so far. SANsurfer provides other options, including showing a topology map of our simple SAN – showing one host, one SAN switch and one connection to the disk array.
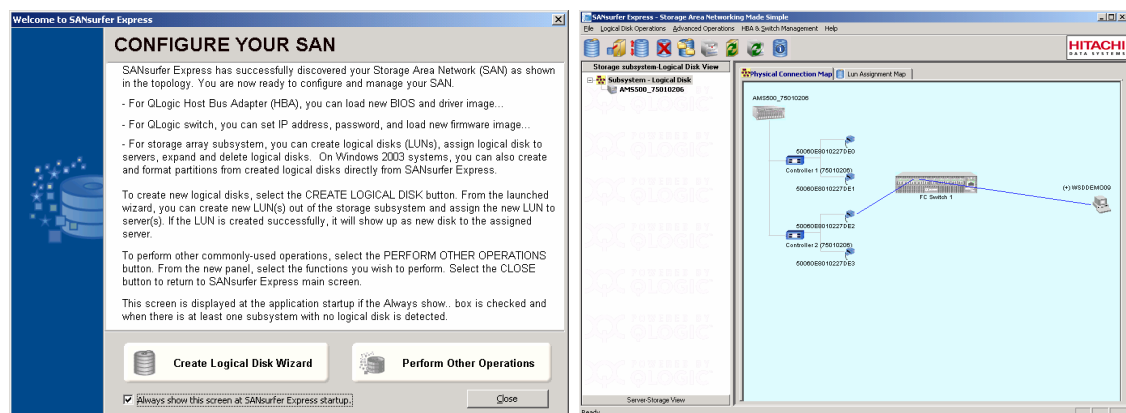
The process of configuring the logical disks was wizard-driven. We selected the entire disk array and created one storage pool from all the storage in the array, selecting all the disk drives. We then created a "File&Print" volume of 25 GB capacity, RAID 5, from the storage pool. SANsurfer then initialized and formatted the disk volume and it was ready to use. We were then able to write files to this volume. The total elapsed time to install and deploy the entire Fibre Channel SAN was 71 minutes, which included the time to initialize and format the disk volume, and capture screen shots for this report. One reboot was required for this process.

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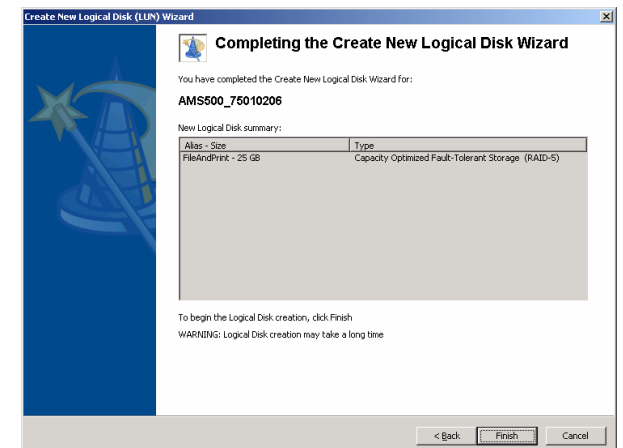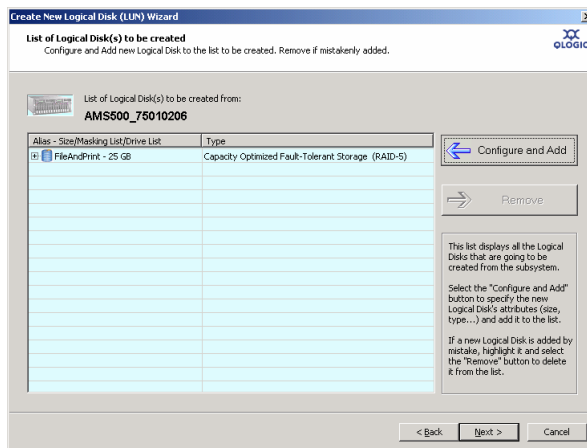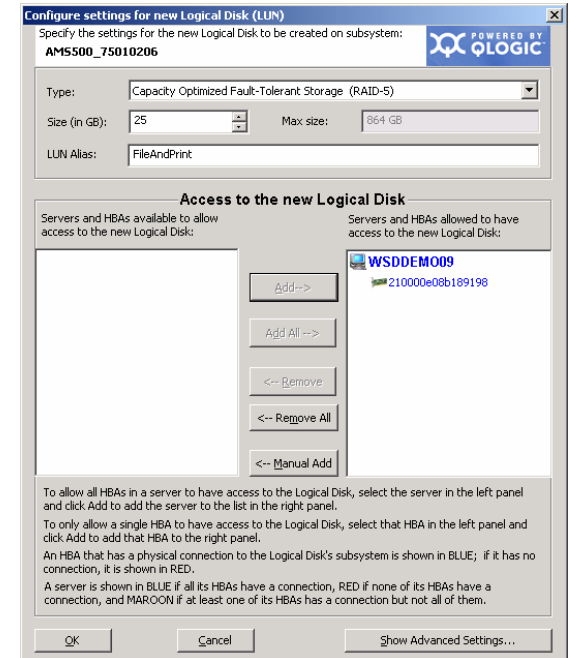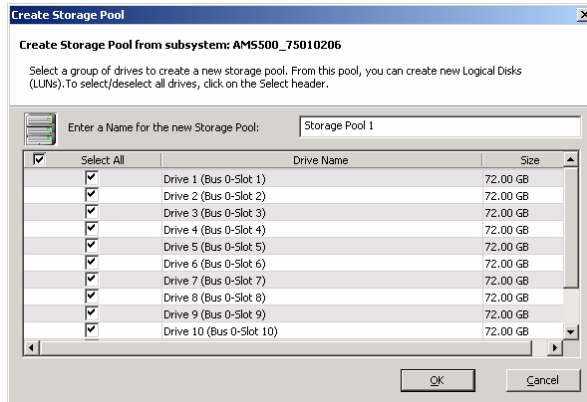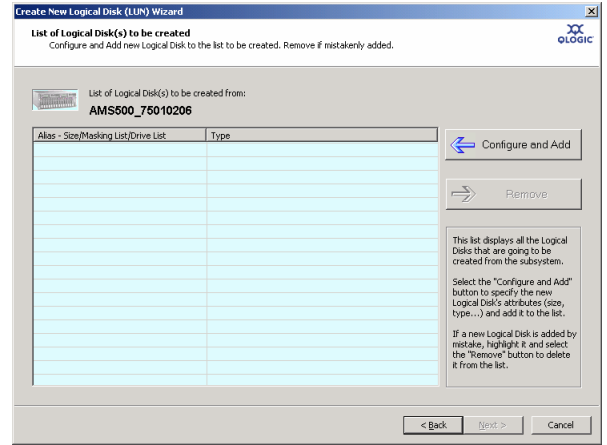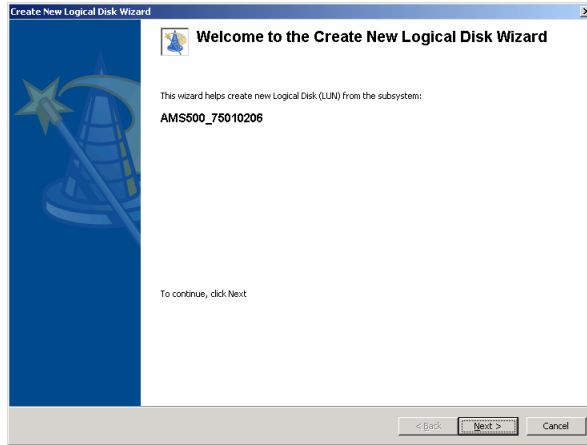
Using Storage Manager for SANs Across Multiple Servers

After seeing how easy it was to install our simple SAN, the next necessary step was to allocate storage to more than one host in our SAN. Storage Manager for SANs provides the ability to do this from a single location.

When LUNs are created, they can be assigned to a specific host server, or left unassigned for later use. If the LUN is to be assigned to a specific server, then the wizard also provides the option to create and format a volume on that LUN for the desired server. If the LUN is not assigned, then the wizard skips the create and format LUN step.

In either case, Storage Manager for SANs provides all the information needed to manage the LUNs from its "LUN Management" selection. All the LUNs that have been allocated on the disk array are shown, including the server assignment. In addition, as various items are highlighted, additional details are shown in the lower portion of the screen, and appropriate action items are shown in right-side panel of the screen.

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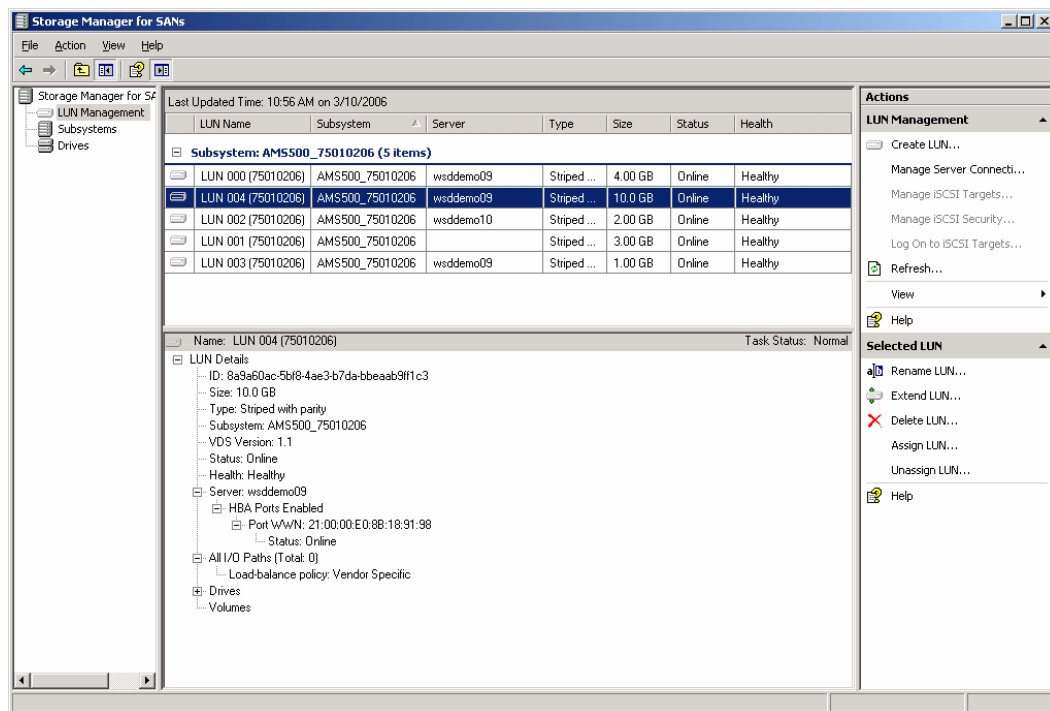
Storage Resource Management

A new component added to Windows Server 2003 R2 is the File Server Resource Manager (FSRM). This component of the operating system provides basic capacity, policy and quota management for the Windows environment.

Capacity Management

It is not uncommon in the small and medium-sized business to manage storage by simply buying more storage. FSRM provides a means to understand the storage capacity utilization on a server by providing information regarding duplicate files, least recently accessed files, most recently accessed files, large files, files by owner, and files by file group (type of file). This information can be obtained at the volume or file folder level, and can be obtained for directly-attached disk storage or SAN-attached disk storage.

The file group report can be particularly helpful in analyzing the amount of storage used by various file types. The pre-defined file types include audio and video files, backup files, compressed files, e-mail files, executable files, image files, office files, system files, temporary files, text files, and web pages files. In addition, custom file groups can be created based on any pattern either in the filename or file extension.

Some of the other reports can be customized based on a minimum size of files, the owner of the files, and the number of days since the file was last accessed.

Policy Management

The ability to set and enforce policies can help administrators control the type of data that is stored on servers. Certain file types can be limited to certain areas or completely forbidden, or can simply be monitored and logged for further review. Reasons for implementing these kinds of policies may be to limit legal exposure, or to force certain types of data onto specific storage volumes.

Quota Management

The ability to set and enforce quotas can help slow the growth of unnecessary data. This quota management can be "hard" or "soft", that is, can be strictly enforced or simply monitored for further review. Quotas can limit the size of a volume or directory, and can be used to help monitor the growth of particular portions of your storage environment.

Some pre-defined threshold templates are provided with FSRM, and custom thresholds can be created. Multiple thresholds can be set for notification of quota usage. For example, thresholds could be set at 70%, 80%, and 90% of quota, each of which would generate specific action such as logging the event, sending an email message, running a command or script, etc.

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Conclusion and Demartek Commentary

Microsoft and its storage partners have proven that SANs can be made simple to deploy and use. This is especially valuable in the small and medium-sized business environment.

Removing complexity is one of the goals that has been achieved by the Simple SAN program. For example, fibre channel switches that are used in Simple SAN solutions have a default configuration of "open zoning", meaning that all the switch ports may communicate with all other ports on that switch. This helps simplify the SAN deployment process and allows administrators to get up and running quickly without becoming SAN experts. Over time, as the administrators develop more sophisticated SAN management skills, they may choose to configure their SAN switches with other forms of SAN switch zoning that may become necessary.

Another goal that has been met by the Simple SAN program is for multiple vendors to work together to make the experience for the administrator much more seamless. One installation program may install software or drivers from multiple vendors. These combinations of software and drivers have been proven to work before they are made available to the customers.

When it comes to managing storage resources, the basic components that are provided with Windows Server 2003 R2, such as File Server Resource Manager (FSRM) and Storage Manager for SANs (SMfS), allow the administrator to perform basic storage management functions that for some time have only been available with the purchase of expensive applications. While these two components do not provide all the advanced functions of expensive storage management applications, they provide basic storage management functions that are suitable for small and medium-sized businesses at no additional charge. We believe that these kinds of basic, easy to use storage management functions should be provided with operating systems that are intended for use in today's small and medium-sized businesses, where administrators often have multiple areas of responsibility, with storage being only one of those areas.

By actually using these features, Demartek can state that Microsoft and its storage partners have achieved the goal of making SANs simple, and have provided solid storage management functions for the Microsoft Windows environment.

Microsoft recently acquired iSCSI target technology and plans to make this available for the Windows environment. This is a great complement to Microsoft's existing iSCSI initiator technology. Customers will be able to deploy complete, low-cost, end-to-end iSCSI solutions using Microsoft technology. These solutions will include the advanced storage features such as snapshots, multi-path, cluster support, LUN resizing, and others.

About Demartek

Demartek seeks to provide detailed feature and technical information about computer products, with an emphasis on business software applications and infrastructures for small, medium and large enterprises.

Dennis Martin is the principal analyst at Demartek, with more than 25 years experience in the computer industry. Dennis founded the Rocky Mountain Windows NT User Group in Denver, Colorado in June 1994, and served as its President until 2000. Dennis is a Microsoft Windows Server Storage MVP.