Microsoft® Windows Server™ 2003 R2

Deploying iSCSI Storage Solutions on the Microsoft® Windows Server™ Platform

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Abstract

In an effort to provide an improved experience for the growing iSCSI storage market, Microsoft and its storage partners have created various iSCSI target solutions for the Microsoft Windows Server environment. These solutions include iSCSI targets based on Microsoft's iSCSI target software and storage partner hardware, and iSCSI targets based on storage partner iSCSI target software and hardware. This paper provides an update on the state of iSCSI storage technology, specifics on several Microsoft storage partner solutions, including the deployment of each solution for specific solutions such as Microsoft Exchange, Microsoft SQL Server, Microsoft SharePoint Server and Microsoft Cluster Server (MSCS).

This report is designed for managers of IT departments and system administrators who are exploring the possible benefits of iSCSI storage solutions or who are looking for actual deployment examples of iSCSI storage solutions.

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Introduction

Internet SCSI (iSCSI) is an industry standard developed to enable transmission of SCSI block storage commands and data over an existing IP network by using the TCP/IP protocol. The encapsulated SCSI commands and data can be transmitted over a local area network (LAN) or a wide area network (WAN). As with traditional SCSI, an iSCSI storage solution requires at least one “initiator” residing on the application server and at least one “target” residing on the storage.

This report provides background on iSCSI technology and information on the current state of iSCSI storage solutions for the Microsoft Windows environment, focusing on the deployment of the iSCSI target solutions from some Microsoft storage partners. Some of these storage solutions are based on the Microsoft iSCSI software target and run on a Microsoft Windows-based platform. Some of these storage solutions are based on the storage partner’s own technology and run on a non-Microsoft platform. All these storage solutions provide storage for hosts that use the free-of-charge Microsoft iSCSI initiator.

Storage Solutions Deployed

The following iSCSI storage solutions were deployed for this report.

- Dell™ PowerVault™ NX1950 Networked Storage Solution
- EqualLogic® PS3800XV
- HDS TagmaStore™ AMS1000
- HP StorageWorks 1200 All-in-One Storage System
- LeftHand Networks® SAN/iQ®

The Dell solution is based on Microsoft Windows Unified Data Storage Server 2003. The HP solution is based on Microsoft Windows Storage Server 2003 R2 and the Microsoft Software iSCSI Target application pack. The EqualLogic, HDS and LeftHand Networks solutions are based on their own respective technology.

These iSCSI target storage solutions provide a variety of advanced storage features including hardware RAID, Multi-path I/O (MPIO), snapshot copy, replication, remote copy and others. Some include integration with Microsoft Volume Shadow Copy (VSS) and provide Microsoft Virtual Disk Service (VDS) providers.

Basic Storage Architectures

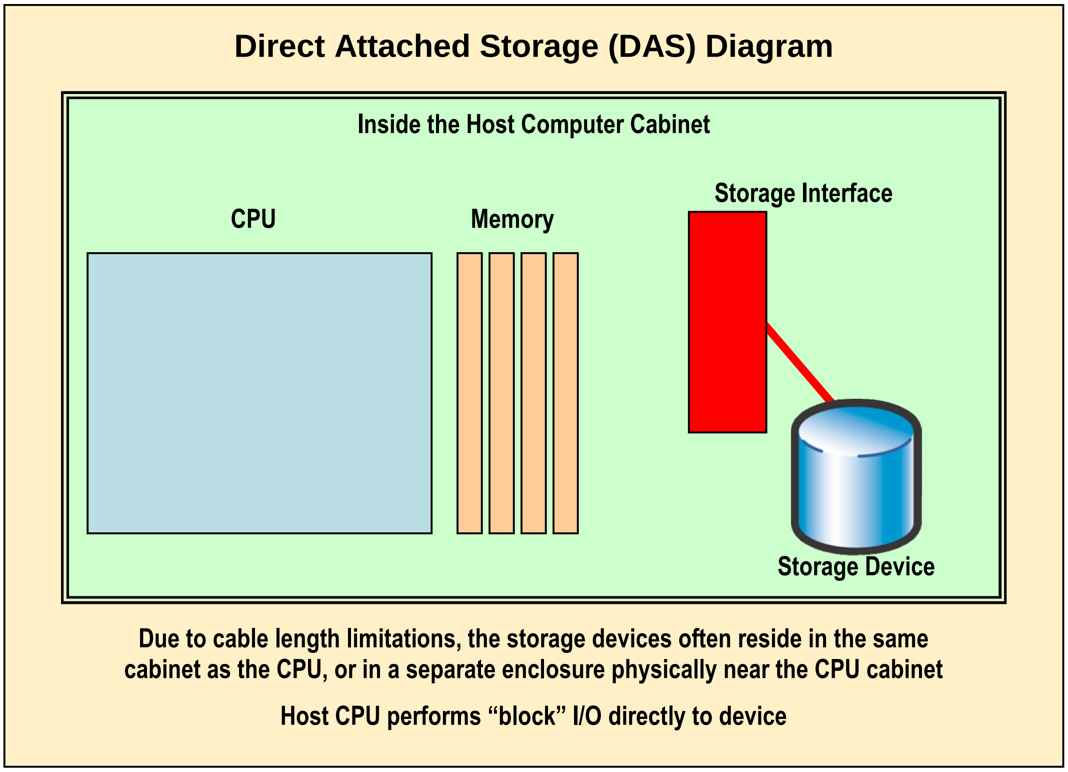
The two basic forms of storage for host computers are direct-attached storage (DAS) and networked storage. DAS is storage that is directly attached to a host computer and is generally privately owned by that computer. Networked storage is storage that is connected to a host computer via some sort of network, such as an Ethernet network or Fibre Channel network, and can take several forms, including variations of Storage Area Networks (SAN) and Network Attached Storage (NAS).

There are two basic forms of networked storage: the Storage Area Network (SAN) and Network-Attached Storage (NAS) and they are generally distinguished by their Input/Output (I/O) characteristics. SAN is generally used for applications that require “block” I/O access. NAS is generally used for applications that require “file” I/O access. An application that uses block I/O is any application that reads or writes its data blocks directly to the storage device or subsystem, such as a databases, email servers, or file systems themselves (such as NTFS). SAN storage devices appear to the applications the same way that DAS devices do, allowing applications to use what appear to be local storage devices. An application that uses file I/O is one that makes its read and write requests in the form of files, such as a network client reading and writing files from a file server. NAS devices typically appear as one or more network file shares to the applications and users. NAS devices are actually host servers themselves that internally use a DAS or SAN I/O connection, but share a “file-system” type of view of their storage resources to other hosts on the network.

The primary reasons for using any form of networked storage are to overcome the disadvantages of the DAS storage model. The various implementations of networked storage can allow the storage to be located potentially many miles from the host CPU requiring the storage and can scale to hundreds, thousands or even millions of storage devices. In addition, the networked storage model allows storage to be placed into a “pool” that is not necessarily owned by any one application client or server but can be shared among many applications or servers.

Direct-Attached Storage (DAS)

DAS is probably the most well-known form of computer storage. In a DAS implementation, the host computer has a private and usually exclusive channel between the host CPU and the storage device or devices, so that the host “owns” the storage. In this context, DAS storage has also been called “server-centric” or “silo” storage. Everything from personal computers to mainframe computers have used this implementation. Over the years, various interfaces have been used for this purpose, including IDE/ATA and SCSI. The advantage of DAS is that it is relatively simple to understand and implement. The disadvantages are that there is limitation to the number of devices that can be connected on the same interface, a relatively short distance between the host CPU and the storage device(s) due to cable length restrictions, and when larger storage devices are required the data must often be moved from the smaller device to the larger device, potentially consuming a large amount of time. In addition, many DAS storage architectures require that the host computer be taken offline when adding or removing storage devices. The DAS model doesn’t scale to large or distant environments very well. A server in this model doesn’t directly share its storage resources.



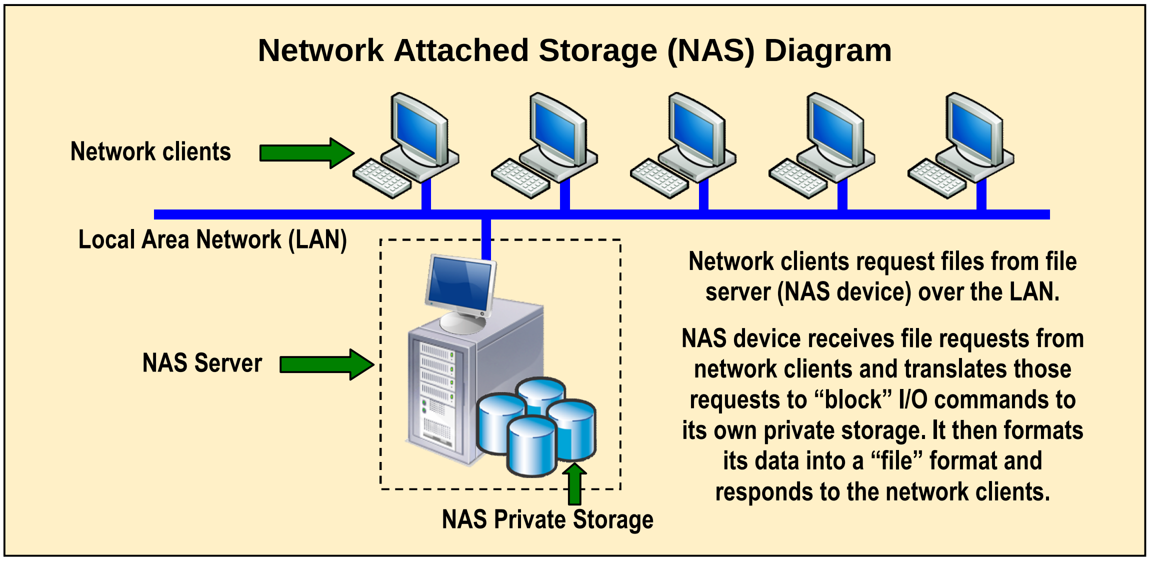
Direct Attached Storage (DAS) Diagram

Due to cable length limitations, the storage devices often reside in the same cabinet as the CPU, or in a separate enclosure physically near the CPU cabinet

Host CPU performs “block” I/O directly to device

Network-Attached Storage (NAS)

NAS devices share their storage resources with other clients on the network, in the form of file “shares.” The clients read and write files on the NAS server using either SMB/CIFS or NFS file protocols. The NAS device has its own storage and internally uses block I/O to store the data in its own internal format. NAS devices typically can have many file “shares” and can potentially be a great physical distance from the network clients.



Network Attached Storage (NAS) Diagram

Network clients request files from file server (NAS device) over the LAN.

NAS device receives file requests from network clients and translates those requests to “block” I/O commands to its own private storage. It then formats its data into a “file” format and responds to the network clients.

Storage Area Network (SAN)

SAN architecture, using “block” I/O, can be implemented over an Ethernet network or a Fibre Channel (FC) network, each having its own strengths and weaknesses.

Ethernet networks are ubiquitous, relatively inexpensive, and they offer a wide variety of choices of built-in, as well as peripheral network hardware solutions. The least expensive solutions use copper cabling and connections. Ethernet networks using TCP/IP protocol typically manage network traffic with software and frequent interrupts to the host computer.

By comparison, Fibre Channel networks tend to be more expensive, because they use dedicated fiber-optic technology, they are physically separate from the local Ethernet network, and they require specialized expertise. FC host bus adapters (HBAs), managed switches, and optical networks are dedicated to block level storage I/O. FC networks manage traffic using highly efficient hardware processing that offloads functionality from the host CPU.

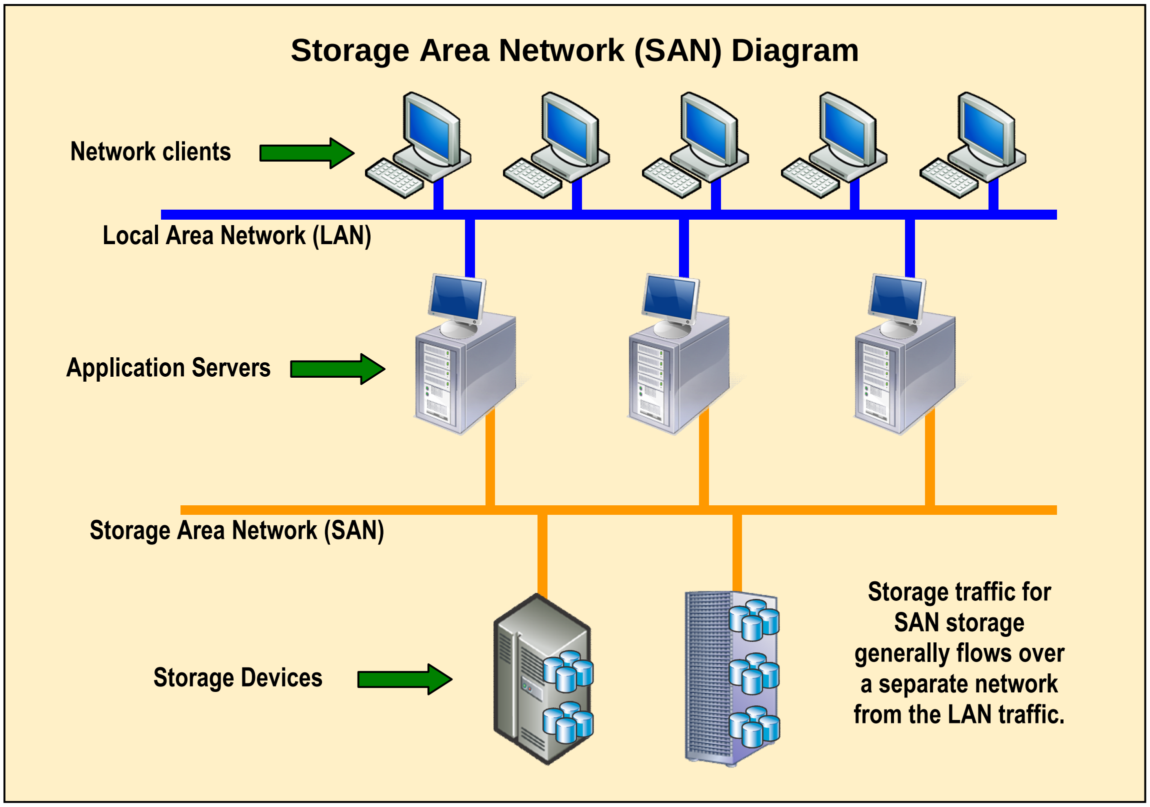
SAN architectures use block SCSI protocol for sending and receiving storage data over their respective networks. Fibre Channel (FC) SANs implement the SCSI protocol within the FC frames. Internet SCSI (iSCSI) SANs implement the same SCSI protocol within TCP/IP packets. Because both technologies allow applications to access storage using the same SCSI command protocol, it is possible to use both technologies in the same enterprise, or move from one to the other.

For the larger enterprises that have implemented SAN technology, most have implemented Fibre Channel technology. These enterprises typically demand proven technology, have the need for high bandwidth storage solutions, have the budgets to pay for more expensive hardware to meet their performance and reliability needs, and typically have full-time staff dedicated to storage management.

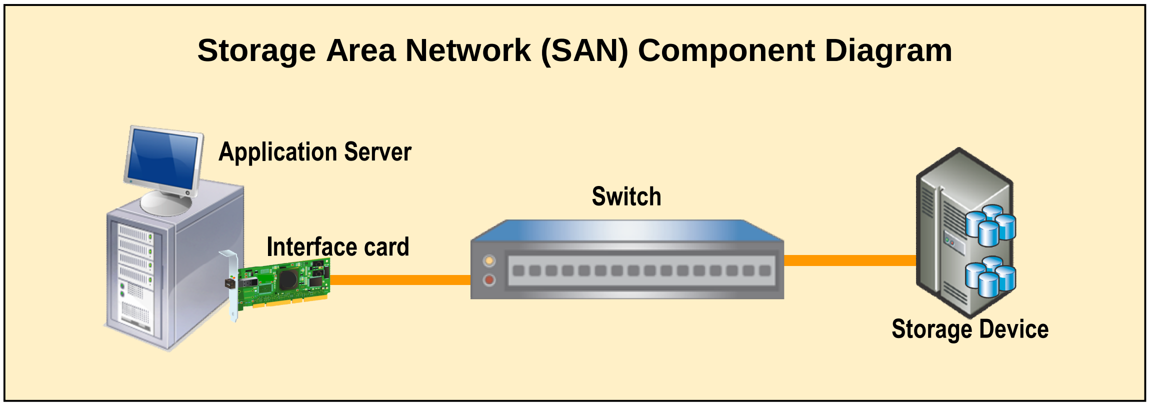
Some organizations have implemented only Fibre Channel SANs into production use. Some organizations have implemented only iSCSI SANs into production use. Some organizations have chosen to implement Fibre Channel SANs and iSCSI SANs. An iSCSI connection can be used to bridge a server into a Fibre Channel SAN. In many cases, iSCSI SANs can be deployed more quickly than Fibre Channel SANs.

Many disk storage solutions available today offer both Fiber Channel and iSCSI interfaces into the same disk subsystem. Many iSCSI-only solutions use the same high-end components in the disk subsystem as the Fibre Channel-only solutions. These design and implementation factors reduce or eliminate concerns about performance and reliability of iSCSI storage solutions.

IP-based SAN technology such as iSCSI has not yet been deployed as widely as Fibre Channel SAN technology, in part, because it is a newer technology. But iSCSI SAN technology has been proven to work reliably, provide excellent performance, and is a cost-effective choice for many storage environments.


Storage Area Network (SAN) Diagram
Network clients
Local Area Network (LAN)
Application Servers
Storage Area Network (SAN)
Storage Devices
Storage traffic for SAN storage generally flows over a separate network from the LAN traffic.

A typical SAN environment consists of one or more application servers, one or more storage devices, a switch between the servers and the storage, the appropriate external hardware interface in the application server, and appropriate cabling.



The components of an iSCSI SAN are equivalent in concept to those found in a Fibre Channel SAN, but typically are less expensive. However, there is a reason for the difference in price of the hardware components. Fibre Channel switches and host bus adapters almost always use managed switches and fiber optic technology including cables, connectors, transceivers, etc., which are more expensive than the typical copper-based technology found in Category 5, 5e, or 6 Ethernet cables, standard NIC cards and unmanaged Ethernet switches. The price differences begin to diminish when comparing fully managed fiber-optic Ethernet and Fibre Channel environments. The line rates found in the Fibre Channel environments are 1, 2, and 4 Gbps. The line rates found in typical Ethernet environments are 1 Gbps or less.

When comparing costs of Fibre Channel and iSCSI storage solutions, it is important to include advanced storage and management functions in the calculations. Many of the iSCSI solutions have done a good job of simplifying common functions such as LUN provisioning and provide advanced storage and management functions in the solution for less cost than other types of solutions.

Unified Storage

Unified Storage is the concept of combining the technologies used in Fibre Channel SANs and/or iSCSI SANs with Network-Attached Storage (NAS) into a single, integrated storage solution. The solutions provide both block and file access to the shared storage environment. This type of storage solution can provide simplified management by combining the management of all storage regardless of the transport or “plumbing” into a single management console. Unified storage solutions often also provide advanced storage capabilities including replication functions, storage resource management, clustering and more.

10-Gigabit Ethernet Technology

10-Gigabit Ethernet (10 GbE) technology promises to deliver increased speed and a unified approach to networking, clustering and storage applications. Current deployments of 10-Gigabit Ethernet are found in server clustering and network-trunking applications, and many 10-Gigabit Ethernet switches available today also support 1-Gigabit connections into the same switch. Fiber-optic technology is used for these applications, as copper-based technology for 10-Gigabit Ethernet is still relatively new. The price ratio between 10-Gigabit Ethernet technology and 1-Gigabit Ethernet technology is dropping, but currently 10-Gigabit Ethernet technology remains priced too high for many organizations.

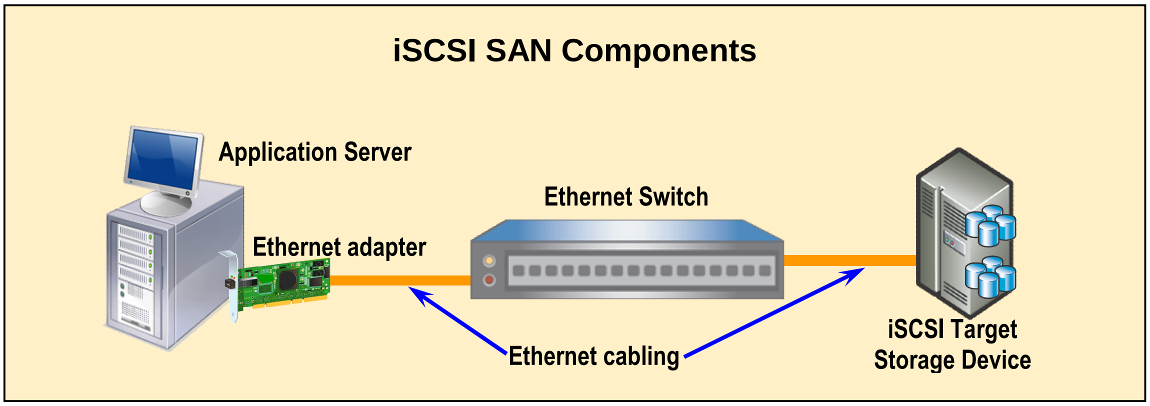
The PCI-Express (PCIe) bus has the bandwidth to handle the new high-speed interconnect technologies, including 10-Gigabit Ethernet technology. As PCI-Express becomes more common in servers and desktop computers, and prices continue to drop for high-speed offload adapters and other devices, 10-Gigabit Ethernet technology may begin to become cost-effective for more common use in iSCSI SANs over the next 12 – 24 months.

iSCSI Technology

Internet SCSI (iSCSI) is the combining of the SCSI command protocol that storage devices use with a TCP/IP network as the transport mechanism in order to provide “block” storage connectivity over an existing network. The iSCSI technology is implemented as a layer above the TCP layer in the TCP/IP protocol stack. Using the SCSI nomenclature of initiator and target, a host server would be the iSCSI initiator and a logical storage device or subsystem would be the iSCSI target. The iSCSI target can be implemented in hardware or software.

Once the connection is established between the iSCSI initiator and the iSCSI target, the operating system on the iSCSI initiator sees the storage as a local storage device that can be formatted, read and written in the usual manner. For example, Windows “Disk Management” sees disk volumes the same way whether they are connected via iSCSI or connected via more traditional means. Some restrictions on the iSCSI initiator are listed on page 19.

The iSCSI hardware and software components comprise an iSCSI storage area network (SAN). Hardware components required to implement iSCSI include a network adapter, a network switch, and an iSCSI target storage device or subsystem. The network adapter used for iSCSI traffic can be the same adapter used for traditional network traffic, but in many cases one or more separate adapters are used for iSCSI traffic. Software components required to implement iSCSI include iSCSI initiator software.



Because Ethernet infrastructure already exists in many environments, adding iSCSI components to an existing Ethernet infrastructure can be relatively inexpensive. Typically the management expertise and Ethernet network infrastructure (network switches and cabling) is already in place in most organizations.

Best practices for iSCSI SANs are to separate iSCSI storage traffic normal LAN traffic through the use of virtual LAN technology or by deploying iSCSI traffic to a physically separate network. This is because adding iSCSI traffic to existing LAN traffic may cause degraded overall network performance due to the different nature of iSCSI storage traffic.

Hardware requirements for iSCSI include a Gigabit Ethernet adapter in the host server connected to a Gigabit Ethernet switch. The iSCSI target storage device must also be connected to the Gigabit Ethernet switch.

As many environments have already moved to a Gigabit Ethernet infrastructure for their basic networking needs, iSCSI can be added for no additional hardware costs. For those who do not have a Gigabit Ethernet infrastructure, it can be created relatively inexpensively. Low-end, unmanaged, five-port Gigabit Ethernet switches are available for less than $100 today. Low-end, unmanaged, eight-port Gigabit Ethernet switches are available today for less than $200. Some unmanaged 16-port and 24-port Gigabit Ethernet switches are available today for less than $300. Category 5E or category 6 cabling is recommended for Gigabit Ethernet networks, which is present in many environments. Most of the newer servers have onboard Gigabit Ethernet network interfaces. Simple Gigabit Ethernet Network Interface Cards (NICs) are widely available for less than $50 and specialized, dual-port, server Gigabit Ethernet NICs with advanced networking features are available for less than $200.

Best practice for iSCSI is to use enterprise class, managed switches that support jumbo frames. Enterprise switches are generally designed to be used in higher-traffic networks and are better choices than low-cost switches for iSCSI traffic.

Some switches are designed with “oversubscription,” which is a design that takes advantage of the fact that average utilization of Ethernet links tends to be significantly less than full-bandwidth. As such, these switches cannot run at full-bandwidth on all ports at the same time. Care must be taken when deploying iSCSI traffic on this type of switch so that the switch is not oversubscribed.

Because iSCSI runs over standard Ethernet networks, there is virtually no distance limitation in the basic technology. Wide Area Networks (WANs) can be used to implement iSCSI technology, and iSCSI technology can be used to bring a remote or “stranded” server into an existing storage infrastructure. However, many applications and operating systems do not have a high tolerance for latency, so response time on storage devices should be considered. It is possible that a very large distance (thousands of miles) may generate a response time that is unacceptable. Some iSCSI storage providers recommend a network latency of less than 5 milliseconds, resulting in a distance of approximately 100 kilometers.

Initiators

Microsoft provides a free iSCSI software initiator, which can be downloaded from the Microsoft web site. There are other iSCSI initiators available, but this report will only discuss the Microsoft iSCSI software initiator. The focus of this report is primarily on iSCSI targets.

The iSCSI initiator works in combination with the network adapter. There are four basic combinations of iSCSI initiators and network adapters available today. Varying degrees of processing can be offloaded to the adapter hardware, depending on the type of network adapter deployed. These combinations of iSCSI initiator and network adapter are:

- Software iSCSI initiator with standard network card
- Software iSCSI initiator with advanced network card that supports Receive-side Scaling
- Software iSCSI initiator with network card that includes a TCP/IP Offload Engine (TOE)
- Hardware iSCSI host bus adapter (HBA) that provides offloaded TCP/IP and iSCSI processing.

The performance aspects of these types of iSCSI initiators are discussed below in the iSCSI performance section. The hardware iSCSI HBAs were not tested for this report but they do help to optimize CPU utilization in servers.

Targets

There are a variety of iSCSI target solutions available. One way to organize iSCSI target solutions is by the underlying technology. Some of these solutions are based on the Microsoft iSCSI target software and run on a Microsoft Windows Server platform. Other solutions run on a non-Microsoft platform. Some specific examples are discussed in further detail in subsequent sections of this document. Target solutions are available in a wide variety of storage capacities, performance levels, and prices.

Multi-Path I/O

Microsoft MPIO is supported with iSCSI Storage Area Networks as well as Fibre Channel and Serial Attached SCSI (SAS) storage. Microsoft includes a Microsoft iSCSI Device Specific Module (DSM) with the Microsoft iSCSI Software Initiator which supports many arrays and allows the creation of multiple paths for failover and load balancing. Storage array vendors can also license the Microsoft MPIO DDK from Microsoft and implement their own DSMs specific allowing their storage to interface to the Microsoft MPIO core driver stack. The Microsoft iSCSI initiator can be installed with Microsoft MPIO, the same MPIO that is available for other types of storage. Multi-path I/O provides the benefits of fail-over if a path fails and load balancing across multiple active paths to increase throughput.

It is important to note that when using multi-path I/O for iSCSI storage solutions, both the iSCSI initiator and the iSCSI target need to support MPIO. Each network adapter and its associated ports in the iSCSI initiator and iSCSI target should have identical features to insure consistent performance. The iSCSI DSM implements several load balance policies designed for different link performance metrics.

Management of iSCSI

The iSCSI solutions discussed in this report are managed using the Microsoft iSCSI initiator. The storage volumes can be managed using standard Windows tools such as “Disk Management”. In addition, most iSCSI target storage solutions provide Microsoft VSS and VDS hardware providers and can be managed with Microsoft Storage Manager for SANs (SMfS), which is available in Windows Server 2003 R2.

Storage Performance and iSCSI

General Performance Comments

One of the concerns about iSCSI is the overall performance of the solution, including the load on the host CPU, the iSCSI target performance, and the Ethernet network performance, especially during periods of heavy I/O. Although this report is not intended to be an exhaustive performance benchmark, some of these performance issues will be discussed.

iSCSI solutions are a blend of traditional network and traditional storage technologies, and most of the iSCSI storage solutions are pre-configured to provide good overall network and storage performance. Administrators may choose to fine-tune various advanced network and storage settings for additional performance or configuration purposes.

The implementations discussed for the various iSCSI target solutions were intentionally disparate to illustrate the variety of ways in which iSCSI targets can be deployed and the configurations discussed for individual products were not necessarily optimized for performance. As a result, the performance of the iSCSI target solutions varied widely, due to the variety of designs and components used. These storage solutions used a variety of storage devices, including SATA disk drives, SCSI (parallel) and SAS disk drives. The disk drives spun at various RPM including 7200, 10K and 15K RPM. Each storage array had a different number of disk drives in the array. Different RAID stripe sizes were used with different arrays. Various disk subsystem caching designs were used, not all of which have been publicly disclosed.

Basic I/O tests were performed with IOMeter, an open-source I/O load generator. The same group of block sizes and I/O patterns was tested with each iSCSI target solution; however the queue depth was varied as an additional data point. Some of the iSCSI target solutions supported multi-path I/O, and where possible, multiple paths were used. The deployment scenarios outlined below include up to 2 sessions. Although the purpose of these tests and this report is not to be a head-to-head performance comparison of the iSCSI target solutions, performance was measured in order to provide some general reference points for the expected performance range of iSCSI target solutions. Some interesting reference points comparing various types of network adapters in the host servers (iSCSI initiators) were also made. The IOMeter test results for each iSCSI target solution are included in their respective sections. Readers should take notice that IOMeter testing is by no mean a substitute for workload testing and modeling. In addition, tools from Microsoft such as LoadSim for Microsoft Exchange and SQLIO and SQLIOSim for SQL Server can be used to test how an iSCSI initiator and target respond for those particular applications.

IMPORTANT NOTE: the iSCSI targets presented in this white paper are different in class, price, and disk I/O characteristics, so head-to-head comparison of the iSCSI targets in the context of this report is not possible. In addition, the tests were run with different parameters to emphasize that this report is not a benchmark report.

Improving iSCSI Storage Performance

Performance improvements for iSCSI solutions can be determined by measuring either the increase in absolute network throughput or the reduction in system resources such as CPU utilization. Benefits may vary depending on the applications. Application performance improvements may depend on the network packet size and/or storage block size in use.

There are several areas that can be adjusted to improve iSCSI initiator performance on Microsoft Windows host platforms. It should be noted that several of these items listed below will improve general network performance as well as iSCSI initiator storage performance.

- Network Infrastructure Settings
- Microsoft Scalable Networking Pack
- Receive-side Scaling
- TCP Offload adapters
- Full iSCSI Host Bus Adapters (HBA)

Network Infrastructure Settings

Many network cards have various feature settings that can improve performance. Not all of these features are available on all network adapters. Jumbo Frames, TCP Checksum Offload and Large Send Offload can be enabled to improve performance. Windows Server 2003 is the first Windows platform that supports network adapters that include hardware TCP Checksum Offload and Large Send Offload features.

In the case of Microsoft Windows Server-based iSCSI target solutions, the network interface adapter settings should be examined on both the iSCSI initiator and the iSCSI target solution. It may be possible to have one side of the iSCSI communication highly optimized and the other side not optimized, resulting in reduced performance. The network features discussed in this section should be examined on the iSCSI initiator and, where possible, the iSCSI target. Implementations and impacts of these features on the iSCSI target may vary.

Network switches should have Jumbo Frames enabled. Flow control may also need to be enabled in the switch and network adapters if there is heavy network congestion. Enterprise switches are generally designed to be used in higher-traffic networks and are better choices than low-cost switches for iSCSI traffic.

Microsoft Scalable Networking Pack

With the gaining popularity of multi-core and multi-processor systems, deployment of the Microsoft Scalable Networking Pack with advanced, server-class network adapters is highly recommended.

Microsoft makes the Scalable Networking Pack (SNP) available as a free download for Microsoft Windows 2003 Server (32-bit and 64-bit) and for Windows XP 64-bit platforms. It is also an integrated component within Windows Server 2003 R2 Service Pack 2. This package provides new and improved network acceleration and compatibility with hardware-based offload technologies. Three technologies included in the Scalable Networking Pack help optimize server performance when processing network traffic. Because iSCSI uses the network, it can take advantage of these technologies. These technologies are Receive-side Scaling, TCP Offload, and NetDMA. NetDMA was not tested for this report.

Receive-side Scaling

Receive-side scaling is especially important in multi-core and multi-processor systems because of the architecture of the NDIS 5.1 miniport drivers. Without the SNP and Receive-side Scaling, multi-processor and multi-core Windows 2003 Server systems route all incoming network traffic interrupts to exactly one processor core, resulting in limited scalability, regardless of the number of processors or processor cores in the system. With SNP and Receive-side Scaling and the NDIS 5.2 miniport driver, incoming network traffic interrupts are distributed among the processors and processor cores on the computer. Receive-side Scaling-capable network adapters are now available, and are required to take advantage of this feature. Support for this feature is currently found in some, but not all server-class network adapters.

The Scalable Networking Pack monitors network adapters for Receive-side Scaling capabilities. If a network adapter supports Receive-side Scaling, the Scalable Networking Pack uses this capability across all TCP connections, including connections that are offloaded through TCP Offload.

TCP Offload Adapters

TCP Chimney is the Microsoft Windows Server term for offloading the TCP protocol stack into network interface adapters. Network adapters that support this feature are also known as TCP/IP Offload Engines (TOE). TCP Chimney is an operating system interface to advanced Ethernet network adapters that can completely manage TCP data transfer, including acknowledgement processing and TCP segmentation and reassembly.

Full iSCSI Host Bus Adapters (HBA)

Another approach to use for offloading CPU processing cycles is to combine the iSCSI initiator and the full TCP processing onto one adapter card and perform all these functions in hardware. This work performed for this report used the Microsoft iSCSI software initiator for all examples, so iSCSI HBAs were not used, but many models are supported on Windows Servers.

Performance Result Summary by Initiator Network Adapter Type

Although this report is not a full performance benchmark, several performance measurements were taken using various network adapters with the same I/O workloads.

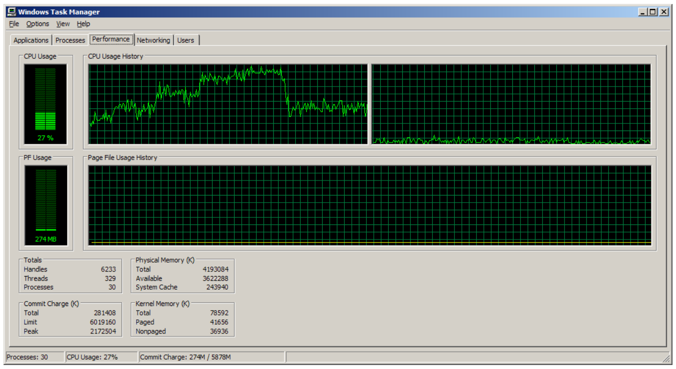
Ethernet network adapters are one important component of an iSCSI storage solution. **It should be noted that best practices recommend that a true server-class network adapter should be used for iSCSI storage applications.** The low-cost network adapter listed below that was used in these tests is not a true server-class network adapter, but was used only as a point of reference. This truly shows the importance of server-class network adapters in iSCSI deployments.

Three different types of Gigabit Ethernet network adapters were used for these tests. Two low-cost network adapters were deployed, each with one port. The advanced network adapter and the TCP Offload adapter are dual-port, server-class network adapters. The low-cost network adapters used in this report are available for the least cost, **but are not recommended for iSCSI storage solutions**. The advanced network adapters are available for a mid-range price. The TCP Offload adapters are, by comparison, more expensive. The three types of network adapters used in the Demartek lab were:

- Low-cost network adapter: *NetGear® GA-311*
- Advanced network adapter supporting Receive-side Scaling: *Intel® Pro/1000 PT*
- TCP Offload network adapter: *Alacritech® SEN2002XT*

The CPU usage on the dual-core, single processor server using the low-cost network adapter, without the Scalable Networking Pack was significantly skewed toward the first core with very little activity on the second core, especially during read operations. When SNP was installed and the advanced network adapter and the TCP Offload adapter were each used, the dual-core processor server exhibited a lower and more evenly balanced CPU utilization. The following Task Manager snapshots highlight the differences for light to moderate workloads using a mid-range iSCSI target solution.

Dual-core server with
low-cost network adapter



Totals
Handles 6233
Threads 329
Processes 30

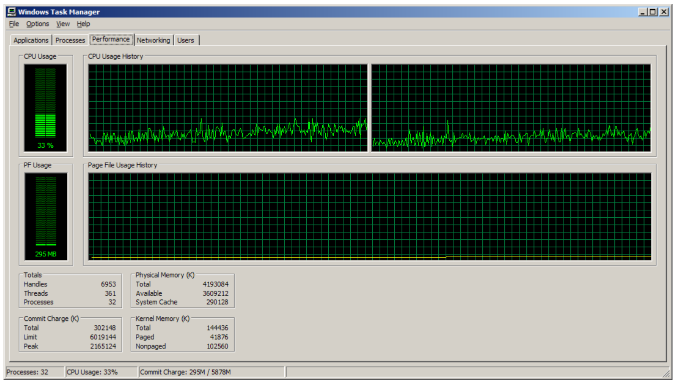
Physical Memory (K)
Total 4193084
Available 3622288
System Cache 243940

Commit Charge (K)
Total 281408
Limit 6019160
Peak 2172504

Kernel Memory (K)
Total 78592
Paged 41656
Nonpaged 36936

Processes: 30 | CPU Usage: 27% | Commit Charge: 274M / 5878M

Dual-core server with
SNP and Receive-side Scaling
server-class network adapter



Totals
Handles 6953
Threads 361
Processes 32

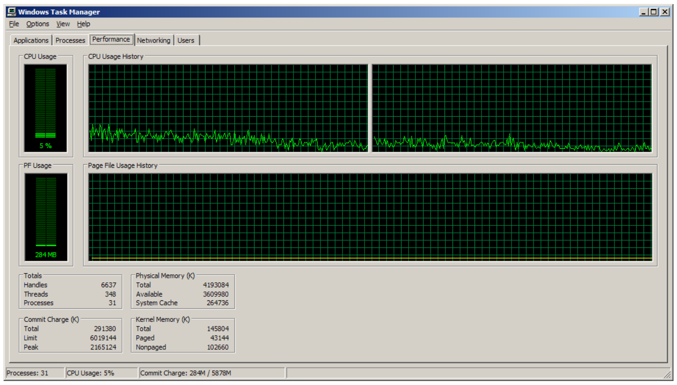
Physical Memory (K)
Total 4193084
Available 3609212
System Cache 290128

Commit Charge (K)
Total 302148
Limit 6019144
Peak 2165124

Kernel Memory (K)
Total 144436
Paged 41876
Nonpaged 102560

Processes: 32 | CPU Usage: 33% | Commit Charge: 295M / 5878M

Dual-core server with
SNP and TCP Offload
server-class network adapter



Totals
Handles 6637
Threads 348
Processes 31

Physical Memory (K)
Total 4193084
Available 3609980
System Cache 264736

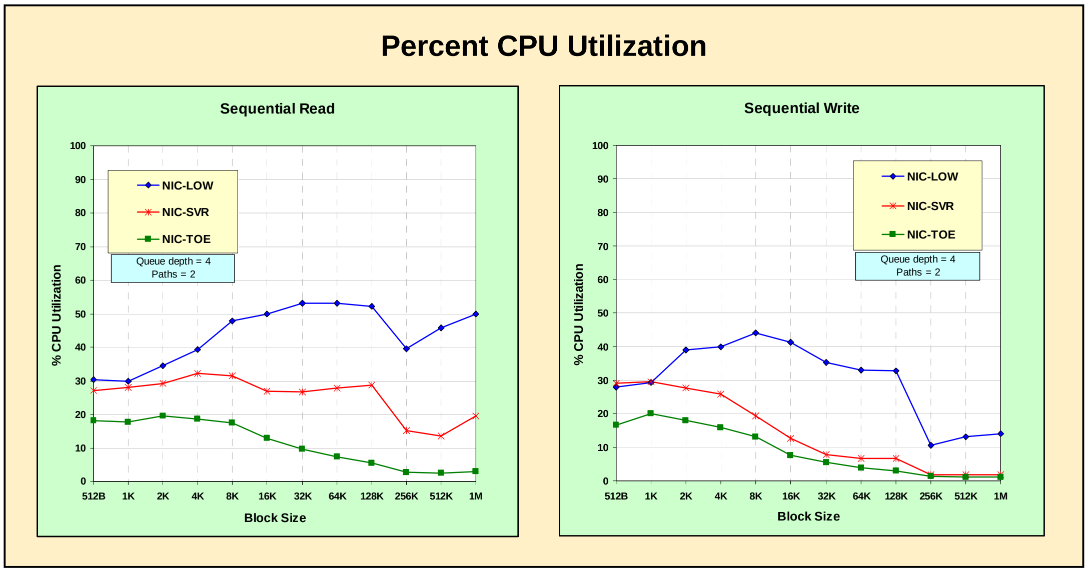
Commit Charge (K)
Total 291380
Limit 6019144
Peak 2165124

Kernel Memory (K)
Total 145804
Paged 43144
Nonpaged 102660

Processes: 31 | CPU Usage: 5% | Commit Charge: 284M / 5878M

The differences between server-class network adapters and low-cost network adapters became obvious during our tests. We found that under heavy workloads with a high-performance iSCSI target solution, the low-cost network adapter configuration became unacceptably slow, fully utilizing the processor and locking out other processes on the server including mouse and keyboard controls. The same workloads using the advanced network adapter and the TCP Offload adapter, which are server-class network adapters, completed the workloads in the expected time and did not lock out other processes.

The charts below show a representative sample of percentage of CPU utilization for the three types of network adapters. Two paths, using MPIO, were used for this sample.



Percent CPU Utilization

Sequential Read

Sequential Write

Network adapter legend:

- NIC-LOW: low cost network adapter
- NIC-SVR: advanced server-class network adapter supporting Receive-side Scaling
- NIC-TOE: TCP Offload adapter supporting TCP/IP Offload Engine

Performance will vary depending on many factors, including number of processors and processor cores in the application server, amount of memory in the application server, network adapter type, specific network adapter features that are enabled, and the iSCSI target storage system characteristics.

Deployment Examples

Deployment Environment

The deployment took place at a lab at Microsoft headquarters and at a lab at Demartek headquarters. The equipment at each location was similar.

Servers

Two host servers were used at each location. Windows 2003 Server R2 Enterprise x64 Edition was installed on all the application servers.

	Microsoft		**Demartek**	
	Server A	**Server B**	**Server A**	**Server B**
Processor	Single Xeon 2.8 GHz	Dual Xeon 3.0 GHz	Pentium D 3.4 GHz	Pentium D 3.4 GHz
Cores	1	1 each	2	2
Memory	1 GB	1 GB	4 GB	4 GB

Network Adapters

The network adapters used in the Microsoft lab servers were standard server-class network adapters. At the Demartek lab, three different types of network adapters were used, including the standard network adapters, advanced server-class network adapters and TCP Offload server-class network adapters.

Network Switches

Both labs used Gigabit switches. The Microsoft lab used a NetGear GS108 unmanaged, 8-port switch. The Demartek lab used a NetGear GS724T smart-switch with 24 ports. Jumbo frames were enabled on the GS724T switch.

Deployment Processes

The deployment processes for this report were broken into several main steps.

- Application Host configuration steps
- Storage Solution configuration steps
- Run applications to use the iSCSI storage
- Additional host configuration steps

In addition, special application scenarios were performed, including:

- Configure Microsoft Exchange 2003 to use iSCSI storage
- Configure Microsoft SQL Server 2005 to use iSCSI storage
- Configure Microsoft Cluster Server to use iSCSI storage

Application Host Configuration Steps

The initial steps used to configure the application host servers were:

- Install fresh copy of Windows Server 2003 R2 Enterprise x64 Edition

- Install Microsoft iSCSI initiator
- Configure Microsoft iSCSI initiator

Storage Solution Configuration Steps

The iSCSI storage solution configuration was separated into the steps necessary on the iSCSI target (storage solution itself) and the steps needed on the iSCSI initiator (application server). The general steps for configuring the iSCSI storage are outlined below, including some optional steps. Each specific iSCSI storage solution configuration follows this general outline, but the exact steps required varied slightly for each iSCSI storage solution. A separate section of this report is devoted to each iSCSI storage solution configuration, including screen shots taken during the deployment.

Target Configuration Steps

1. Configure network settings for iSCSI target device
2. Launch management console
3. Create LUNs on disk array
4. Make LUNs ready for use (formatting, etc.)
5. Create iSCSI Targets
6. Optional – Configure multi-path I/O for iSCSI Targets
7. Optional – Configure security for iSCSI Targets (CHAP, etc.)
8. Make iSCSI Targets ready for use for iSCSI Initiators (virtual disks, etc.)

Initiator Configuration Steps

1. Optional – Configure multi-path I/O from application host (iSCSI initiator)

Run Applications to Use the iSCSI Storage

Applications were used to read and write to the iSCSI storage, including basic Windows management functions such as Disk Manager.

In addition, IOMeter was used to read and write various block sizes to the iSCSI storage. IOMeter is an open-source I/O load generator and performance analysis tool. IOMeter is available from Source Forge at: http://sourceforge.net/projects/iometer/.

Although this report is not a performance benchmark for iSCSI storage solutions, some performance data are included to provide a general idea of the type of performance that can be expected with some iSCSI storage solutions. Two different lab locations and two different sets of servers were used for the deployments described in this document.

Application Host Configuration Steps

The following steps were used to initially configure each of the application hosts. These hosts became the iSCSI initiators.

Install Microsoft Windows 2003 Server R2 Enterprise x64 Edition

Each host was configured by installing Microsoft Windows 2003 Server R2 Enterprise x64 Edition. This particular version was installed so that all possible memory and clustering options could be explored. All the required security updates were installed after installing the base operating system.

The Microsoft iSCSI initiator can be installed on the following Microsoft Windows platform families

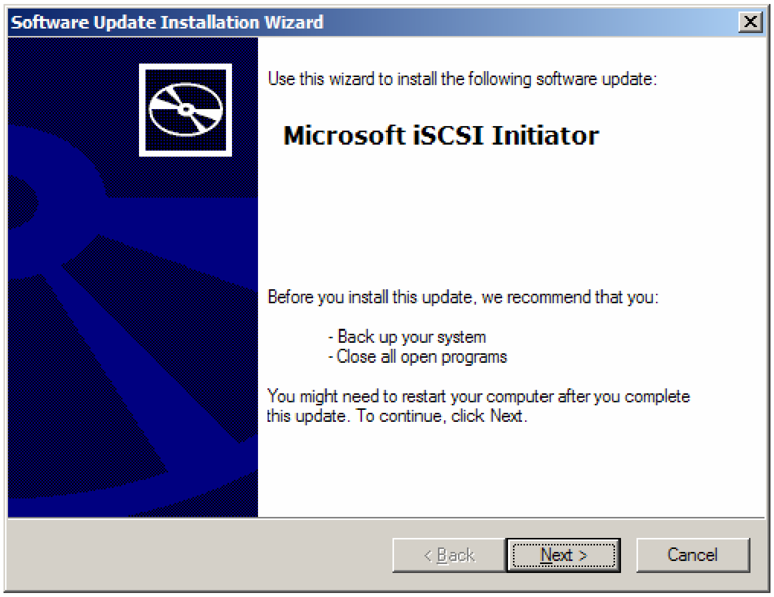
- Microsoft Windows Server 2000 SP4 or later
- Microsoft Windows XP Professional (32-bit or 64-bit)
- Microsoft Windows 2003 Server (32-bit or 64-bit) – Service Pack 1 or higher is recommended

Beginning with Microsoft Windows Vista and the next release of Windows Server, the Microsoft iSCSI initiator is pre-installed.

Install Microsoft iSCSI Initiator

The Microsoft iSCSI initiator is a free download from the Microsoft web site. There are versions for x86 (32-bit), x64 (AMD64 and Intel EM64T) and IA64 (Intel Itanium) processors. Version 2.03 of the iSCSI initiator was used on all hosts for this report.

The iSCSI initiator installation process is the same relatively simple process for all the application hosts, and is wizard-based.



Use this wizard to install the following software update:

Microsoft iSCSI Initiator

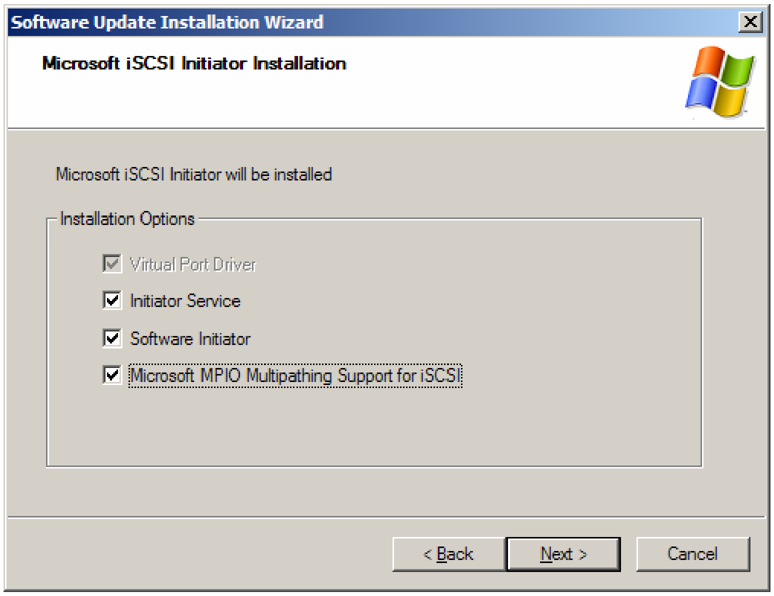
Before you install this update, we recommend that you:

- Back up your system
- Close all open programs

You might need to restart your computer after you complete this update. To continue, click Next.

By default, the “Initiator Service” and “Software Initiator” features are checked. By default, the Microsoft MPIO multi-pathing feature is not checked. All the installations for this report used the MPIO feature and so this item was checked during installation.

If MPIO is not selected at installation, but desired later, the installer must be run again and the MPIO option selected. Beginning with Microsoft Windows Vista and the next release of Windows Server, MPIO is a feature that can be selected without re-installing.



Software Update Installation Wizard

Microsoft iSCSI Initiator Installation

Microsoft iSCSI Initiator will be installed

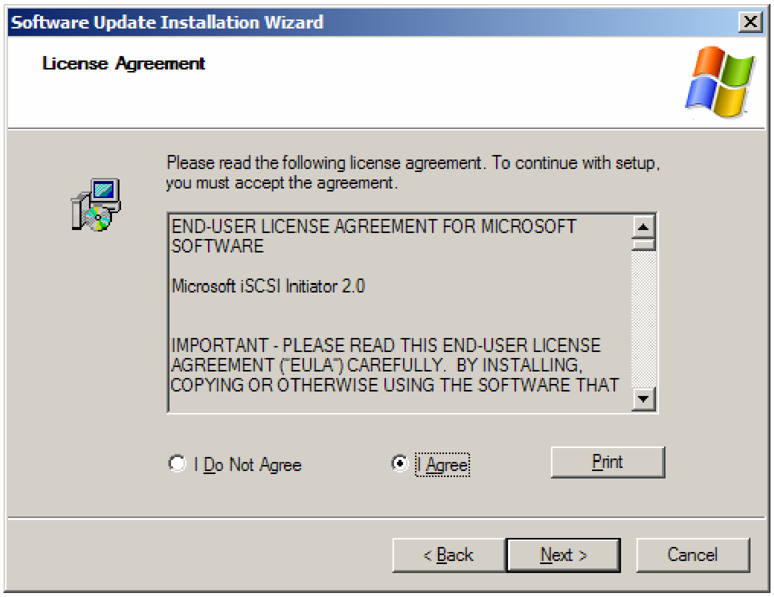
Installation Options

☑ Virtual Port Driver

☑ Initiator Service

☑ Software Initiator

☑ Microsoft MPIO Multipathing Support for iSCSI



Software Update Installation Wizard

License Agreement

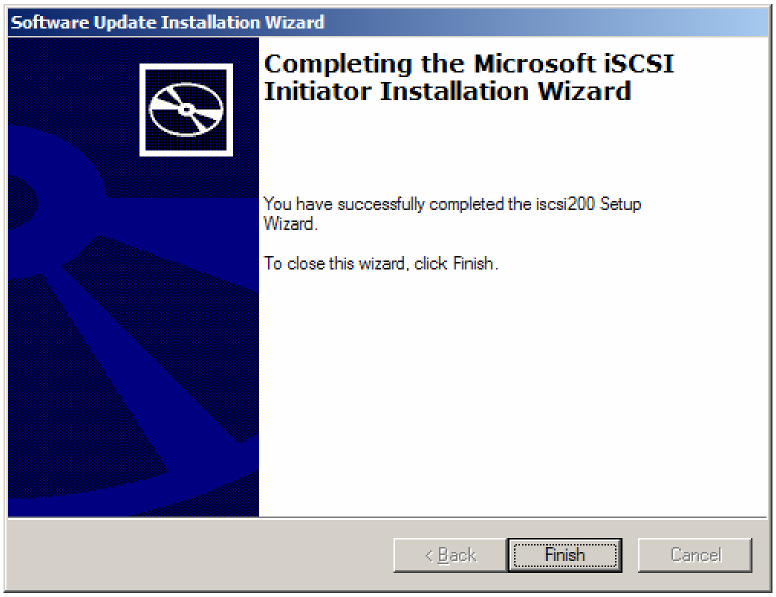
Please read the following license agreement. To continue with setup, you must accept the agreement.

END-USER LICENSE AGREEMENT FOR MICROSOFT SOFTWARE

Microsoft iSCSI Initiator 2.0

IMPORTANT - PLEASE READ THIS END-USER LICENSE AGREEMENT ("EULA") CAREFULLY. BY INSTALLING, COPYING OR OTHERWISE USING THE SOFTWARE THAT

○ I Do Not Agree ● I Agree



Completing the Microsoft iSCSI Initiator Installation Wizard

You have successfully completed the iscsi200 Setup Wizard.

To close this wizard, click Finish.

A command-line utility, "iSCSIcli" is also installed that can be used to configure connections to iSCSI targets from the Windows Server host.

The release notes and user guide are installed onto the local host when the iSCSI initiator is installed. A few items from the release notes are worth mentioning here. Some of the restrictions listed here may change in future releases.

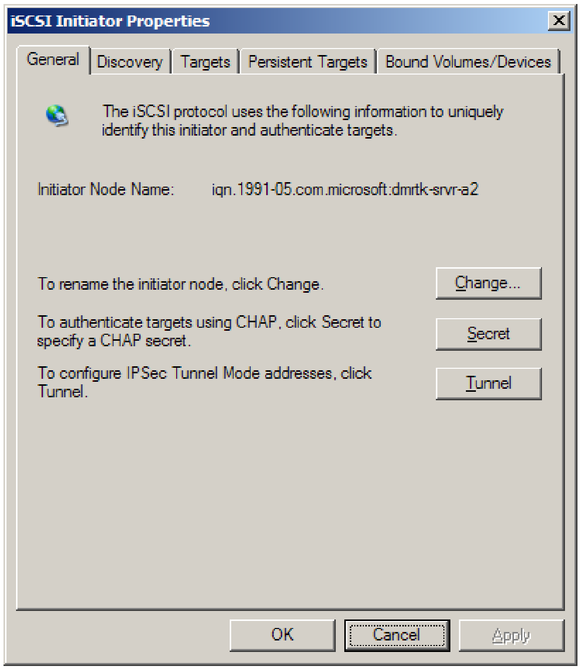
- Dynamic disks on an iSCSI session are not supported. With Windows Vista and Windows Server Codename "Longhorn", Dynamic Volumes are supported; however for best performance and redundancy, it is recommended that customers use basic disks or volumes in Windows combined with hardware RAID available in the storage arrays.
- Note that the default iSCSI node name is generated from the Windows computer name. If the Windows computer name contains a character that would be invalid within an iSCSI node name, such as '_', then the Microsoft iSCSI Initiator service will convert the invalid character to '-'.
- Both initiator and target CHAP secrets should be greater than or equal to 12 bytes, and less than or equal to 16 bytes if IPSec is not being used. It should be greater than 1 byte and less than or equal to 16 bytes if IPSec is being used.
- The checked and retail versions of the Microsoft iSCSI Software Initiator will only install on retail version builds of Windows. There is no package that installs on checked builds of Windows.

Configure Microsoft iSCSI Initiator

After installation, the Microsoft iSCSI initiator is used to manage the iSCSI environment.

General Tab

The general tab shows the initiator node name, which is the iSCSI Qualified Name (IQN).



The iSCSI protocol uses the following information to uniquely identify this initiator and authenticate targets.

Initiator Node Name: iqn.1991-05.com.microsoft:dmrtk-srvr-a2

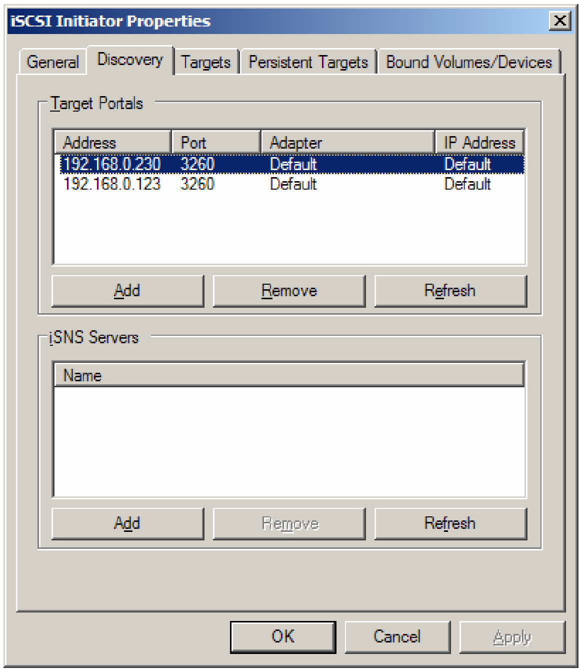
To rename the initiator node, click Change.

To authenticate targets using CHAP, click Secret to specify a CHAP secret.

To configure IPSec Tunnel Mode addresses, click Tunnel.

Discovery Tab

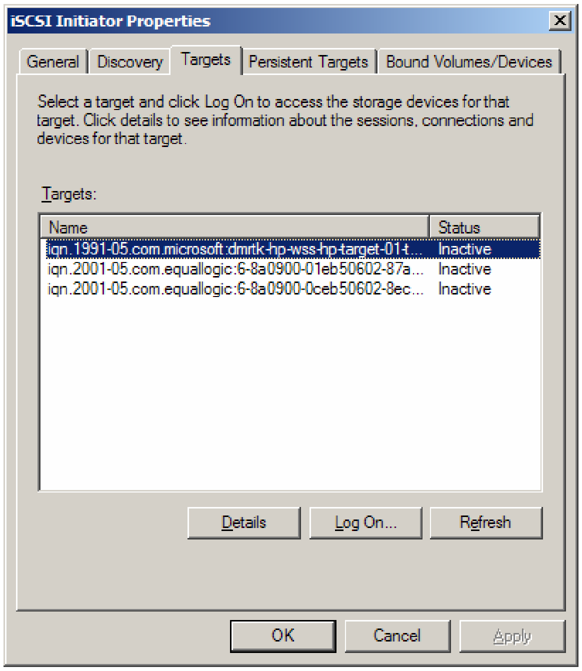
The discovery tab provides the list of discovered iSCSI target portals available to this initiator. The target portal is the primary IP address of the iSCSI target solution. Some target solutions use a virtual IP address and some iSCSI target solutions provide the first actual IP address of the solution. If there are no target portals listed, they can be added by IP address or DNS name. In this case two iSCSI target portals have already been discovered. If there is an iSNS server available, it can provide all the iSCSI discovery information.



Address	Port	Adapter	IP Address
192.168.0.230	3260	Default	Default
192.168.0.123	3260	Default	Default

Targets Tab

The targets tab provides the list of individual targets available to the iSCSI initiator. In this case, three targets are available to the iSCSI initiator.

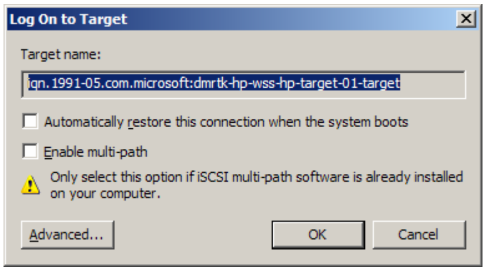


Select a target and click Log On to access the storage devices for that target. Click details to see information about the sessions, connections and devices for that target.

Targets:

Name	Status
iqn.1991-05.com.microsoft:dmrtk-hp-wss-hp-target-01-t...	Inactive
iqn.2001-05.com.equallogic:6-8a0900-01eb50602-87a...	Inactive
iqn.2001-05.com.equallogic:6-8a0900-0ceb50602-8ec...	Inactive

To gain access to the target, the initiator must “Log On” to the target. If there is only one path to the target, there is only one step needed for log on.



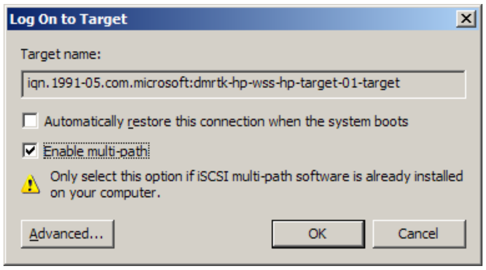
Target name: iqn.1991-05.com.microsoft:dmrtk-hp-wss-hp-target-01-target

☐ Automatically restore this connection when the system boots

☐ Enable multi-path

Only select this option if iSCSI multi-path software is already installed on your computer.

If there are multiple-paths to the target, then each path must be described to the iSCSI initiator. This is done by enabling multi-path and clicking on the “Advanced” tab. The Log on process must be repeated for each separate path.



Target name: iqn.1991-05.com.microsoft:dmrtk-hp-wss-hp-target-01-target

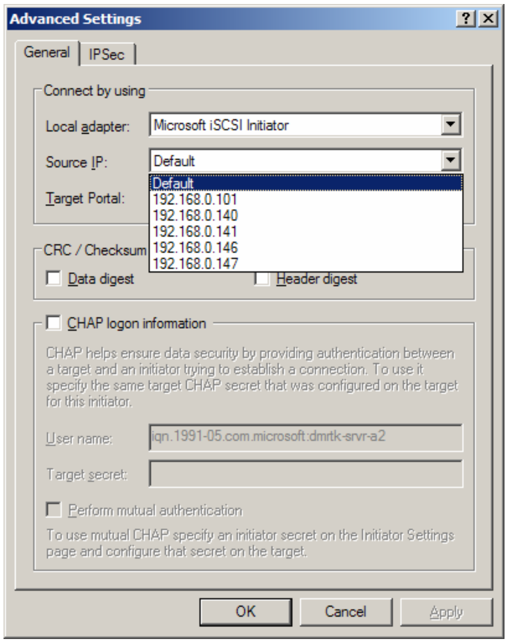
☐ Automatically restore this connection when the system boots

☑ Enable multi-path

Only select this option if iSCSI multi-path software is already installed on your computer.

The advanced tab provides a drop-down box for all the possible source (initiator) IP addresses and a separate drop-down box for all possible target portal addresses. Some target solutions provide one virtual IP address for multi-path operations. In these cases, the target solution manages the actual paths and IP addresses internally. Other target solutions expose each available IP address that can be used for multi-path operations.

The administrator must select each desired combination of source IP address and target IP address.



Advanced Settings

General | IPSec

Connect by using

Local adapter: Microsoft iSCSI Initiator

Source IP: Default

- Default
- 192.168.0.101
- 192.168.0.140
- 192.168.0.141
- 192.168.0.146
- 192.168.0.147

Target Portal:

CRC / Checksum

□ Data digest □ Header digest

□ CHAP logon information

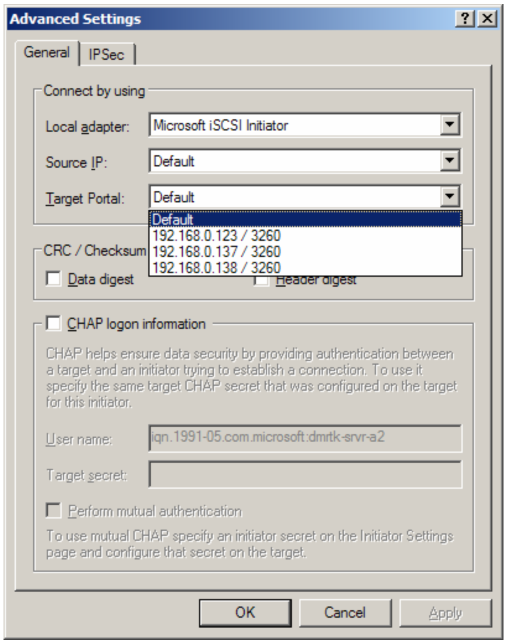
CHAP helps ensure data security by providing authentication between a target and an initiator trying to establish a connection. To use it specify the same target CHAP secret that was configured on the target for this initiator.

User name: iqn.1991-05.com.microsoft:dmrtk-srvr-a2

Target secret:

□ Perform mutual authentication

To use mutual CHAP specify an initiator secret on the Initiator Settings page and configure that secret on the target.



Advanced Settings

General | IPSec

Connect by using

Local adapter: Microsoft iSCSI Initiator

Source IP: Default

Target Portal: Default

- Default
- 192.168.0.123 / 3260
- 192.168.0.137 / 3260
- 192.168.0.138 / 3260

CRC / Checksum

□ Data digest □ Header digest

□ CHAP logon information

CHAP helps ensure data security by providing authentication between a target and an initiator trying to establish a connection. To use it specify the same target CHAP secret that was configured on the target for this initiator.

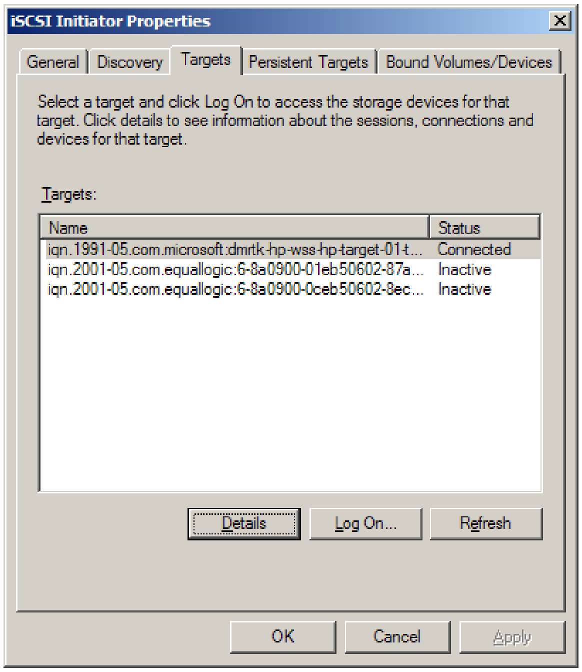
User name: iqn.1991-05.com.microsoft:dmrtk-srvr-a2

Target secret:

□ Perform mutual authentication

To use mutual CHAP specify an initiator secret on the Initiator Settings page and configure that secret on the target.

After the IP address or addresses have been selected, the initiator is connected to the target and the log on process is complete.



iSCSI Initiator Properties

General | Discovery | Targets | Persistent Targets | Bound Volumes/Devices

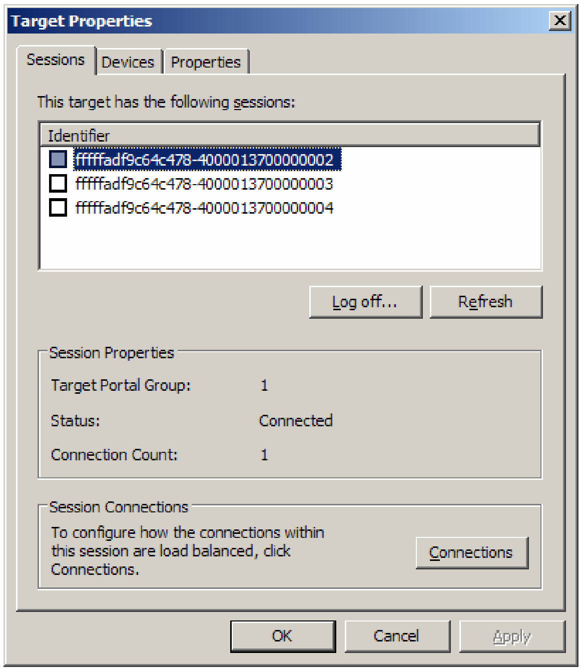
Select a target and click Log On to access the storage devices for that target. Click details to see information about the sessions, connections and devices for that target.

Targets:

Name	Status
iqn.1991-05.com.microsoft:dmrtk-hp-wss-hp-target-01-t...	Connected
iqn.2001-05.com.equallogic:6-8a0900-01eb50602-87a...	Inactive
iqn.2001-05.com.equallogic:6-8a0900-0ceb50602-8ec...	Inactive

Path Load-balancing and fail-over are configured here. During the target logon process, multiple paths can be configured by selecting different combinations of source and target IP addresses. After all the paths have been selected, the desired load-balancing or fail-over behavior can be configured. This behavior must be assigned for the session and the individual targets.

In this example, three paths have been specified for this target as shown by selecting “Details” from the targets window. For even load-balancing, select “Round Robin” for the session connections load balance policy.



This target has the following sessions:

Identifier
☐ fffffadf9c64c478-4000013700000002
☐ fffffadf9c64c478-4000013700000003
☐ fffffadf9c64c478-4000013700000004

Session Properties

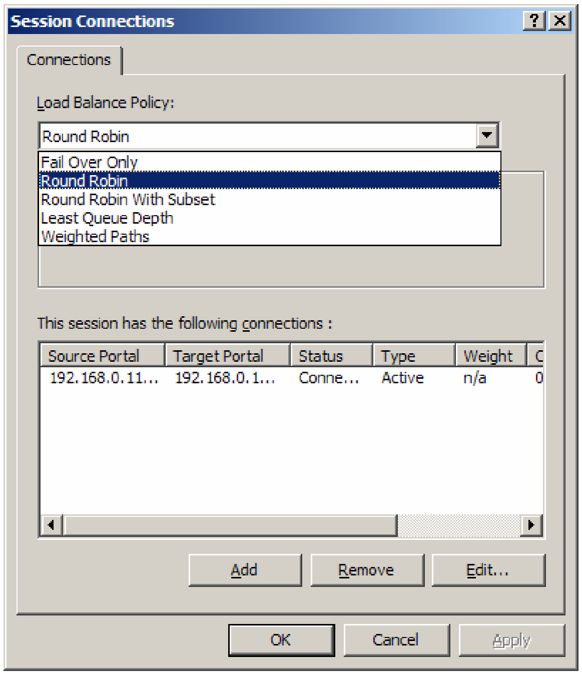
Target Portal Group: 1

Status: Connected

Connection Count: 1

Session Connections

To configure how the connections within this session are load balanced, click Connections.

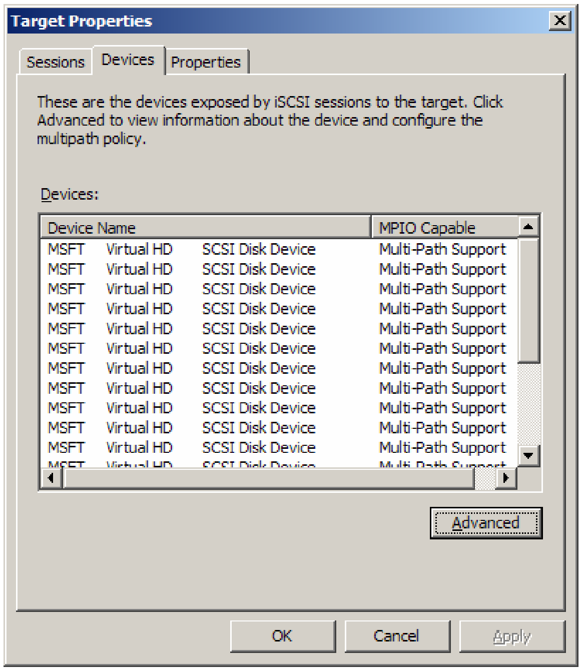


Load Balance Policy: Round Robin

This session has the following connections :

Source Portal	Target Portal	Status	Type	Weight	C
192.168.0.11...	192.168.0.1...	Conne...	Active	n/a	0

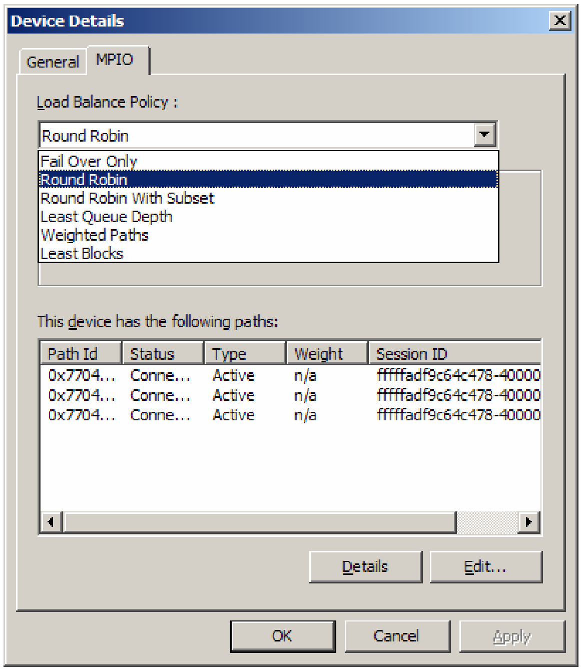
For the target multi-pathing configuration, select the “Devices” tab from the targets window, then select “Advanced” to get to the MPIO selection tab. Select the load balance policy for each device.



These are the devices exposed by iSCSI sessions to the target. Click Advanced to view information about the device and configure the multipath policy.

Devices:

Device Name	MPIO Capable
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support
MSFT Virtual HD SCSI Disk Device	Multi-Path Support



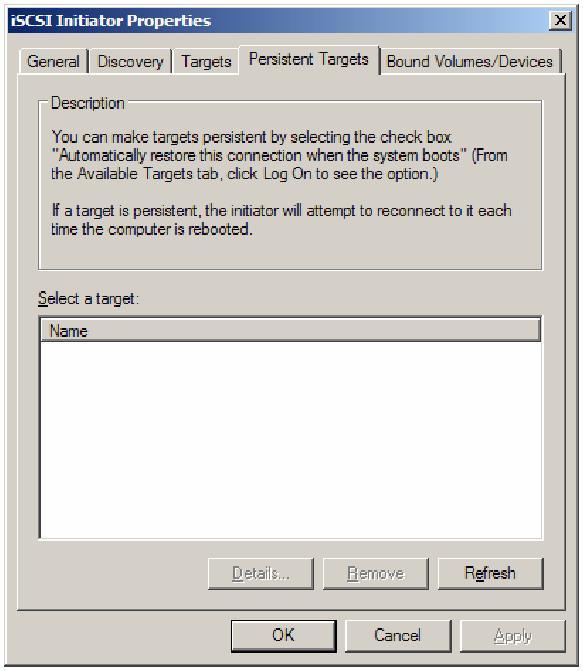
Load Balance Policy : Round Robin

This device has the following paths:

Path Id	Status	Type	Weight	Session ID
0x7704...	Conne...	Active	n/a	fffffadf9c64c478-40000
0x7704...	Conne...	Active	n/a	fffffadf9c64c478-40000
0x7704...	Conne...	Active	n/a	fffffadf9c64c478-40000

Persistent Targets Tab

Targets can be configured to be persistent, which means that the connection to the target is automatically restored when the system reboots. If the targets are configured to be persistent, they appear in this dialog box.



Description

You can make targets persistent by selecting the check box "Automatically restore this connection when the system boots" (From the Available Targets tab, click Log On to see the option.)

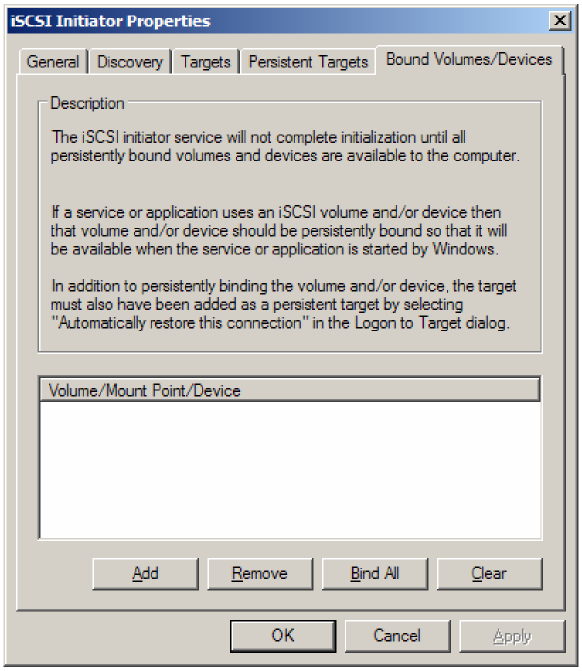
If a target is persistent, the initiator will attempt to reconnect to it each time the computer is rebooted.

Select a target:

Name

Bound Volumes Tab

If a host service or application depends on the availability of an iSCSI volume, it should be "bound" so that the iSCSI service includes each "bound" volume as part of its initialization.



Description

The iSCSI initiator service will not complete initialization until all persistently bound volumes and devices are available to the computer.

If a service or application uses an iSCSI volume and/or device then that volume and/or device should be persistently bound so that it will be available when the service or application is started by Windows.

In addition to persistently binding the volume and/or device, the target must also have been added as a persistent target by selecting "Automatically restore this connection" in the Logon to Target dialog.

Volume/Mount Point/Device

Security for iSCSI

Security for iSCSI includes some security features in the iSCSI layer itself, separate from any security layers that may be present in the lower TCP, IP, and Ethernet layers. The iSCSI security features can be enabled or disabled, as desired.

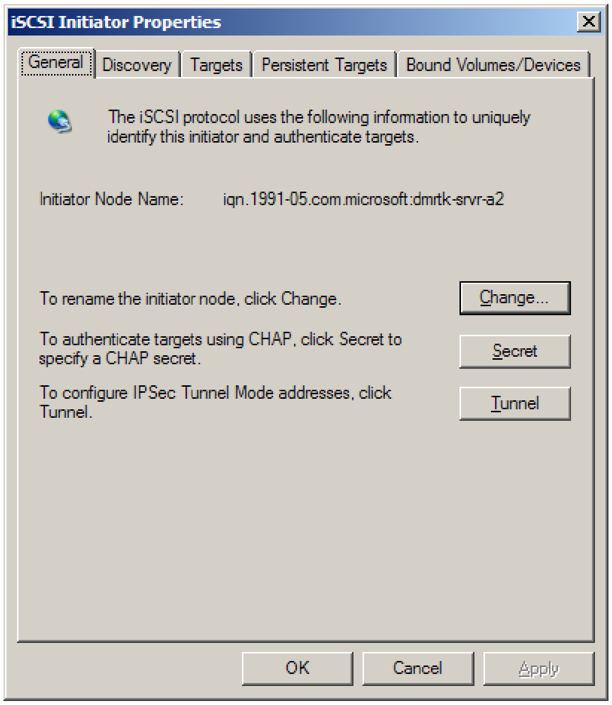
Each environment will need to address the issue of running storage traffic over the same network as the “public” LAN. Many will address this by running iSCSI storage traffic over a separate network or VLAN, which is the ***recommended best practice*** from Microsoft for applications using iSCSI storage. The items listed below are features of iSCSI which can provide increased security even if the iSCSI traffic is on a separate network.

The Microsoft iSCSI initiator uses Challenge Handshake Authentication Protocol (CHAP) to verify the identity of iSCSI host systems that are attempting to access storage targets. Using CHAP, the iSCSI initiator and iSCSI target share a predefined secret. The initiator combines the secret with other information into a value and calculates a one-way hash using MD5. The hash value is transmitted to the target. The target computes a one-way hash of its shared secret and other information. If the hash values match, the initiator is authenticated. The other information includes an ID value that is increased with each CHAP dialog to protect against replay attacks. Mutual CHAP is supported.

CHAP is generally regarded as more secure than PAP. More information is available on CHAP and PAP in RFC1334.

IPSec is also available for iSCSI. If IPSec is enabled, all IP packets sent during data transfers are encrypted and authenticated. A common key is set on all IP portals, allowing all peers to authenticate each other and negotiate packet encryption.

The Microsoft iSCSI initiator can be configured with the CHAP secret by clicking the “Secret” button from the “General” tab of the iSCSI initiator.


iSCSI Initiator Properties

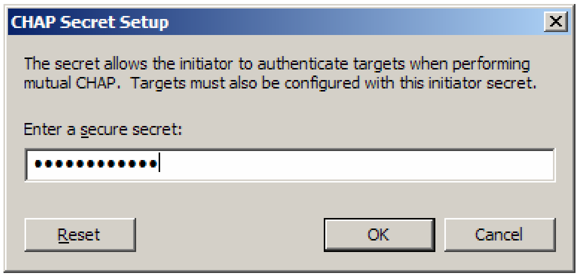
The iSCSI protocol uses the following information to uniquely identify this initiator and authenticate targets.

Initiator Node Name: iqn.1991-05.com.microsoft:dmrtk-srvr-a2

To rename the initiator node, click Change.

To authenticate targets using CHAP, click Secret to specify a CHAP secret.

To configure IPSec Tunnel Mode addresses, click Tunnel.


CHAP Secret Setup

The secret allows the initiator to authenticate targets when performing mutual CHAP. Targets must also be configured with this initiator secret.

Enter a secure secret: ••••••••••••

Microsoft Application Deployments for iSCSI

Microsoft Cluster Server

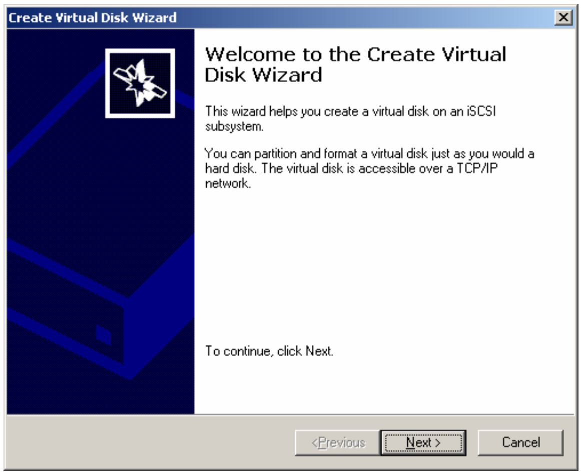
Microsoft Cluster Server (MSCS) supports the use of iSCSI connected disks as shared storage. Before creating the cluster, the storage that will be shared among the cluster nodes, including the quorum disk must be available. The volumes that will be shared by the cluster must be created on the iSCSI target and made available to the first node (iSCSI initiator) of the cluster. After the cluster is created, the iSCSI target should be configured to allow the other nodes of the cluster to access the same volumes as the first node.

Pre-Cluster Network Preparation

Microsoft clusters require at least one network interface configured with a static IP address on each node of the cluster for cluster communication. The cluster nodes also need at least one separate network interface to communicate to the clients on the LAN. Consult the Related Links section of this document for additional information on Microsoft Clusters.

Target Pre-Cluster Preparation Tasks

The volumes are created and associated with the iSCSI target that is mapped to the first node of the cluster. In the following example, the HP StorageWorks 1200 All-in-One was used for the iSCSI target storage for the cluster, which uses virtual disks for the volumes.



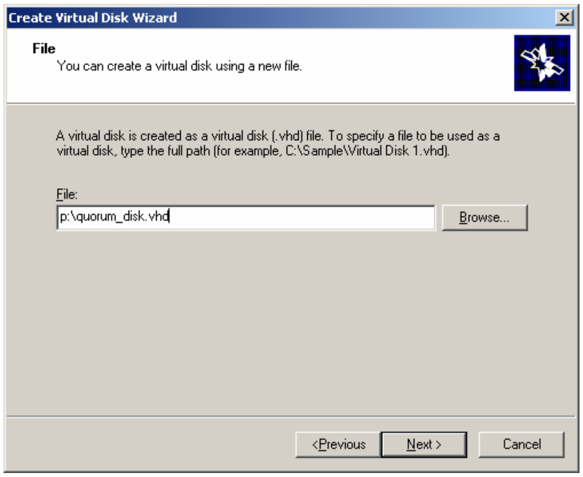
Welcome to the Create Virtual Disk Wizard

This wizard helps you create a virtual disk on an iSCSI subsystem.

You can partition and format a virtual disk just as you would a hard disk. The virtual disk is accessible over a TCP/IP network.

To continue, click Next.

Create the virtual disk for the volume that will be used as the quorum disk.



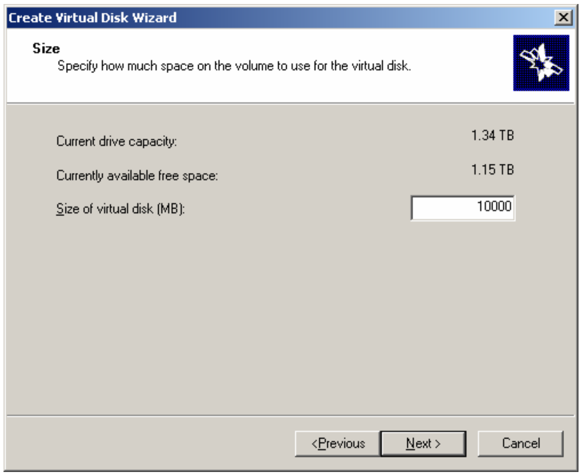
Create Virtual Disk Wizard

File

You can create a virtual disk using a new file.

A virtual disk is created as a virtual disk (.vhd) file. To specify a file to be used as a virtual disk, type the full path (for example, C:\Sample\Virtual Disk 1.vhd).

File: p:\quorum_disk.vhd



Create Virtual Disk Wizard

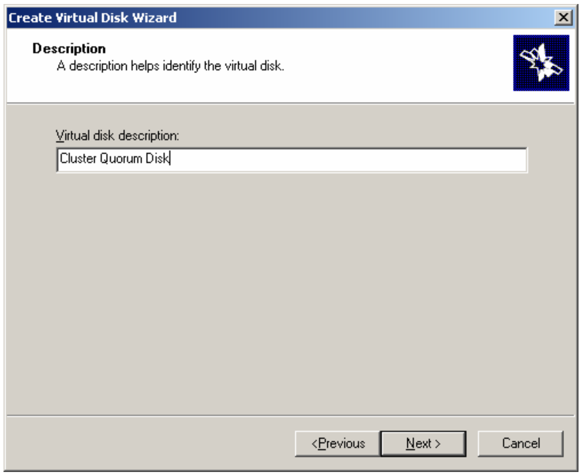
Size

Specify how much space on the volume to use for the virtual disk.

Current drive capacity: 1.34 TB

Currently available free space: 1.15 TB

Size of virtual disk (MB): 10000

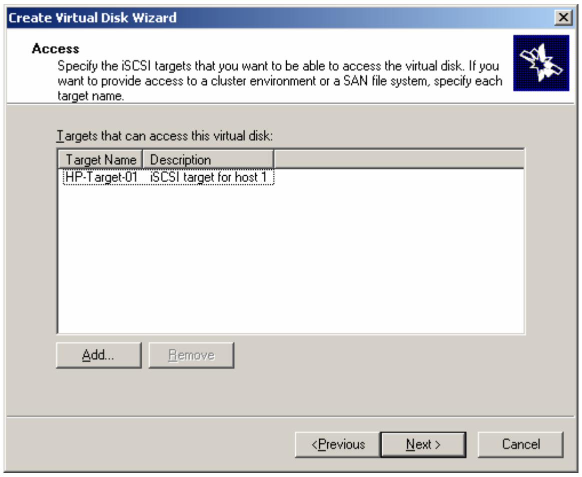


Create Virtual Disk Wizard

Description

A description helps identify the virtual disk.

Virtual disk description: Cluster Quorum Disk



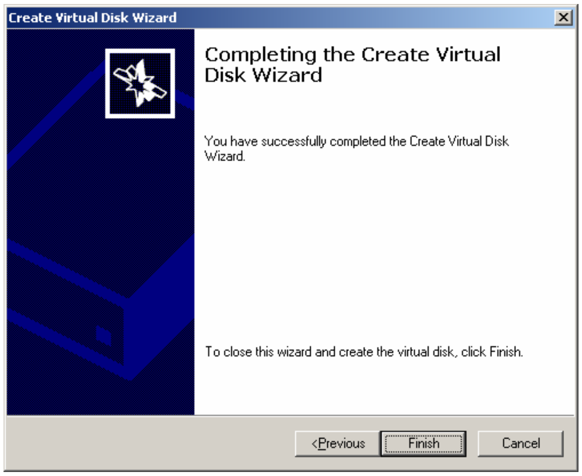
Create Virtual Disk Wizard

Access

Specify the iSCSI targets that you want to be able to access the virtual disk. If you want to provide access to a cluster environment or a SAN file system, specify each target name.

Targets that can access this virtual disk:

Target Name	Description
HP-Target-01	iSCSI target for host 1

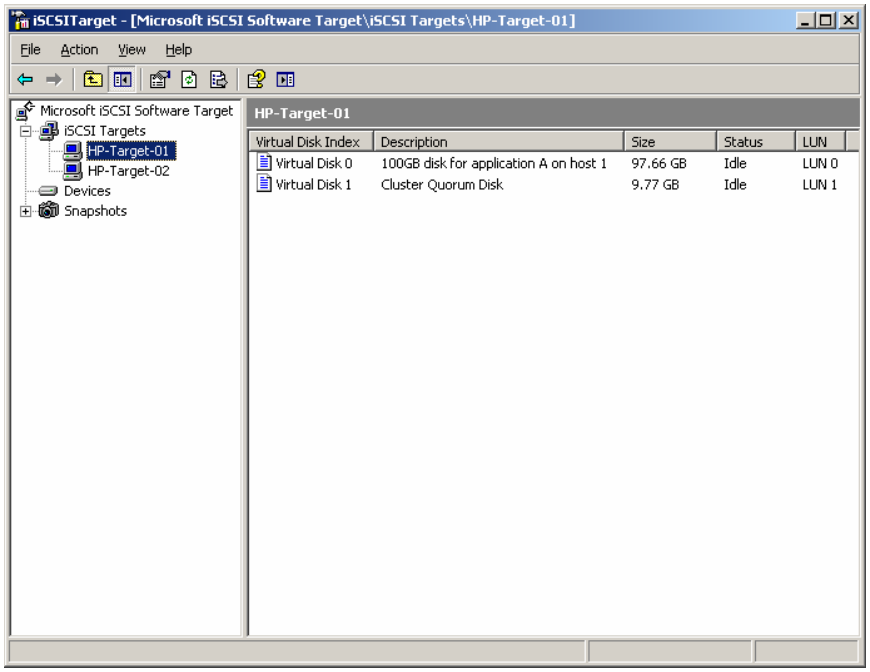


Create Virtual Disk Wizard

Completing the Create Virtual Disk Wizard

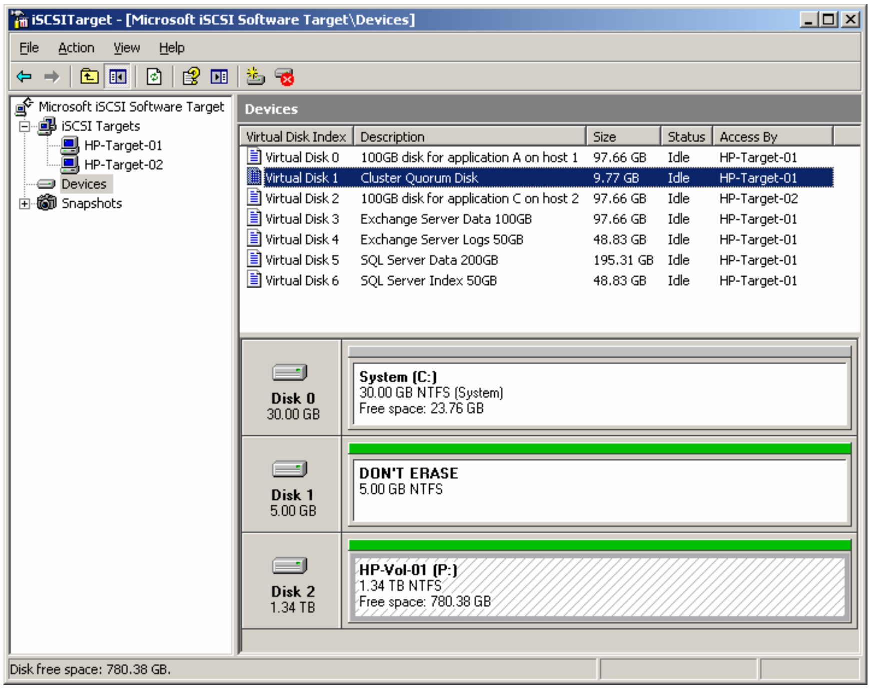
You have successfully completed the Create Virtual Disk Wizard.

To close this wizard and create the virtual disk, click Finish.


iSCSITarget - [Microsoft iSCSI Software Target\iSCSI Targets\HP-Target-01]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
HP-Target-02
Devices
Snapshots
HP-Target-01

Virtual Disk Index	Description	Size	Status	LUN
Virtual Disk 0	100GB disk for application A on host 1	97.66 GB	Idle	LUN 0
Virtual Disk 1	Cluster Quorum Disk	9.77 GB	Idle	LUN 1

Other virtual disk volumes are created for applications that will use the cluster.


iSCSITarget - [Microsoft iSCSI Software Target\Devices]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
HP-Target-02
Devices
Snapshots
Devices

Virtual Disk Index	Description	Size	Status	Access By
Virtual Disk 0	100GB disk for application A on host 1	97.66 GB	Idle	HP-Target-01
Virtual Disk 1	Cluster Quorum Disk	9.77 GB	Idle	HP-Target-01
Virtual Disk 2	100GB disk for application C on host 2	97.66 GB	Idle	HP-Target-02
Virtual Disk 3	Exchange Server Data 100GB	97.66 GB	Idle	HP-Target-01
Virtual Disk 4	Exchange Server Logs 50GB	48.83 GB	Idle	HP-Target-01
Virtual Disk 5	SQL Server Data 200GB	195.31 GB	Idle	HP-Target-01
Virtual Disk 6	SQL Server Index 50GB	48.83 GB	Idle	HP-Target-01

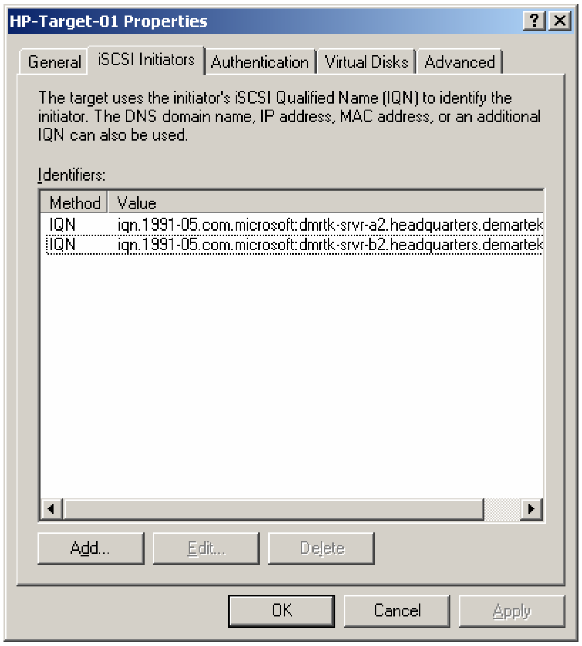
Disk 0
30.00 GB
System (C:)
30.00 GB NTFS (System)
Free space: 23.76 GB

Disk 1
5.00 GB
DON'T ERASE
5.00 GB NTFS

Disk 2
1.34 TB
HP-Vol-01 (P:)
1.34 TB NTFS
Free space: 780.38 GB

Disk free space: 780.38 GB.

After the volumes are created, the second node is added to the iSCSI initiator list for the target.



The target uses the initiator's iSCSI Qualified Name (IQN) to identify the initiator. The DNS domain name, IP address, MAC address, or an additional IQN can also be used.

Identifiers:

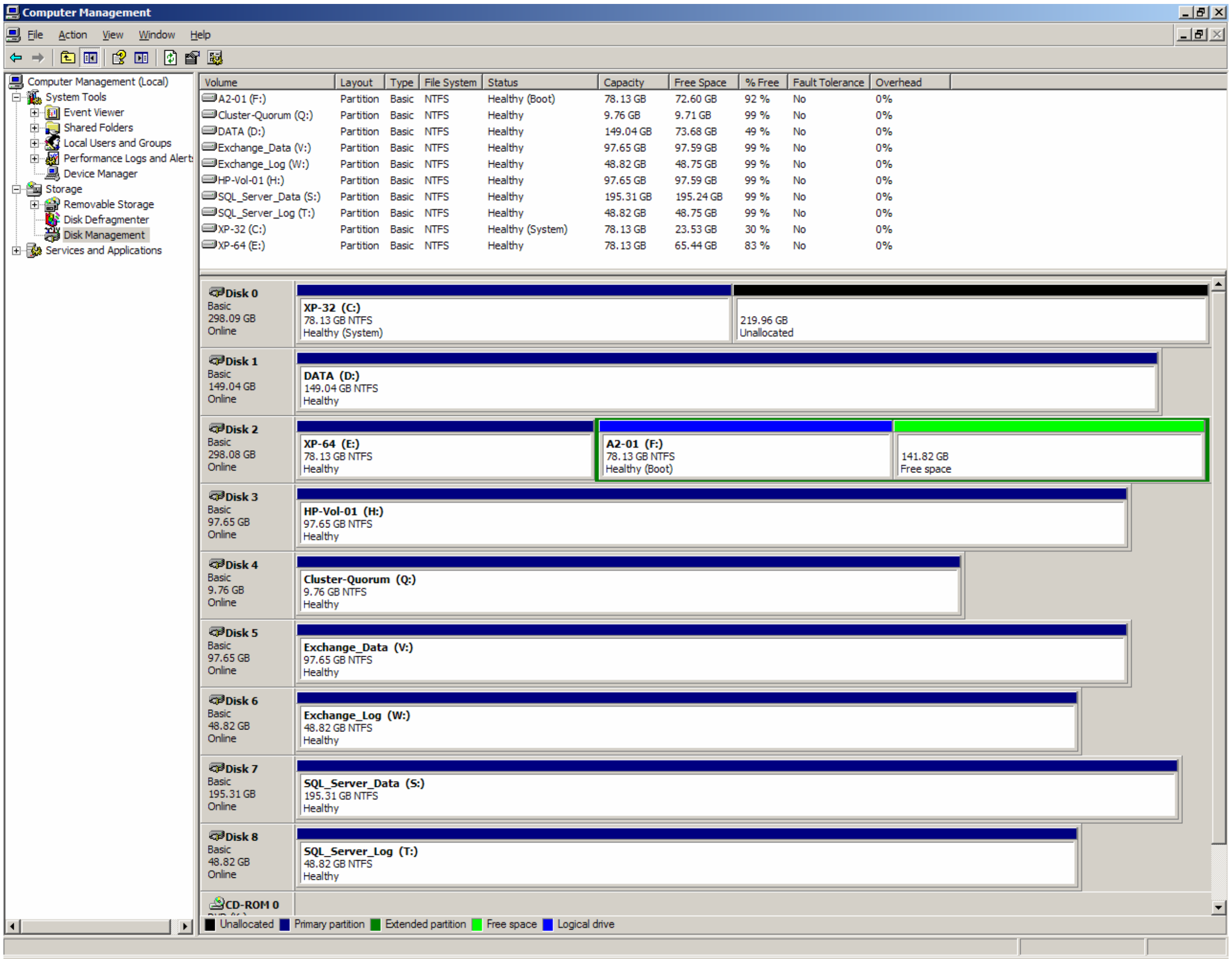
Method	Value
IQN	iqn.1991-05.com.microsoft:dmrtk-srvr-a2.headquarters.demartek
IQN	iqn.1991-05.com.microsoft:dmrtk-srvr-b2.headquarters.demartek

Because cluster nodes must be members of a domain, the full domain identifiers are added to the list of iSCSI initiators.

Cluster Creation Tasks

Once the storage is available for the cluster, the storage must be activated on the first node, and then the cluster itself can be created.

Disks 3 through 8 are volumes on the iSCSI target storage system. These disks are activated via Disk Manager on the first node, and then formatted in the standard fashion.

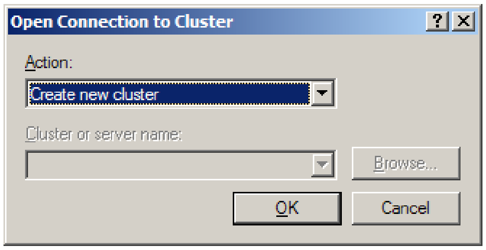


Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free	Fault Tolerance	Overhead
A2-01 (F:)	Partition	Basic	NTFS	Healthy (Boot)	78.13 GB	72.60 GB	92 %	No	0%
Cluster-Quorum (Q:)	Partition	Basic	NTFS	Healthy	9.76 GB	9.71 GB	99 %	No	0%
DATA (D:)	Partition	Basic	NTFS	Healthy	149.04 GB	73.68 GB	49 %	No	0%
Exchange_Data (V:)	Partition	Basic	NTFS	Healthy	97.65 GB	97.59 GB	99 %	No	0%
Exchange_Log (W:)	Partition	Basic	NTFS	Healthy	48.82 GB	48.75 GB	99 %	No	0%
HP-Vol-01 (H:)	Partition	Basic	NTFS	Healthy	97.65 GB	97.59 GB	99 %	No	0%
SQL_Server_Data (S:)	Partition	Basic	NTFS	Healthy	195.31 GB	195.24 GB	99 %	No	0%
SQL_Server_Log (T:)	Partition	Basic	NTFS	Healthy	48.82 GB	48.75 GB	99 %	No	0%
XP-32 (C:)	Partition	Basic	NTFS	Healthy (System)	78.13 GB	23.53 GB	30 %	No	0%
XP-64 (E:)	Partition	Basic	NTFS	Healthy	78.13 GB	65.44 GB	83 %	No	0%

Disk	Partitions
Disk 0 Basic 298.09 GB Online	XP-32 (C:) 78.13 GB NTFS Healthy (System) 219.96 GB Unallocated
Disk 1 Basic 149.04 GB Online	DATA (D:) 149.04 GB NTFS Healthy
Disk 2 Basic 298.08 GB Online	XP-64 (E:) 78.13 GB NTFS Healthy A2-01 (F:) 78.13 GB NTFS Healthy (Boot) 141.82 GB Free space
Disk 3 Basic 97.65 GB Online	HP-Vol-01 (H:) 97.65 GB NTFS Healthy
Disk 4 Basic 9.76 GB Online	Cluster-Quorum (Q:) 9.76 GB NTFS Healthy
Disk 5 Basic 97.65 GB Online	Exchange_Data (V:) 97.65 GB NTFS Healthy
Disk 6 Basic 48.82 GB Online	Exchange_Log (W:) 48.82 GB NTFS Healthy
Disk 7 Basic 195.31 GB Online	SQL_Server_Data (S:) 195.31 GB NTFS Healthy
Disk 8 Basic 48.82 GB Online	SQL_Server_Log (T:) 48.82 GB NTFS Healthy
CD-ROM 0	

■ Unallocated ■ Primary partition ■ Extended partition ■ Free space ■ Logical drive

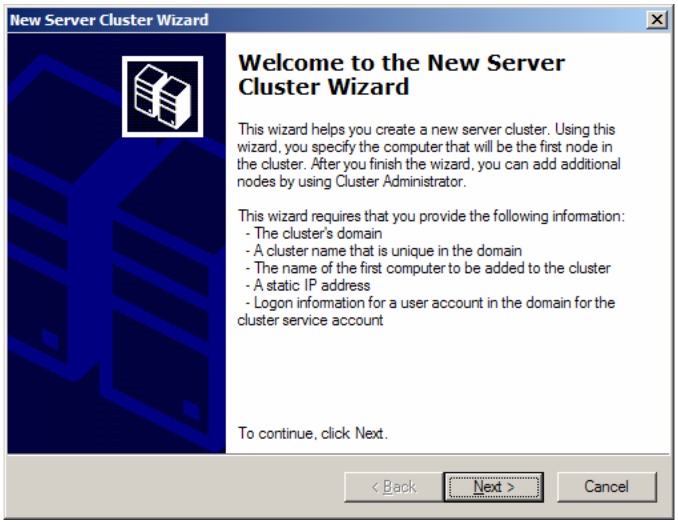
The Cluster Administrator wizard is used to create the cluster and assign the resources, and is launched on the first node.



Open Connection to Cluster

Action: Create new cluster

Cluster or server name:



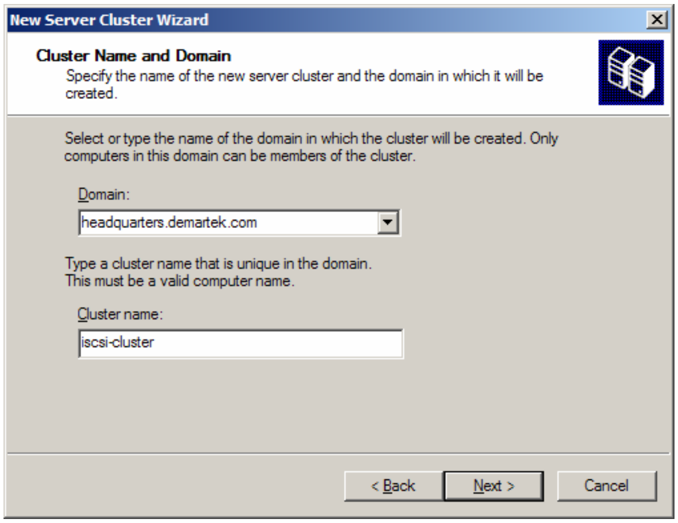
Welcome to the New Server Cluster Wizard

This wizard helps you create a new server cluster. Using this wizard, you specify the computer that will be the first node in the cluster. After you finish the wizard, you can add additional nodes by using Cluster Administrator.

This wizard requires that you provide the following information:
- The cluster's domain
- A cluster name that is unique in the domain
- The name of the first computer to be added to the cluster
- A static IP address
- Logon information for a user account in the domain for the cluster service account

To continue, click Next.

The cluster name is given to the cluster.



Cluster Name and Domain

Specify the name of the new server cluster and the domain in which it will be created.

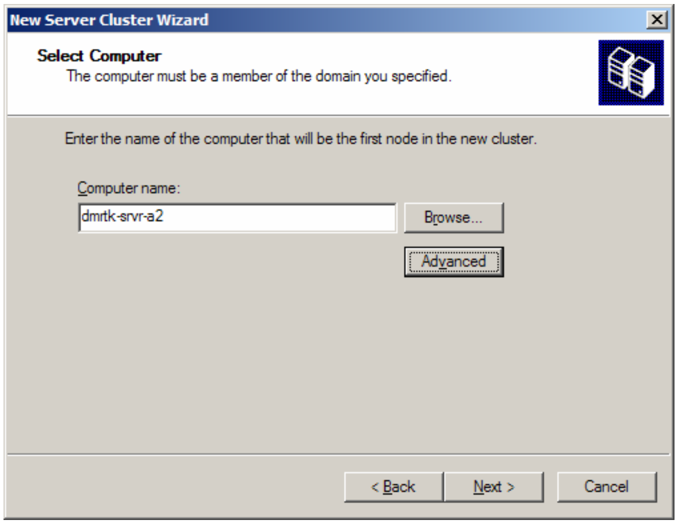
Select or type the name of the domain in which the cluster will be created. Only computers in this domain can be members of the cluster.

Domain: headquarters.demartek.com

Type a cluster name that is unique in the domain. This must be a valid computer name.

Cluster name: iscsi-cluster

The first node of the cluster is identified. The first node name is “dmrtk-srvr-a2”.



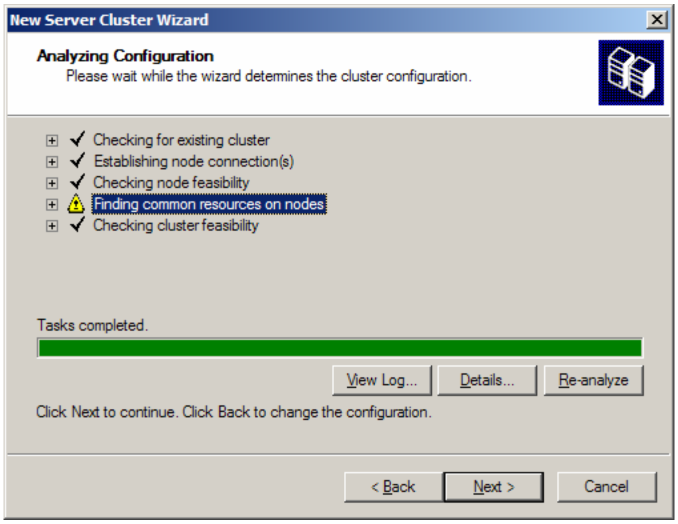
New Server Cluster Wizard

Select Computer
The computer must be a member of the domain you specified.

Enter the name of the computer that will be the first node in the new cluster.

Computer name: dmrtk-srvr-a2

The cluster wizard performs its initial analysis of the node, the network, and the storage.



New Server Cluster Wizard

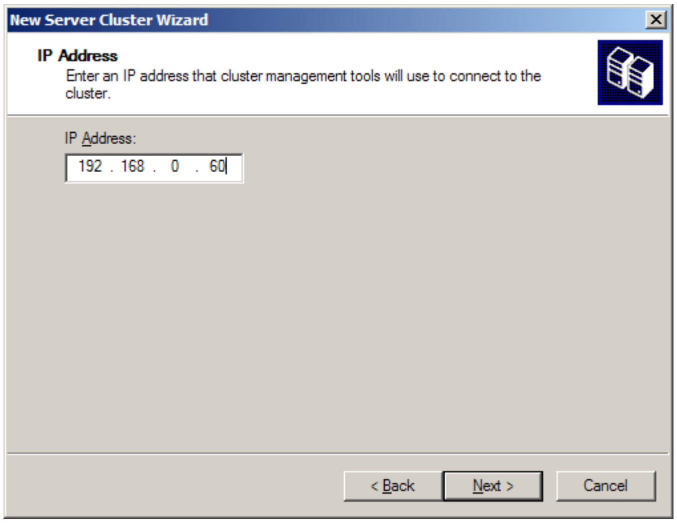
Analyzing Configuration
Please wait while the wizard determines the cluster configuration.

- ✓ Checking for existing cluster
- ✓ Establishing node connection(s)
- ✓ Checking node feasibility
- ⚠ Finding common resources on nodes
- ✓ Checking cluster feasibility

Tasks completed.

Click Next to continue. Click Back to change the configuration.

The cluster IP address is given.



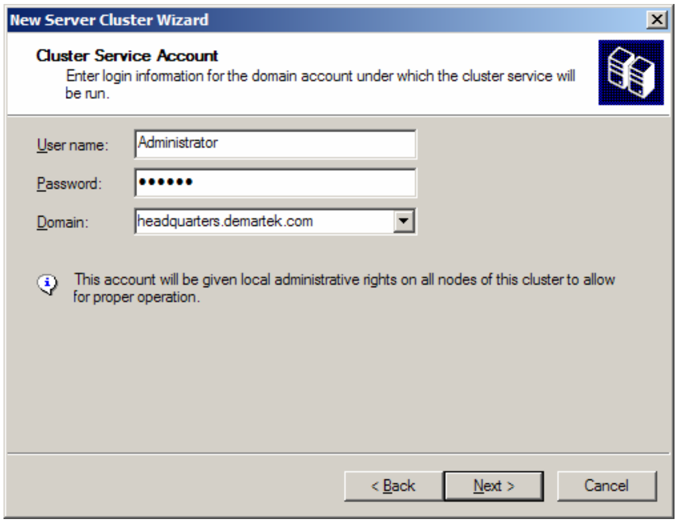
New Server Cluster Wizard

IP Address

Enter an IP address that cluster management tools will use to connect to the cluster.

IP Address: 192 . 168 . 0 . 60

The cluster service domain account is provided.



New Server Cluster Wizard

Cluster Service Account

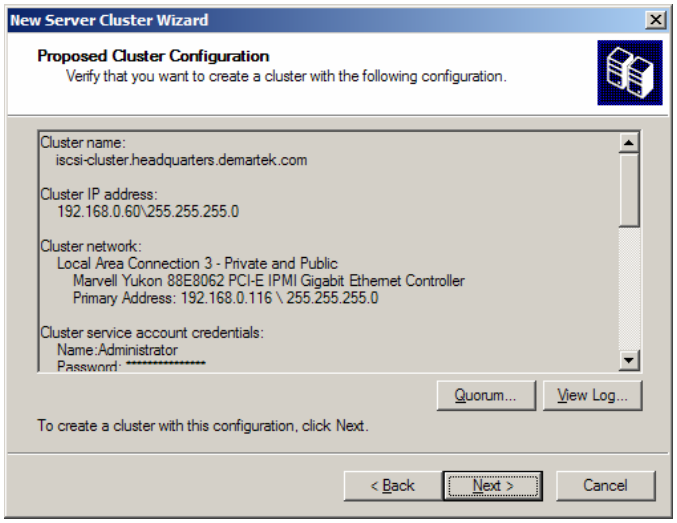
Enter login information for the domain account under which the cluster service will be run.

User name: Administrator

Password: ••••••

Domain: headquarters.demartek.com

This account will be given local administrative rights on all nodes of this cluster to allow for proper operation.



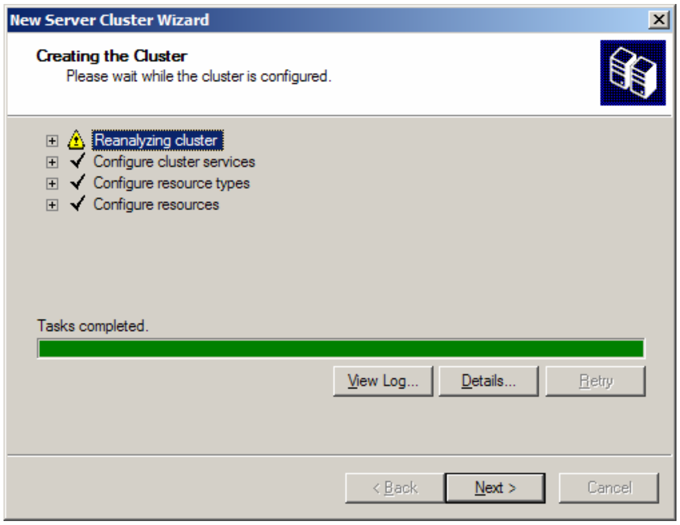
Proposed Cluster Configuration

Verify that you want to create a cluster with the following configuration.

```
Cluster name:
   iscsi-cluster.headquarters.demartek.com

Cluster IP address:
   192.168.0.60\255.255.255.0

Cluster network:
   Local Area Connection 3 - Private and Public
      Marvell Yukon 88E8062 PCI-E IPMI Gigabit Ethernet Controller
      Primary Address: 192.168.0.116 \ 255.255.255.0

Cluster service account credentials:
   Name:Administrator
   Password: ***************
```

To create a cluster with this configuration, click Next.

The cluster wizard performs its final analysis.

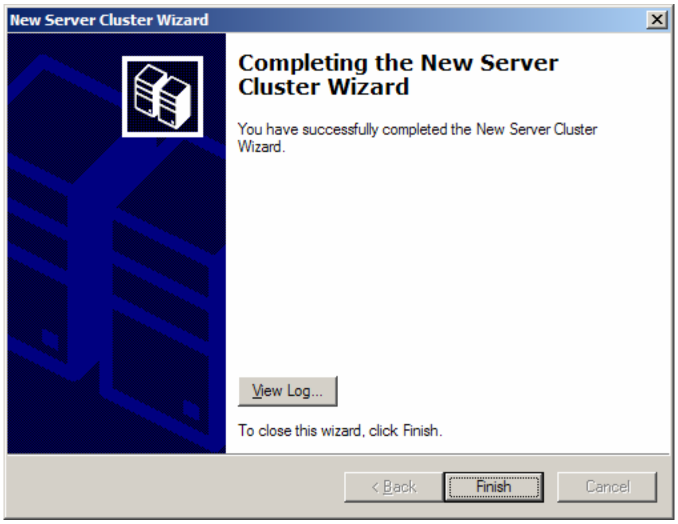


Creating the Cluster

Please wait while the cluster is configured.

- ⚠ Reanalyzing cluster
- ✓ Configure cluster services
- ✓ Configure resource types
- ✓ Configure resources

Tasks completed.

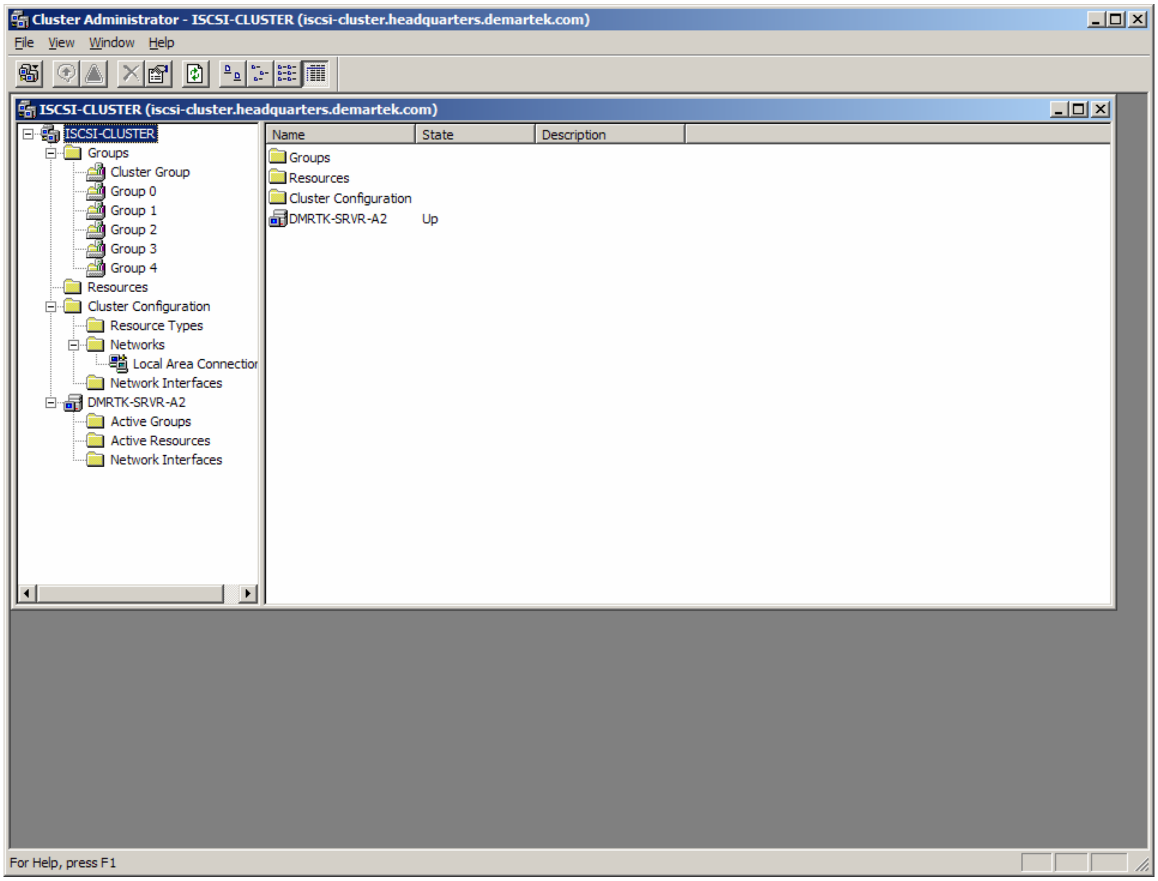


Completing the New Server Cluster Wizard

You have successfully completed the New Server Cluster Wizard.

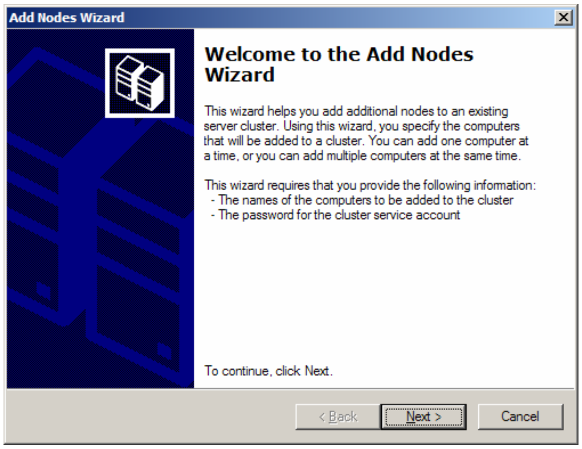
To close this wizard, click Finish.

The Cluster Administrator has the first node of the cluster.



Name	State	Description
Groups		
Resources		
Cluster Configuration		
DMRTK-SRVR-A2	Up	

The next step is to add another node to the cluster.



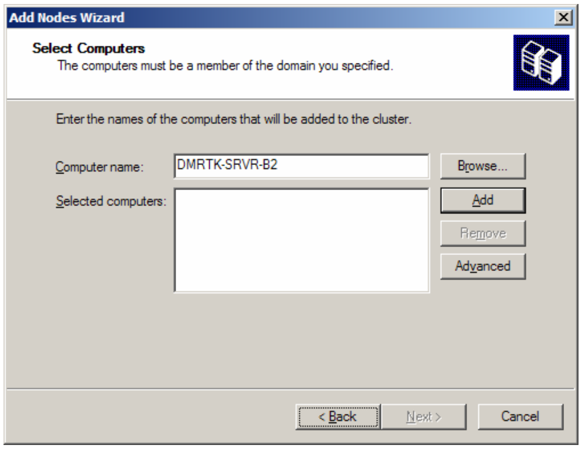
Welcome to the Add Nodes Wizard

This wizard helps you add additional nodes to an existing server cluster. Using this wizard, you specify the computers that will be added to a cluster. You can add one computer at a time, or you can add multiple computers at the same time.

This wizard requires that you provide the following information:
- The names of the computers to be added to the cluster
- The password for the cluster service account

To continue, click Next.

The second node is "dmrtk-srvr-b2".

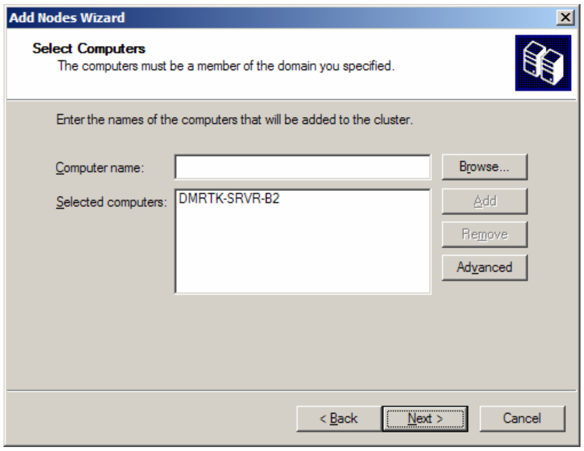


Select Computers
The computers must be a member of the domain you specified.

Enter the names of the computers that will be added to the cluster.

Computer name: DMRTK-SRVR-B2

Selected computers:



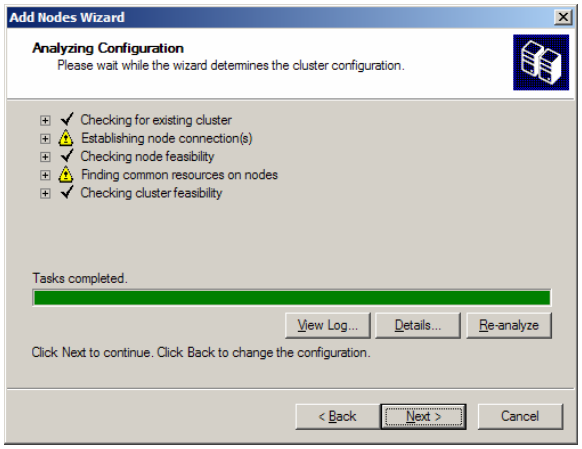
Select Computers
The computers must be a member of the domain you specified.

Enter the names of the computers that will be added to the cluster.

Computer name:

Selected computers: DMRTK-SRVR-B2

The wizard performs its initial analysis of the second node.



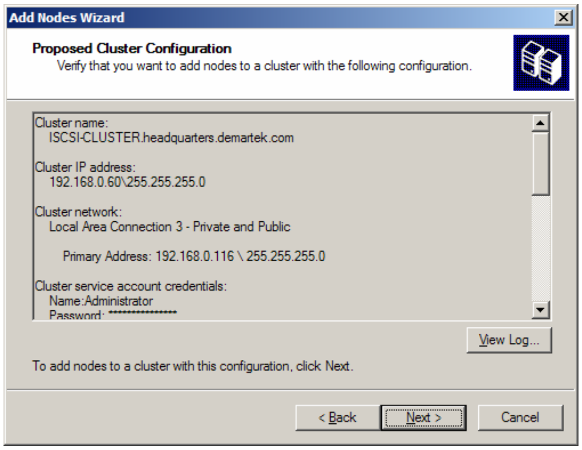
Analyzing Configuration

Please wait while the wizard determines the cluster configuration.

- ✓ Checking for existing cluster
- ⚠ Establishing node connection(s)
- ✓ Checking node feasibility
- ⚠ Finding common resources on nodes
- ✓ Checking cluster feasibility

Tasks completed.

Click Next to continue. Click Back to change the configuration.

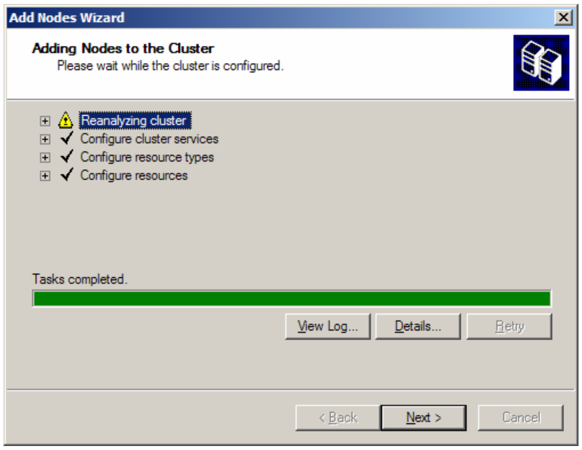


Proposed Cluster Configuration

Verify that you want to add nodes to a cluster with the following configuration.

```
Cluster name:
   ISCSI-CLUSTER.headquarters.demartek.com

Cluster IP address:
   192.168.0.60\255.255.255.0

Cluster network:
   Local Area Connection 3 - Private and Public

      Primary Address: 192.168.0.116 \ 255.255.255.0

Cluster service account credentials:
   Name:Administrator
   Password: ***************
```

To add nodes to a cluster with this configuration, click Next.

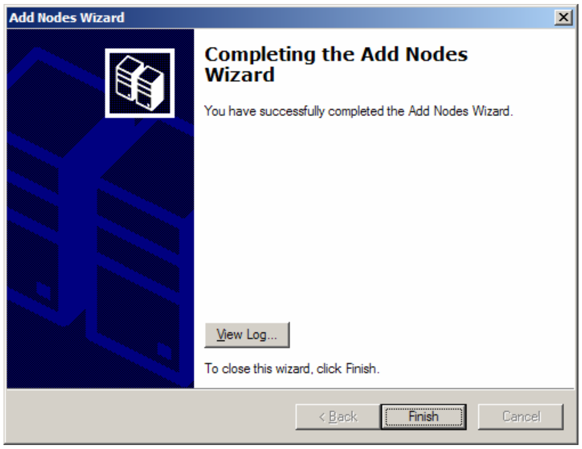


Adding Nodes to the Cluster

Please wait while the cluster is configured.

- ⚠ Reanalyzing cluster
- ✓ Configure cluster services
- ✓ Configure resource types
- ✓ Configure resources

Tasks completed.

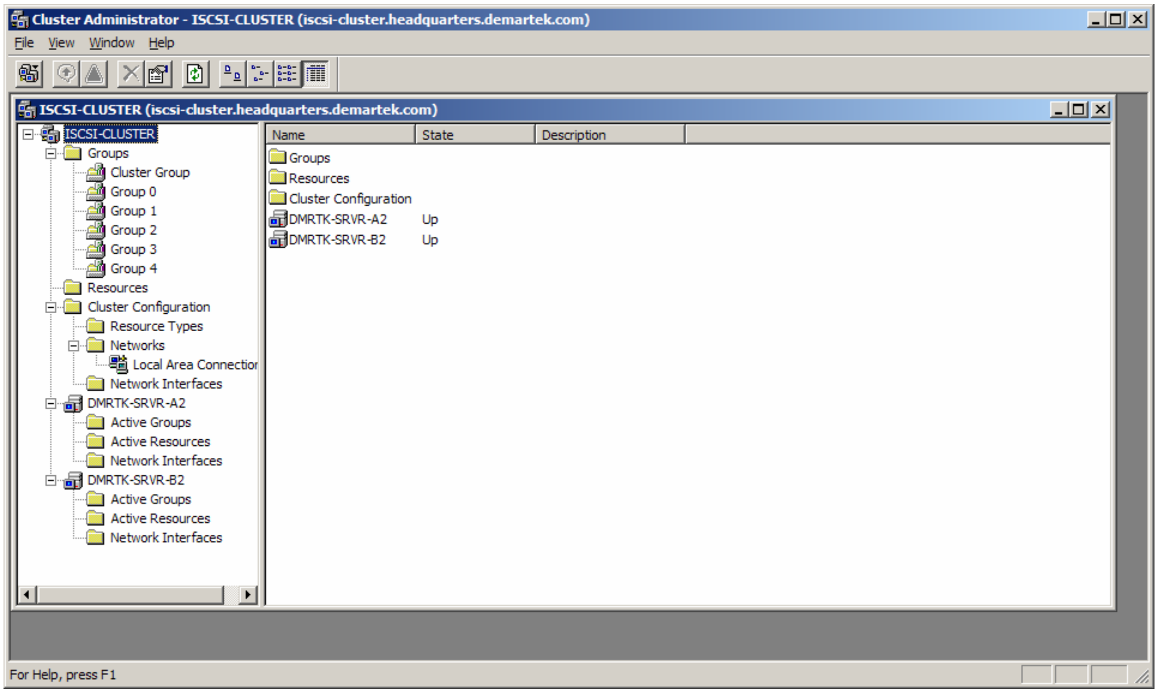


Completing the Add Nodes Wizard

You have successfully completed the Add Nodes Wizard.

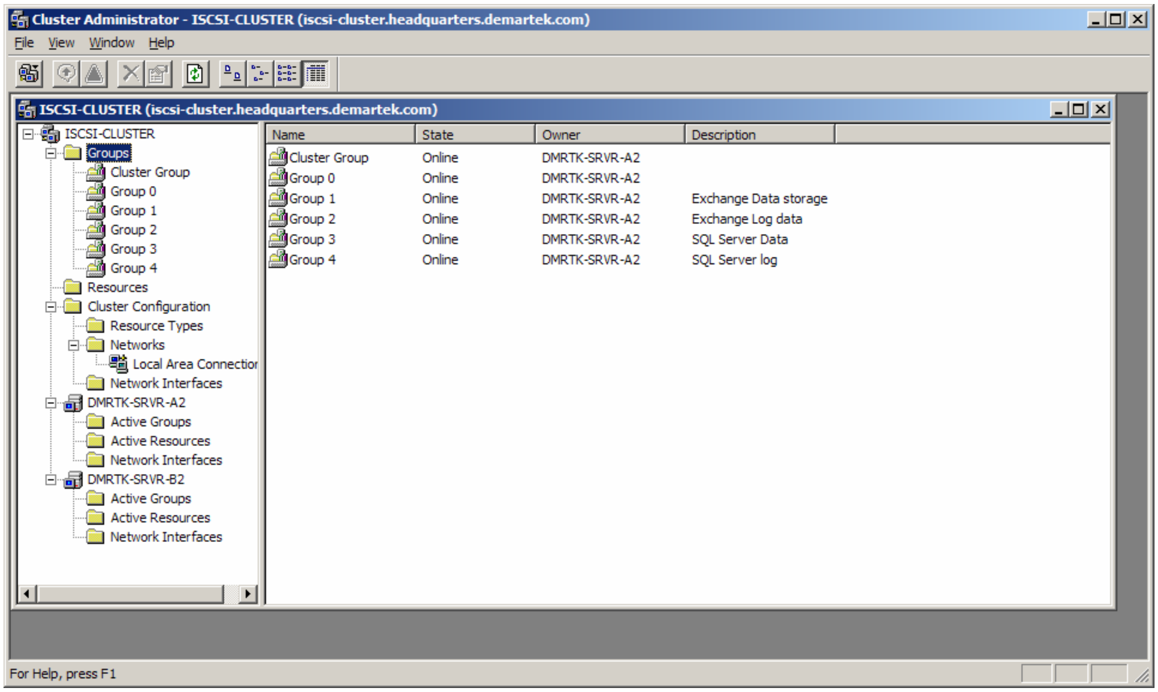
To close this wizard, click Finish.

The Cluster Administrator now has the second node.



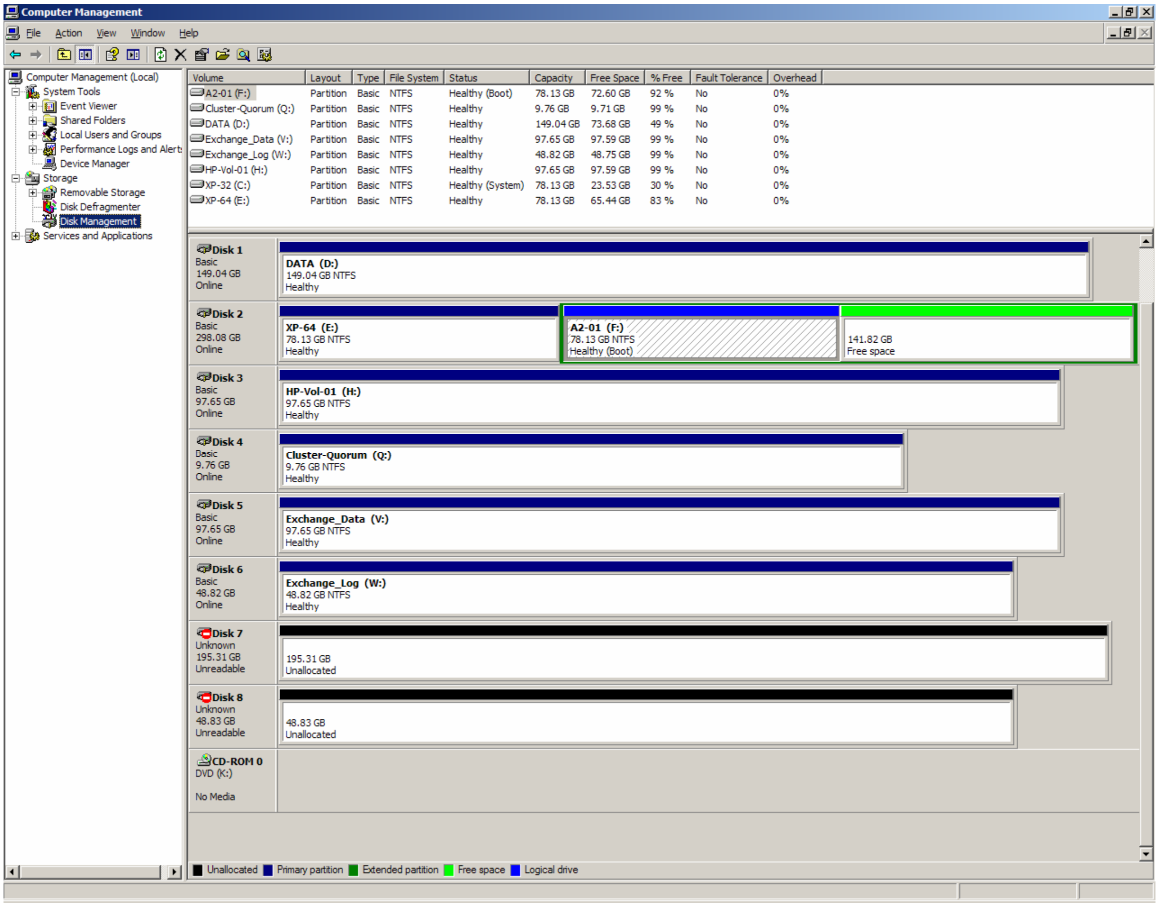
Name	State	Description
Groups		
Resources		
Cluster Configuration		
DMRTK-SRVR-A2	Up	
DMRTK-SRVR-B2	Up	

The cluster groups are displayed.



Name	State	Owner	Description
Cluster Group	Online	DMRTK-SRVR-A2	
Group 0	Online	DMRTK-SRVR-A2	
Group 1	Online	DMRTK-SRVR-A2	Exchange Data storage
Group 2	Online	DMRTK-SRVR-A2	Exchange Log data
Group 3	Online	DMRTK-SRVR-A2	SQL Server Data
Group 4	Online	DMRTK-SRVR-A2	SQL Server log

The groups can be assigned to the other node, as needed. Groups 3 and 4 are moved to the other node, as in a fail-over scenario. This storage is now visible to the second node, and no longer visible to the first node. The Disk Manager view below is from the first node after moving the resources to the second node. Notice that disks 7 and 8 are not accessible to the first node.



Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free	Fault Tolerance	Overhead
A2-01 (F:)	Partition	Basic	NTFS	Healthy (Boot)	78.13 GB	72.60 GB	92 %	No	0%
Cluster-Quorum (Q:)	Partition	Basic	NTFS	Healthy	9.76 GB	9.71 GB	99 %	No	0%
DATA (D:)	Partition	Basic	NTFS	Healthy	149.04 GB	73.68 GB	49 %	No	0%
Exchange_Data (V:)	Partition	Basic	NTFS	Healthy	97.65 GB	97.59 GB	99 %	No	0%
Exchange_Log (W:)	Partition	Basic	NTFS	Healthy	48.82 GB	48.75 GB	99 %	No	0%
HP-Vol-01 (H:)	Partition	Basic	NTFS	Healthy	97.65 GB	97.59 GB	99 %	No	0%
XP-32 (C:)	Partition	Basic	NTFS	Healthy (System)	78.13 GB	23.53 GB	30 %	No	0%
XP-64 (E:)	Partition	Basic	NTFS	Healthy	78.13 GB	65.44 GB	83 %	No	0%

Disk	Partitions
Disk 1 Basic 149.04 GB Online	**DATA (D:)** 149.04 GB NTFS Healthy
Disk 2 Basic 298.08 GB Online	**XP-64 (E:)** 78.13 GB NTFS Healthy **A2-01 (F:)** 78.13 GB NTFS Healthy (Boot) 141.82 GB Free space
Disk 3 Basic 97.65 GB Online	**HP-Vol-01 (H:)** 97.65 GB NTFS Healthy
Disk 4 Basic 9.76 GB Online	**Cluster-Quorum (Q:)** 9.76 GB NTFS Healthy
Disk 5 Basic 97.65 GB Online	**Exchange_Data (V:)** 97.65 GB NTFS Healthy
Disk 6 Basic 48.82 GB Online	**Exchange_Log (W:)** 48.82 GB NTFS Healthy
Disk 7 Unknown 195.31 GB Unreadable	195.31 GB Unallocated
Disk 8 Unknown 48.83 GB Unreadable	48.83 GB Unallocated
CD-ROM 0 DVD (K:) No Media	

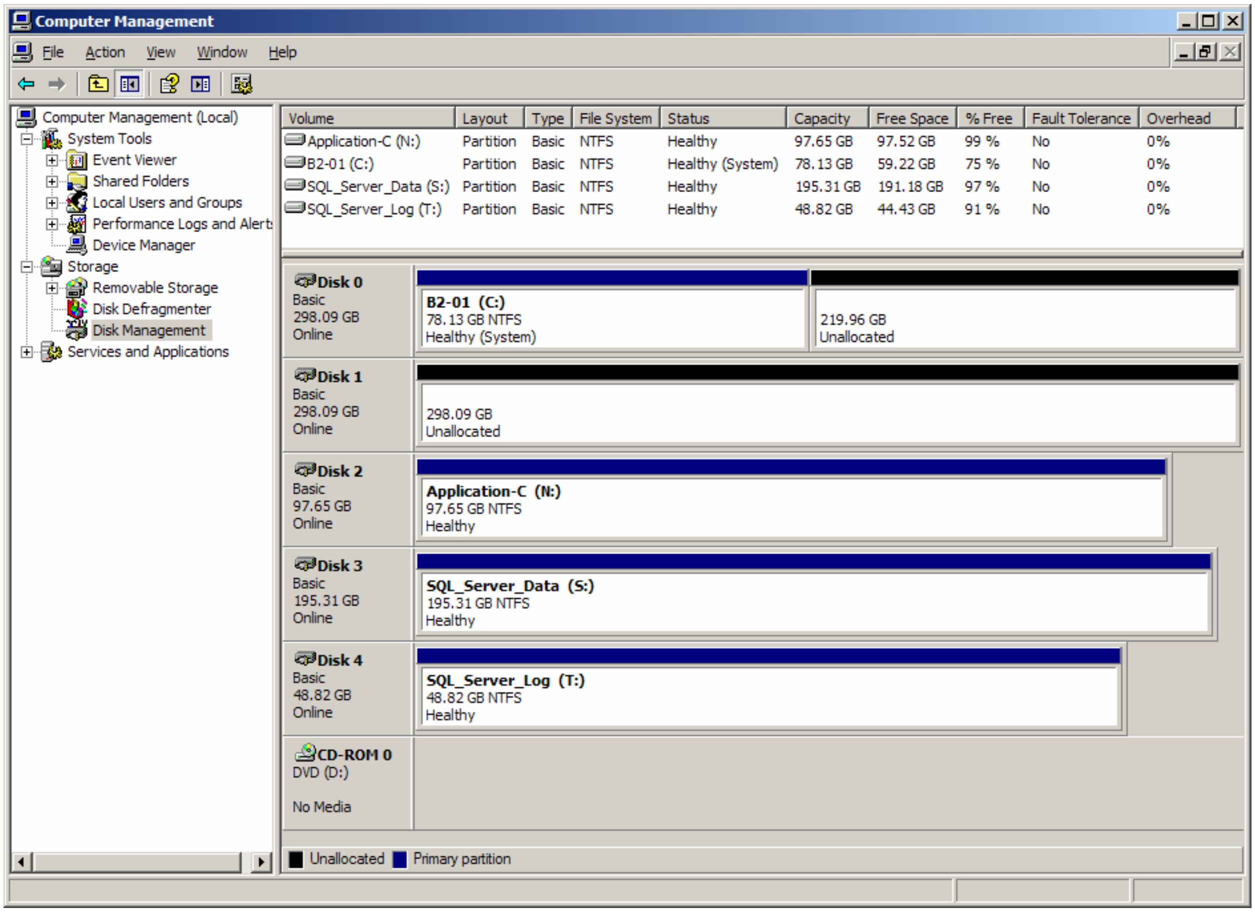
■ Unallocated ■ Primary partition ■ Extended partition ■ Free space ■ Logical drive

The cluster is now ready for applications and data.

Microsoft Office SharePoint Server 2007

Microsoft Office SharePoint Server 2007 supports the use of iSCSI connected disks as storage for the SharePoint Server and its associated data files.

For this installation, the disk drive letters “N”, “S” and “T” are all iSCSI target volumes allocated to server DMRTK-SRVR-B2, which is running Microsoft Windows Server 2003 R2 Enterprise x64 Edition. The iSCSI target volumes were created in the standard fashion described in other sections of this document.



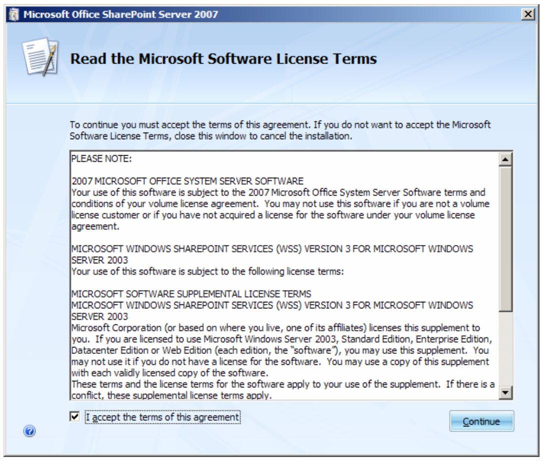
Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free	Fault Tolerance	Overhead
Application-C (N:)	Partition	Basic	NTFS	Healthy	97.65 GB	97.52 GB	99 %	No	0%
B2-01 (C:)	Partition	Basic	NTFS	Healthy (System)	78.13 GB	59.22 GB	75 %	No	0%
SQL_Server_Data (S:)	Partition	Basic	NTFS	Healthy	195.31 GB	191.18 GB	97 %	No	0%
SQL_Server_Log (T:)	Partition	Basic	NTFS	Healthy	48.82 GB	44.43 GB	91 %	No	0%

Disk 0 Basic 298.09 GB Online	**B2-01 (C:)** 78.13 GB NTFS Healthy (System)	219.96 GB Unallocated
Disk 1 Basic 298.09 GB Online	298.09 GB Unallocated	
Disk 2 Basic 97.65 GB Online	**Application-C (N:)** 97.65 GB NTFS Healthy	
Disk 3 Basic 195.31 GB Online	**SQL_Server_Data (S:)** 195.31 GB NTFS Healthy	
Disk 4 Basic 48.82 GB Online	**SQL_Server_Log (T:)** 48.82 GB NTFS Healthy	
CD-ROM 0 DVD (D:) No Media		

■ Unallocated ■ Primary partition

SharePoint Deployment

The installation wizard prompts steps through the installation with minimal interaction from the user.



Microsoft Office SharePoint Server 2007

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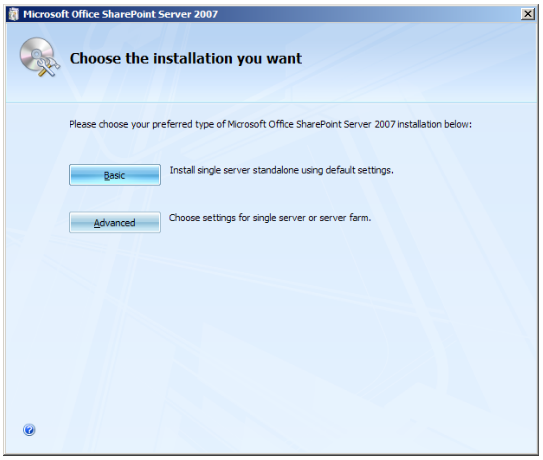
☑ I accept the terms of this agreement



Microsoft Office SharePoint Server 2007

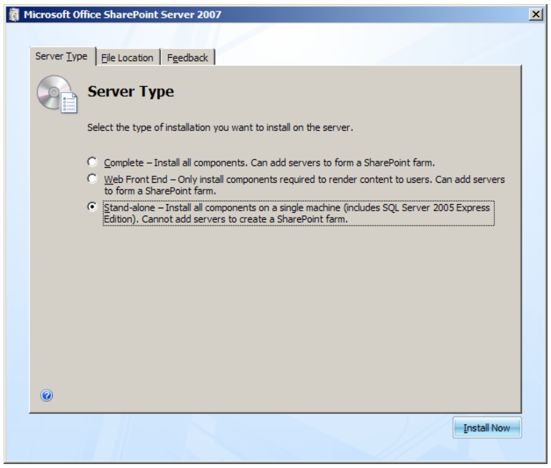
Choose the installation you want

Please choose your preferred type of Microsoft Office SharePoint Server 2007 installation below:

Basic — Install single server standalone using default settings.

Advanced — Choose settings for single server or server farm.

The Advanced installation option is chosen so that the iSCSI target device, drive letter "N", can be used for the location of all the SharePoint programs and data. A stand-alone deployment will be performed.

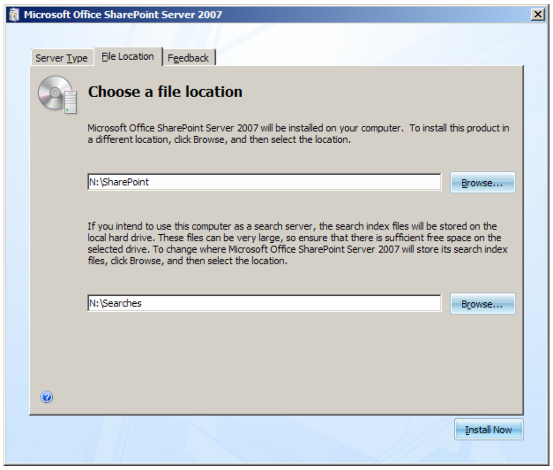


Microsoft Office SharePoint Server 2007

Server Type

Select the type of installation you want to install on the server.

○ Complete – Install all components. Can add servers to form a SharePoint farm.
○ Web Front End – Only install components required to render content to users. Can add servers to form a SharePoint farm.
● Stand-alone – Install all components on a single machine (includes SQL Server 2005 Express Edition). Cannot add servers to create a SharePoint farm.



Microsoft Office SharePoint Server 2007

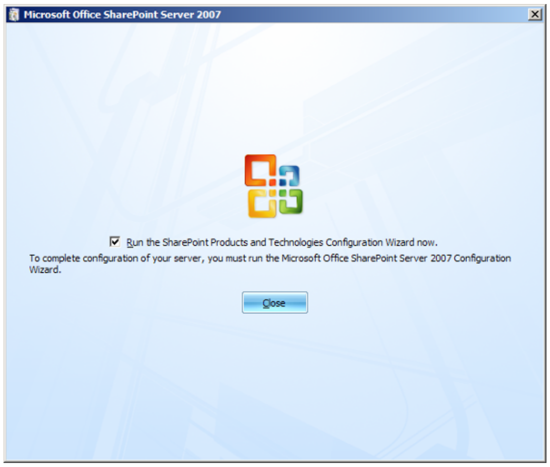
Choose a file location

Microsoft Office SharePoint Server 2007 will be installed on your computer. To install this product in a different location, click Browse, and then select the location.

N:\SharePoint

If you intend to use this computer as a search server, the search index files will be stored on the local hard drive. These files can be very large, so ensure that there is sufficient free space on the selected drive. To change where Microsoft Office SharePoint Server 2007 will store its search index files, click Browse, and then select the location.

N:\Searches

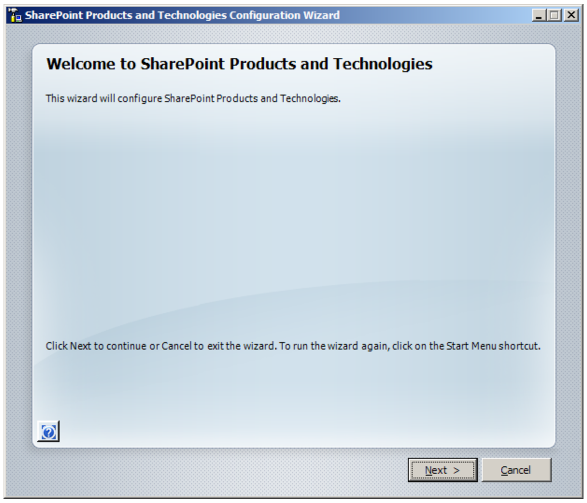


Microsoft Office SharePoint Server 2007

☑ Run the SharePoint Products and Technologies Configuration Wizard now.

To complete configuration of your server, you must run the Microsoft Office SharePoint Server 2007 Configuration Wizard.

When the installation wizard completes, the SharePoint configuration wizard is launched.

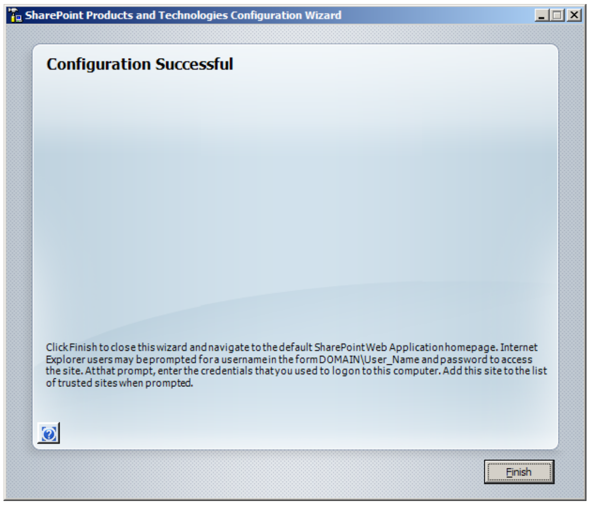


SharePoint Products and Technologies Configuration Wizard

Welcome to SharePoint Products and Technologies

This wizard will configure SharePoint Products and Technologies.

Click Next to continue or Cancel to exit the wizard. To run the wizard again, click on the Start Menu shortcut.

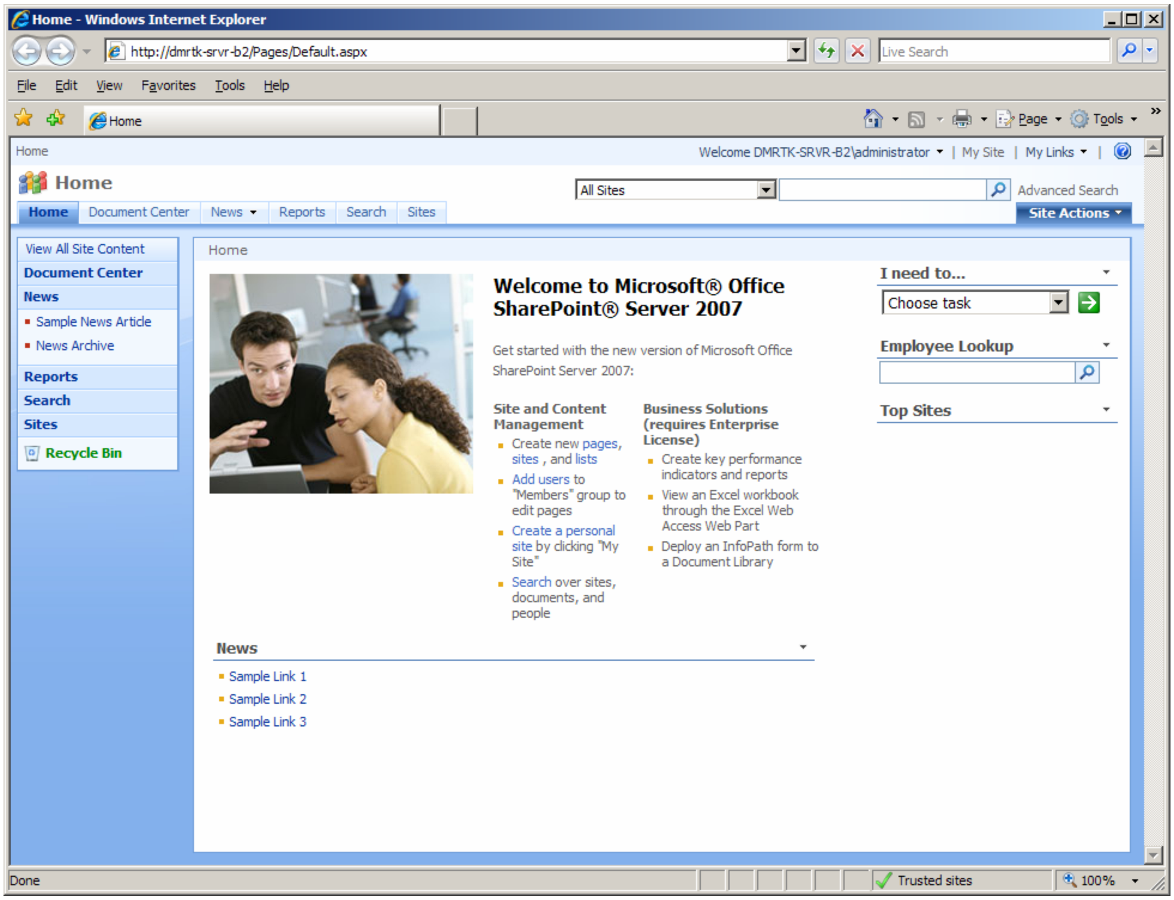


SharePoint Products and Technologies Configuration Wizard

Configuration Successful

Click Finish to close this wizard and navigate to the default SharePoint Web Application homepage. Internet Explorer users may be prompted for a username in the form DOMAIN\User_Name and password to access the site. At that prompt, enter the credentials that you used to logon to this computer. Add this site to the list of trusted sites when prompted.

After the configuration wizard finishes, the SharePoint default home page is displayed and SharePoint is ready to use.



Home - Windows Internet Explorer

http://dmrtk-srvr-b2/Pages/Default.aspx

Welcome DMRTK-SRVR-B2\administrator | My Site | My Links

Welcome to Microsoft® Office SharePoint® Server 2007

Get started with the new version of Microsoft Office SharePoint Server 2007:

Site and Content Management

- Create new pages, sites , and lists
- Add users to "Members" group to edit pages
- Create a personal site by clicking "My Site"
- Search over sites, documents, and people

Business Solutions (requires Enterprise License)

- Create key performance indicators and reports
- View an Excel workbook through the Excel Web Access Web Part
- Deploy an InfoPath form to a Document Library

Microsoft Exchange Server 2007

Microsoft Exchange Server 2007 can be deployed using an iSCSI storage solution. The basic requirements for storage for Exchange Server 2007 are that there is enough capacity, acceptable disk latency and response time, and enough disk throughput to meet service level agreements. The disk storage must be formatted using NTFS. Due to its 64-bit nature, increases in database cache and other improvements, transactional I/O requirements for Exchange Server 2007 have been reduced from previous releases.

Unlike previous versions of Exchange Server, network-attached storage is not supported in Exchange Server 2007. The only network-based storage transports supported for Exchange Server 2007 are iSCSI and Fibre Channel. In Microsoft test labs, iSCSI has been proven as a capable storage transport for Exchange Server. When high throughput is required, Microsoft recommends multiple network adapters and the use of MPIO.

Microsoft provides detailed deployment guides for Exchange Server 2007. These deployment guides include a major chapter on the planning of disk storage for Exchange Server and cover a variety of topics including storage capacity, storage technology, RAID selection, LUN sizes, storage validation (i.e. Jetstress), and more. These deployment guides are available at: http://www.microsoft.com/exchange. In addition, Microsoft has created the *Exchange Solution Reviewed Program – Storage* (ESRP), which is a Microsoft Exchange Server program designed to facilitate third-party storage testing and solution publishing for Exchange Server. Details about ESRP are available at: http://technet.microsoft.com/en-us/exchange/bb412164.aspx.

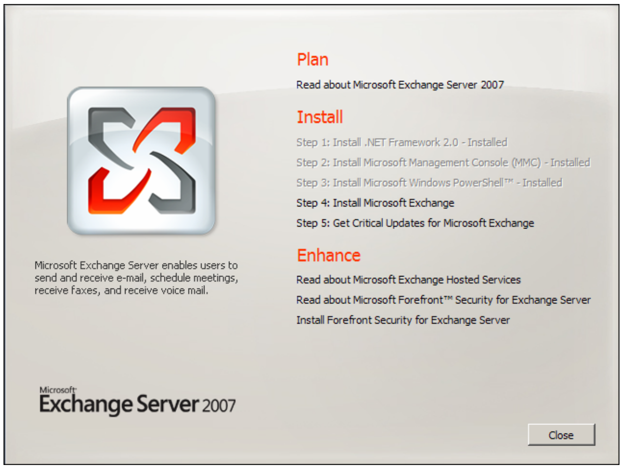
Prerequisites for Deployment

The following steps were completed on the server before installing Exchange Server 2007:

- All updates applied to Windows 2003 Server R2 Enterprise x64 Edition
- Domain controller functional level raised to Windows Server 2003 level
- Server DMRTK-SRVR-B2 joined the DEMARTEK domain
- Microsoft .NET Framework 2.0 installed on server
- Microsoft .NET Framework 2.0 x64 HotFix KB926776 applied
- Microsoft Windows PowerShell installed
- iSCSI targets logged on as volumes “M” and “N”

Exchange Server 2007 Deployment

Exchange Server 2007 provides a wizard to perform the installation.



Plan

Read about Microsoft Exchange Server 2007

Install

Step 1: Install .NET Framework 2.0 - Installed

Step 2: Install Microsoft Management Console (MMC) - Installed

Step 3: Install Microsoft Windows PowerShell™ - Installed

Step 4: Install Microsoft Exchange

Step 5: Get Critical Updates for Microsoft Exchange

Enhance

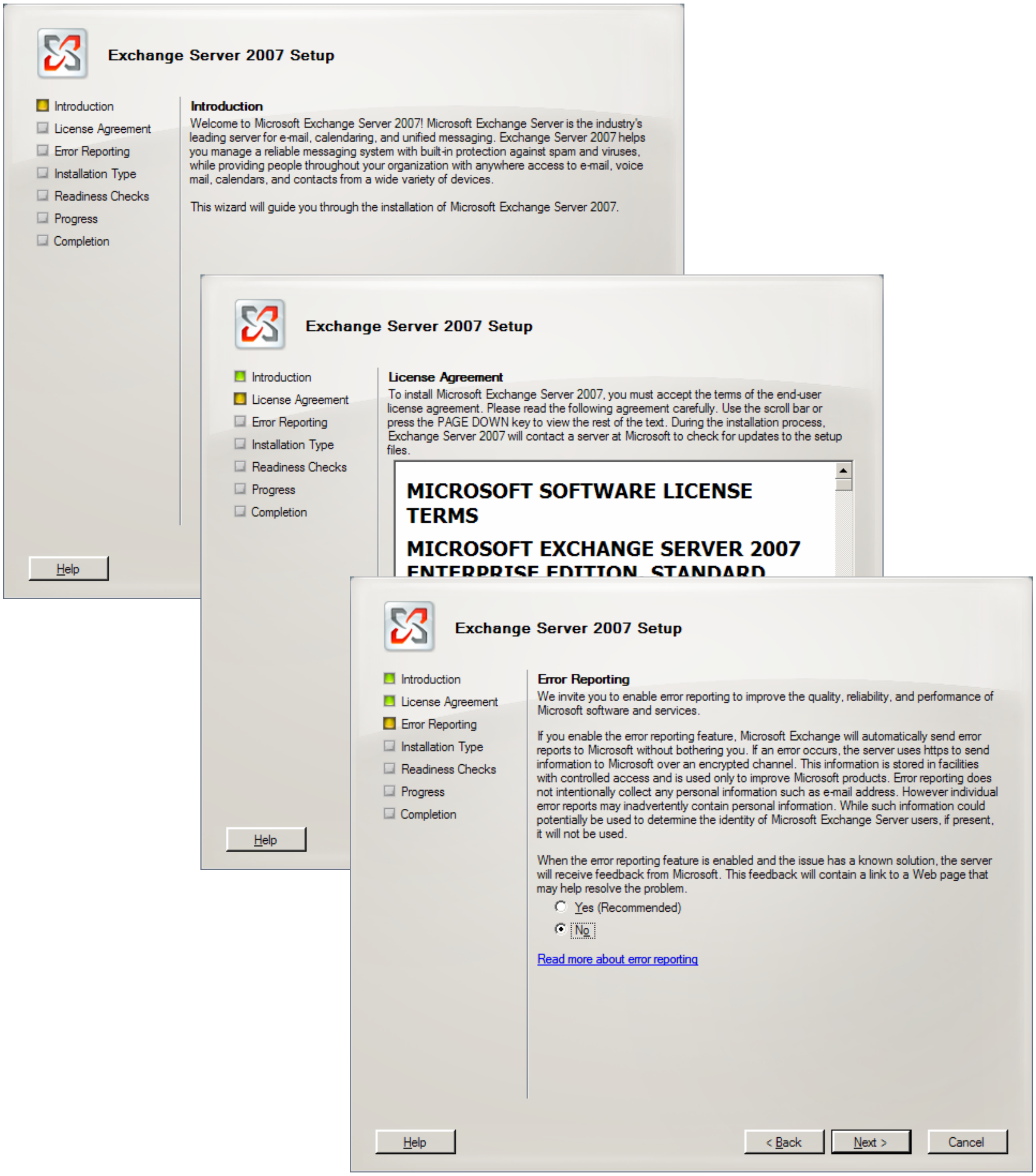
Read about Microsoft Exchange Hosted Services

Read about Microsoft Forefront™ Security for Exchange Server

Install Forefront Security for Exchange Server

Microsoft Exchange Server enables users to send and receive e-mail, schedule meetings, receive faxes, and receive voice mail.

Steps 1, 2 and 3 had already been completed before the Exchange Server 2007 installation began. The wizard was launched, license agreement reviewed and installation choices made.



Introduction

Welcome to Microsoft Exchange Server 2007! Microsoft Exchange Server is the industry's leading server for e-mail, calendaring, and unified messaging. Exchange Server 2007 helps you manage a reliable messaging system with built-in protection against spam and viruses, while providing people throughout your organization with anywhere access to e-mail, voice mail, calendars, and contacts from a wide variety of devices.

This wizard will guide you through the installation of Microsoft Exchange Server 2007.

License Agreement

To install Microsoft Exchange Server 2007, you must accept the terms of the end-user license agreement. Please read the following agreement carefully. Use the scroll bar or press the PAGE DOWN key to view the rest of the text. During the installation process, Exchange Server 2007 will contact a server at Microsoft to check for updates to the setup files.

MICROSOFT SOFTWARE LICENSE TERMS

MICROSOFT EXCHANGE SERVER 2007 ENTERPRISE EDITION, STANDARD

Error Reporting

We invite you to enable error reporting to improve the quality, reliability, and performance of Microsoft software and services.

If you enable the error reporting feature, Microsoft Exchange will automatically send error reports to Microsoft without bothering you. If an error occurs, the server uses https to send information to Microsoft over an encrypted channel. This information is stored in facilities with controlled access and is used only to improve Microsoft products. Error reporting does not intentionally collect any personal information such as e-mail address. However individual error reports may inadvertently contain personal information. While such information could potentially be used to determine the identity of Microsoft Exchange Server users, if present, it will not be used.

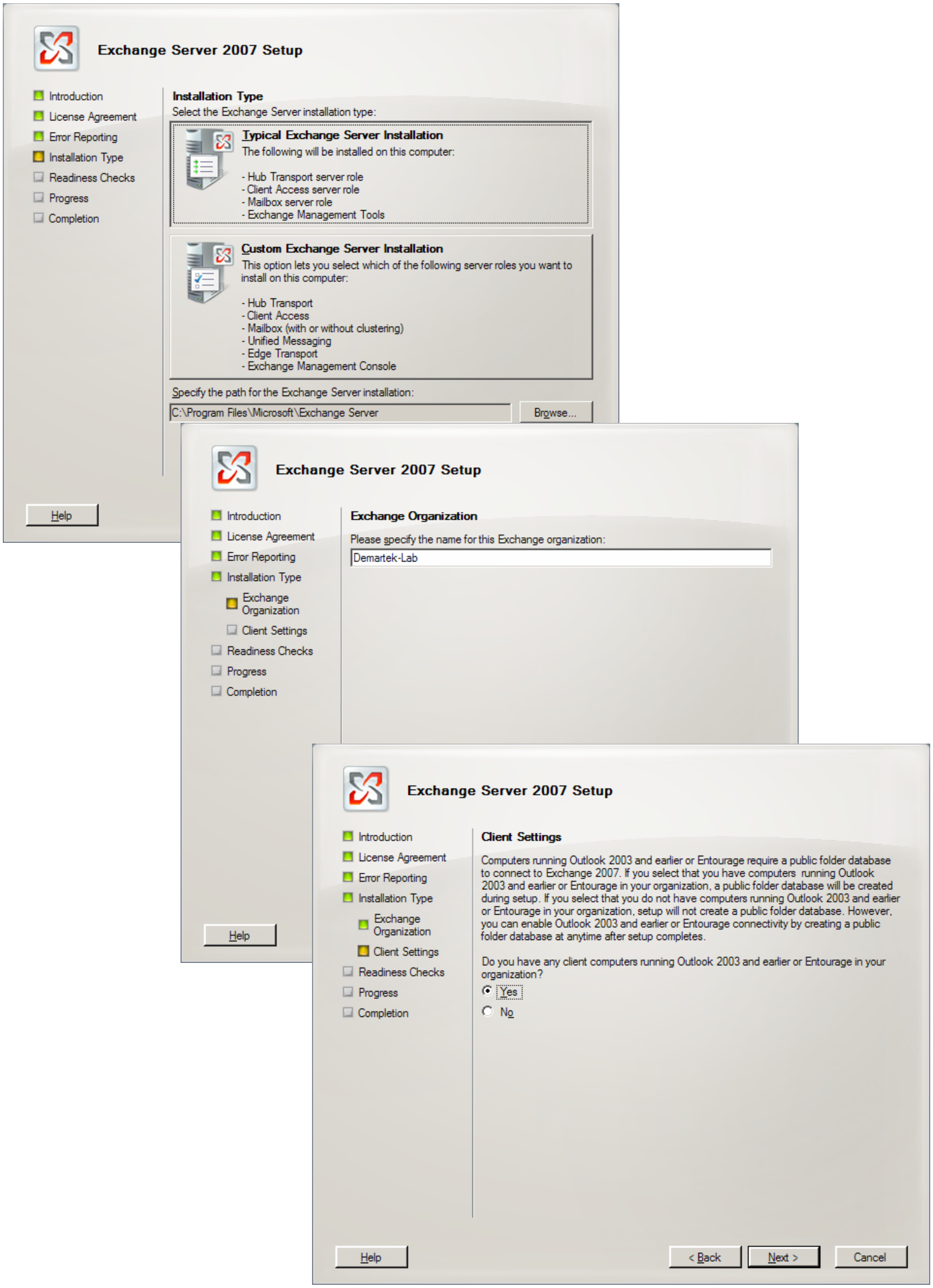
When the error reporting feature is enabled and the issue has a known solution, the server will receive feedback from Microsoft. This feedback will contain a link to a Web page that may help resolve the problem.

○ Yes (Recommended)

● No

Read more about error reporting

A “typical” installation was performed. The Exchange Server will be installed in the default location. The Exchange organization was given as “Demartek-Lab”. Outlook 2003 clients are available in this environment, so the public folder database will be created.



Installation Type

Select the Exchange Server installation type:

Typical Exchange Server Installation

The following will be installed on this computer:

- Hub Transport server role
- Client Access server role
- Mailbox server role
- Exchange Management Tools

Custom Exchange Server Installation

This option lets you select which of the following server roles you want to install on this computer:

- Hub Transport
- Client Access
- Mailbox (with or without clustering)
- Unified Messaging
- Edge Transport
- Exchange Management Console

Specify the path for the Exchange Server installation:

C:\Program Files\Microsoft\Exchange Server

Exchange Organization

Please specify the name for this Exchange organization:

Demartek-Lab

Client Settings

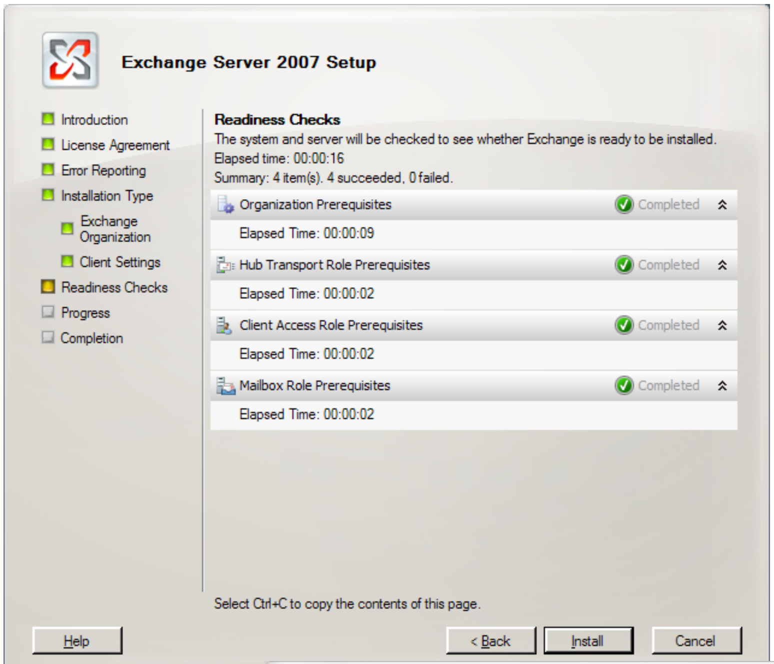
Computers running Outlook 2003 and earlier or Entourage require a public folder database to connect to Exchange 2007. If you select that you have computers running Outlook 2003 and earlier or Entourage in your organization, a public folder database will be created during setup. If you select that you do not have computers running Outlook 2003 and earlier or Entourage in your organization, setup will not create a public folder database. However, you can enable Outlook 2003 and earlier or Entourage connectivity by creating a public folder database at anytime after setup completes.

Do you have any client computers running Outlook 2003 and earlier or Entourage in your organization?

● Yes

○ No

After providing the data needed, the wizard performed the Readiness Checks then performed the actual installation.



Exchange Server 2007 Setup

Readiness Checks

The system and server will be checked to see whether Exchange is ready to be installed.
Elapsed time: 00:00:16
Summary: 4 item(s). 4 succeeded, 0 failed.

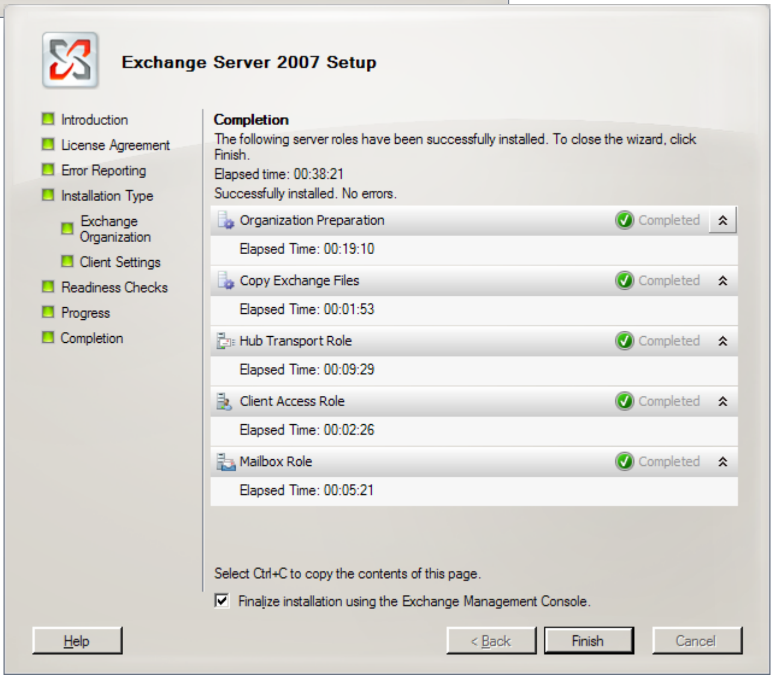
Organization Prerequisites ✓ Completed
Elapsed Time: 00:00:09

Hub Transport Role Prerequisites ✓ Completed
Elapsed Time: 00:00:02

Client Access Role Prerequisites ✓ Completed
Elapsed Time: 00:00:02

Mailbox Role Prerequisites ✓ Completed
Elapsed Time: 00:00:02

Select Ctrl+C to copy the contents of this page.



Exchange Server 2007 Setup

Completion

The following server roles have been successfully installed. To close the wizard, click Finish.
Elapsed time: 00:38:21
Successfully installed. No errors.

Organization Preparation ✓ Completed
Elapsed Time: 00:19:10

Copy Exchange Files ✓ Completed
Elapsed Time: 00:01:53

Hub Transport Role ✓ Completed
Elapsed Time: 00:09:29

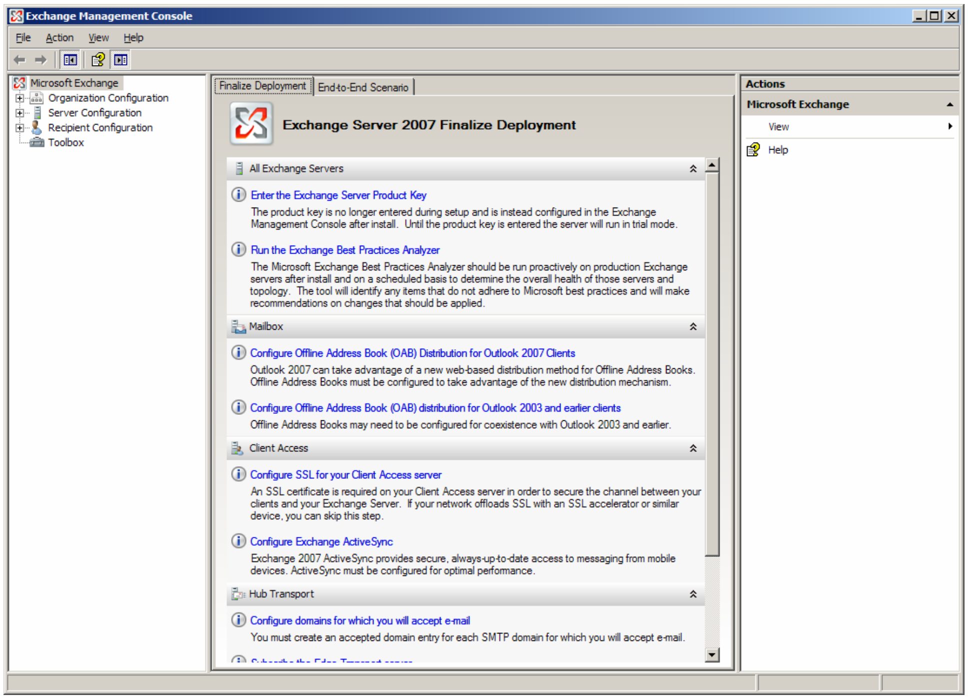
Client Access Role ✓ Completed
Elapsed Time: 00:02:26

Mailbox Role ✓ Completed
Elapsed Time: 00:05:21

Select Ctrl+C to copy the contents of this page.

☑ Finalize installation using the Exchange Management Console.

Update Rollup 1 for Exchange Server 2007 was applied, and then the Exchange Server Management Console was launched.



Exchange Server 2007 Finalize Deployment

All Exchange Servers

Enter the Exchange Server Product Key

The product key is no longer entered during setup and is instead configured in the Exchange Management Console after install. Until the product key is entered the server will run in trial mode.

Run the Exchange Best Practices Analyzer

The Microsoft Exchange Best Practices Analyzer should be run proactively on production Exchange servers after install and on a scheduled basis to determine the overall health of those servers and topology. The tool will identify any items that do not adhere to Microsoft best practices and will make recommendations on changes that should be applied.

Mailbox

Configure Offline Address Book (OAB) Distribution for Outlook 2007 Clients

Outlook 2007 can take advantage of a new web-based distribution method for Offline Address Books. Offline Address Books must be configured to take advantage of the new distribution mechanism.

Configure Offline Address Book (OAB) distribution for Outlook 2003 and earlier clients

Offline Address Books may need to be configured for coexistence with Outlook 2003 and earlier.

Client Access

Configure SSL for your Client Access server

An SSL certificate is required on your Client Access server in order to secure the channel between your clients and your Exchange Server. If your network offloads SSL with an SSL accelerator or similar device, you can skip this step.

Configure Exchange ActiveSync

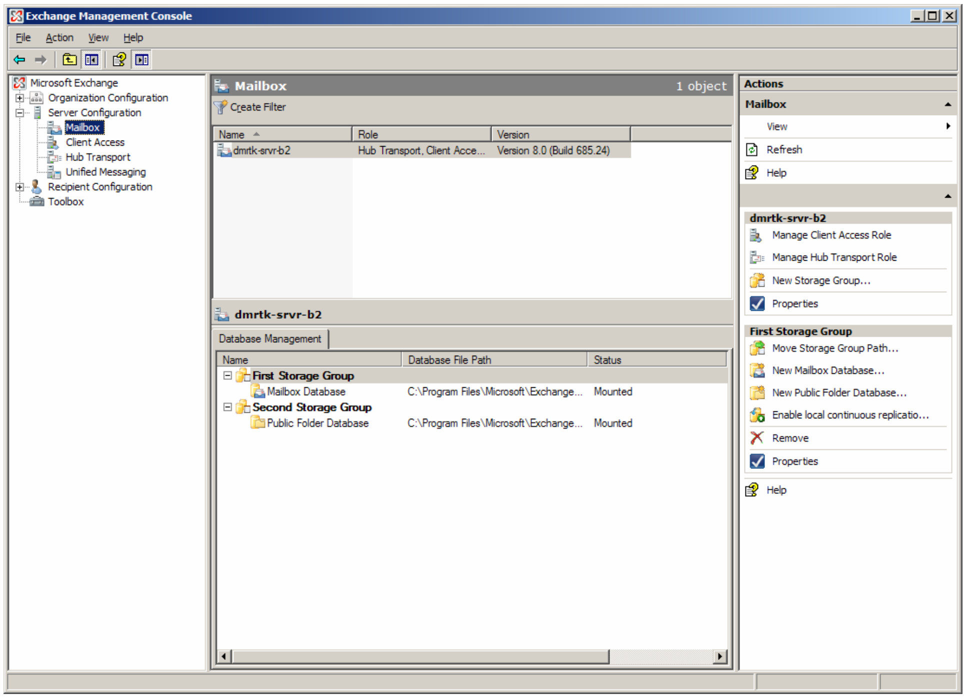
Exchange 2007 ActiveSync provides secure, always-up-to-date access to messaging from mobile devices. ActiveSync must be configured for optimal performance.

Hub Transport

Configure domains for which you will accept e-mail

You must create an accepted domain entry for each SMTP domain for which you will accept e-mail.

Clicking the "Mailbox" item in the left panel revealed the details of the Exchange storage groups.



Mailbox 1 object

Create Filter

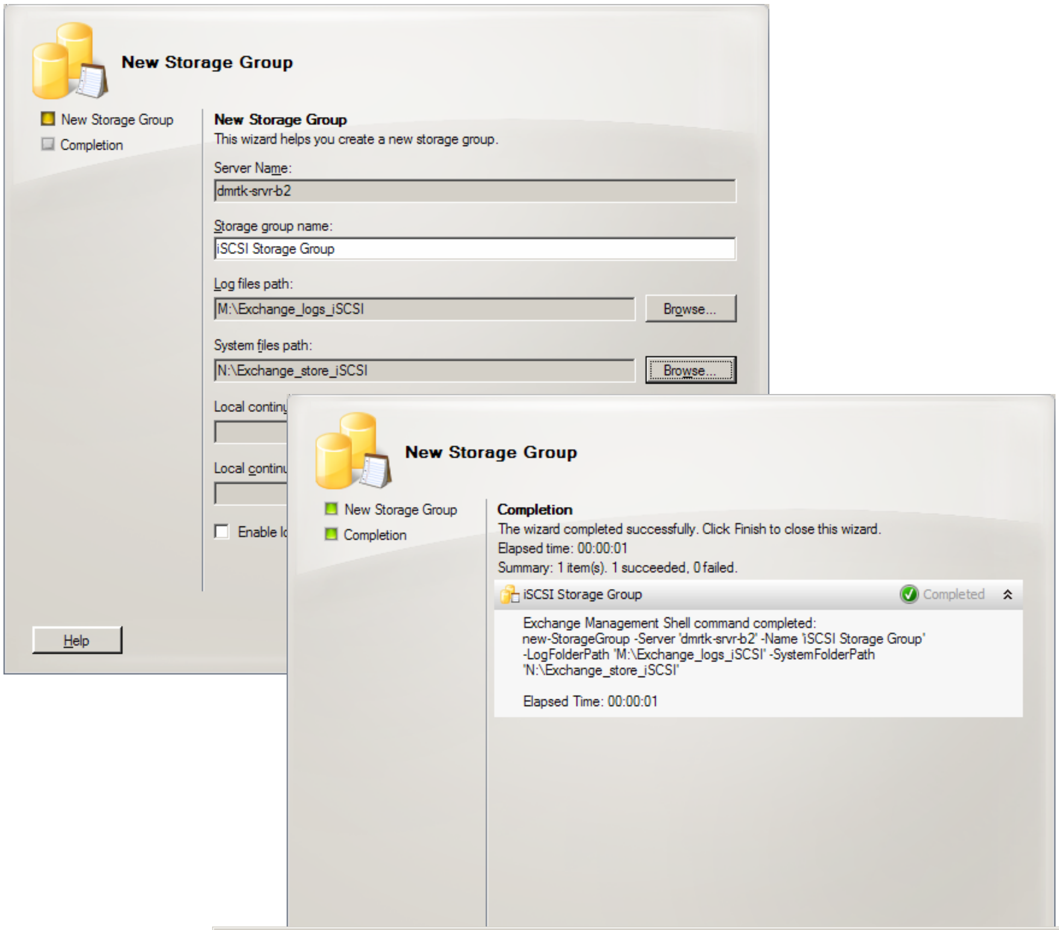
Name	Role	Version
dmrtk-srvr-b2	Hub Transport, Client Acce...	Version 8.0 (Build 685.24)

dmrtk-srvr-b2

Database Management

Name	Database File Path	Status
First Storage Group		
Mailbox Database	C:\Program Files\Microsoft\Exchange...	Mounted
Second Storage Group		
Public Folder Database	C:\Program Files\Microsoft\Exchange...	Mounted

A new storage group will be created on the iSCSI target devices. The logs will be placed on the “M” volume and the data store will be on the “N” volume.



New Storage Group

This wizard helps you create a new storage group.

Server Name: dmrtk-srvr-b2

Storage group name: iSCSI Storage Group

Log files path: M:\Exchange_logs_iSCSI

System files path: N:\Exchange_store_iSCSI

Completion

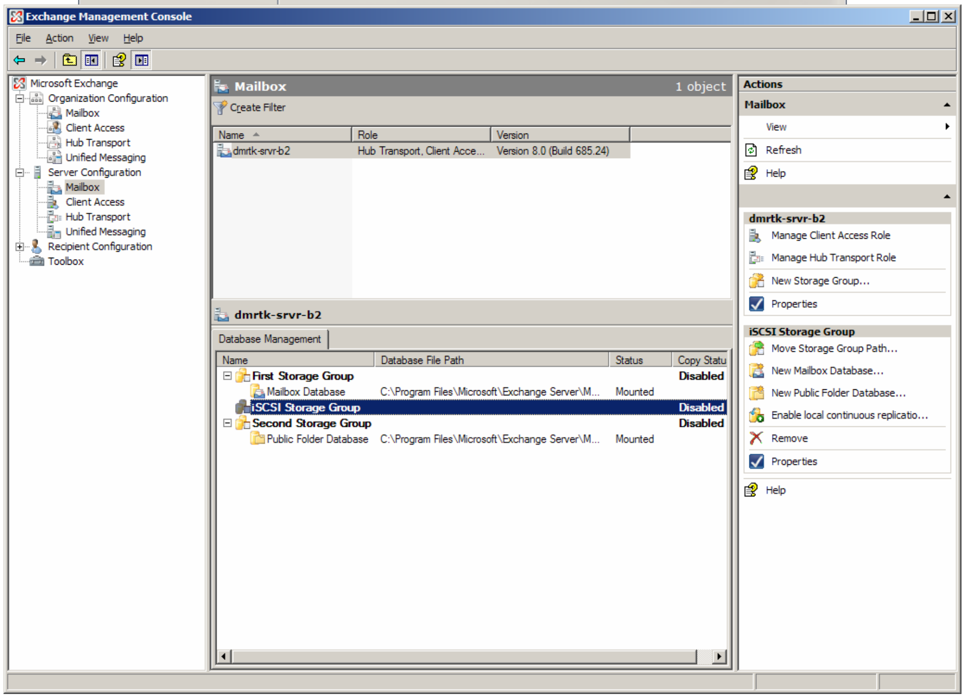
The wizard completed successfully. Click Finish to close this wizard.
Elapsed time: 00:00:01
Summary: 1 item(s). 1 succeeded, 0 failed.

iSCSI Storage Group — Completed

Exchange Management Shell command completed:
new-StorageGroup -Server 'dmrtk-srvr-b2' -Name 'iSCSI Storage Group' -LogFolderPath 'M:\Exchange_logs_iSCSI' -SystemFolderPath 'N:\Exchange_store_iSCSI'

Elapsed Time: 00:00:01

The iSCSI Storage Group now appears with the First Storage Group.

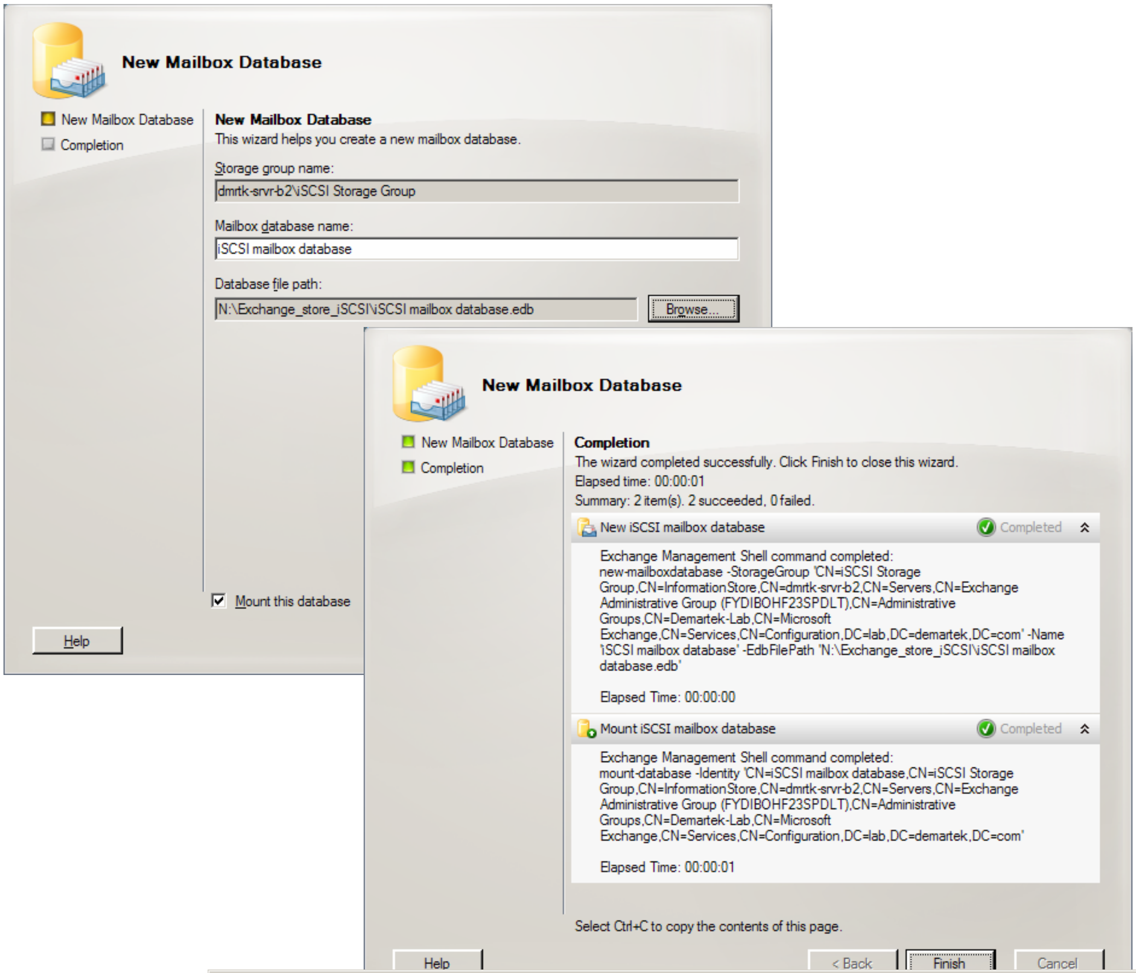


Exchange Management Console

Name	Role	Version
dmrtk-srvr-b2	Hub Transport, Client Acce...	Version 8.0 (Build 685.24)

Name	Database File Path	Status	Copy Statu
First Storage Group			Disabled
Mailbox Database	C:\Program Files\Microsoft\Exchange Server\M...	Mounted	
iSCSI Storage Group			Disabled
Second Storage Group			Disabled
Public Folder Database	C:\Program Files\Microsoft\Exchange Server\M...	Mounted	

A new mailbox database will be created and mounted on the “N” iSCSI target volume.



New Mailbox Database

New Mailbox Database

This wizard helps you create a new mailbox database.

Storage group name: dmrtk-srvr-b2\iSCSI Storage Group

Mailbox database name: iSCSI mailbox database

Database file path: N:\Exchange_store_iSCSI\iSCSI mailbox database.edb

☑ Mount this database

New Mailbox Database

Completion

The wizard completed successfully. Click Finish to close this wizard.

Elapsed time: 00:00:01

Summary: 2 item(s). 2 succeeded, 0 failed.

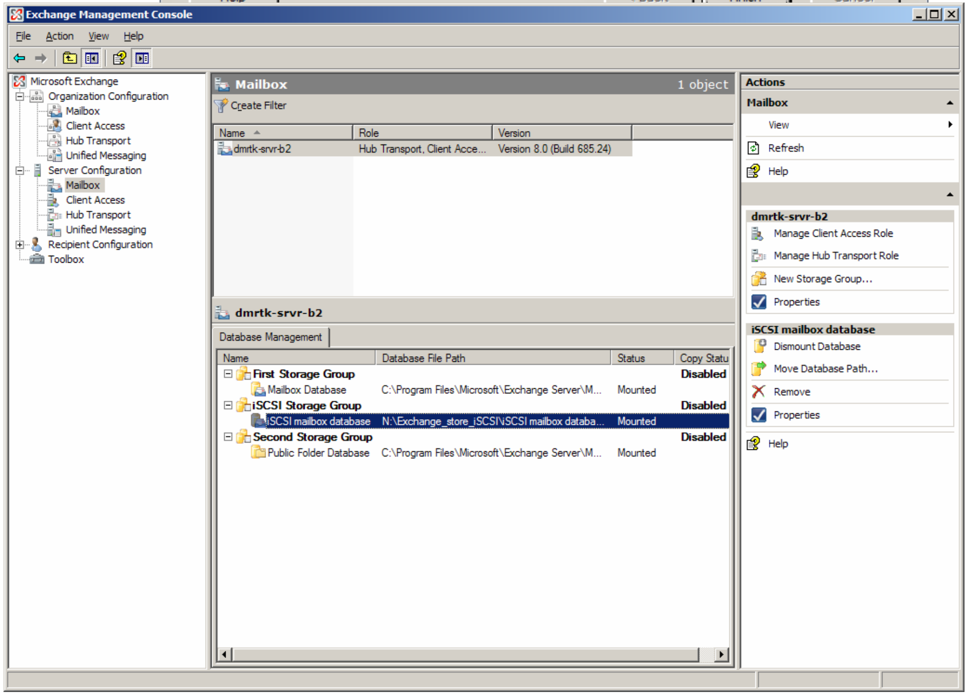
New iSCSI mailbox database ✓ Completed

```
Exchange Management Shell command completed:
new-mailboxdatabase -StorageGroup 'CN=iSCSI Storage
Group,CN=InformationStore,CN=dmrtk-srvr-b2,CN=Servers,CN=Exchange
Administrative Group (FYDIBOHF23SPDLT),CN=Administrative
Groups,CN=Demartek-Lab,CN=Microsoft
Exchange,CN=Services,CN=Configuration,DC=lab,DC=demartek,DC=com' -Name
'iSCSI mailbox database' -EdbFilePath 'N:\Exchange_store_iSCSI\iSCSI mailbox
database.edb'

Elapsed Time: 00:00:00
```

Mount iSCSI mailbox database ✓ Completed

```
Exchange Management Shell command completed:
mount-database -Identity 'CN=iSCSI mailbox database,CN=iSCSI Storage
Group,CN=InformationStore,CN=dmrtk-srvr-b2,CN=Servers,CN=Exchange
Administrative Group (FYDIBOHF23SPDLT),CN=Administrative
Groups,CN=Demartek-Lab,CN=Microsoft
Exchange,CN=Services,CN=Configuration,DC=lab,DC=demartek,DC=com'

Elapsed Time: 00:00:01
```

Select Ctrl+C to copy the contents of this page.



Exchange Management Console

Mailbox 1 object

Name	Role	Version
dmrtk-srvr-b2	Hub Transport, Client Acce...	Version 8.0 (Build 685.24)

dmrtk-srvr-b2

Database Management

Name	Database File Path	Status	Copy Statu
First Storage Group			**Disabled**
Mailbox Database	C:\Program Files\Microsoft\Exchange Server\M...	Mounted	
iSCSI Storage Group			**Disabled**
iSCSI mailbox database	N:\Exchange_store_iSCSI\iSCSI mailbox databa...	Mounted	
Second Storage Group			**Disabled**
Public Folder Database	C:\Program Files\Microsoft\Exchange Server\M...	Mounted	

The new mailbox is now ready for use.

Microsoft SQL Server 2005

SQL Server 2005 can use iSCSI storage solutions for databases, log files and other SQL-related files in much the same way that it can use other storage technologies. Network-attached storage (NAS) storage is not recommended for SQL Server data, but iSCSI is a capable storage transport for SQL Server data. High throughput with iSCSI can be obtained by using multiple network adapters with MPIO. Microsoft provides extensive information regarding SQL Server at http://www.microsoft.com/sqlserver.

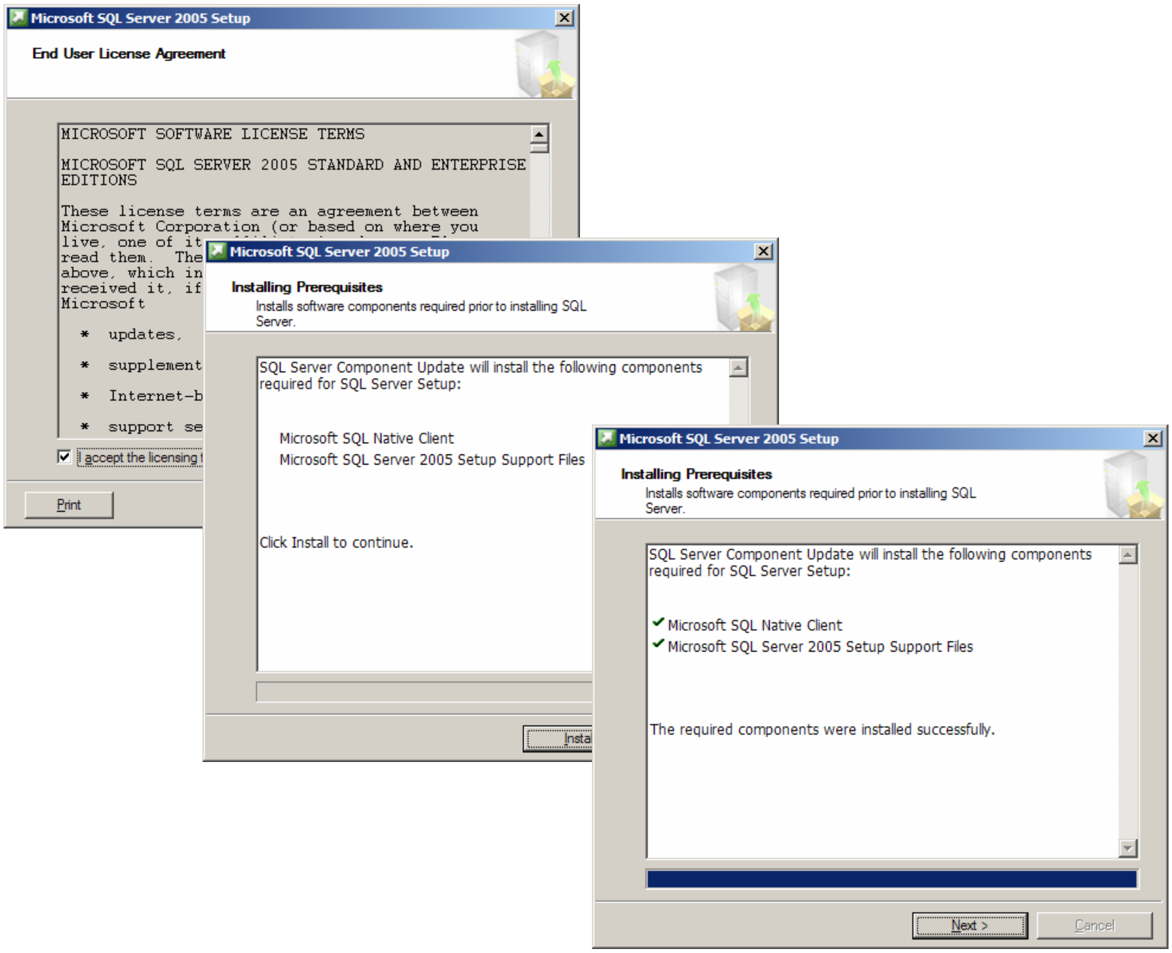
Prerequisites for Deployment

SQL Server 2005 was installed onto server DMRTK-SRVR-A2, which was running Windows 2003 Server R2 Enterprise x64 Edition. The following steps were completed on the server before installing SQL Server 2005:

- All updates applied to Windows 2003 Server R2 Enterprise x64 Edition
- Microsoft .NET Framework 2.0 installed on server
- iSCSI targets logged on as volumes "Q" and "R"

SQL Server 2005 Deployment

SQL Server 2005 provides a wizard to perform the installation. Most of the defaults were selected. First the wizard checked for SQL Server prerequisites.



Microsoft SQL Server 2005 Setup
End User License Agreement

```
MICROSOFT SOFTWARE LICENSE TERMS

MICROSOFT SQL SERVER 2005 STANDARD AND ENTERPRISE
EDITIONS

These license terms are an agreement between
Microsoft Corporation (or based on where you
live, one of it
read them.  The
above, which in
received it, if
Microsoft

  *  updates,

  *  supplement

  *  Internet-b

  *  support se
```

☑ I accept the licensing t
Print
Microsoft SQL Server 2005 Setup
Installing Prerequisites
Installs software components required prior to installing SQL Server.

SQL Server Component Update will install the following components required for SQL Server Setup:

Microsoft SQL Native Client
Microsoft SQL Server 2005 Setup Support Files

Click Install to continue.

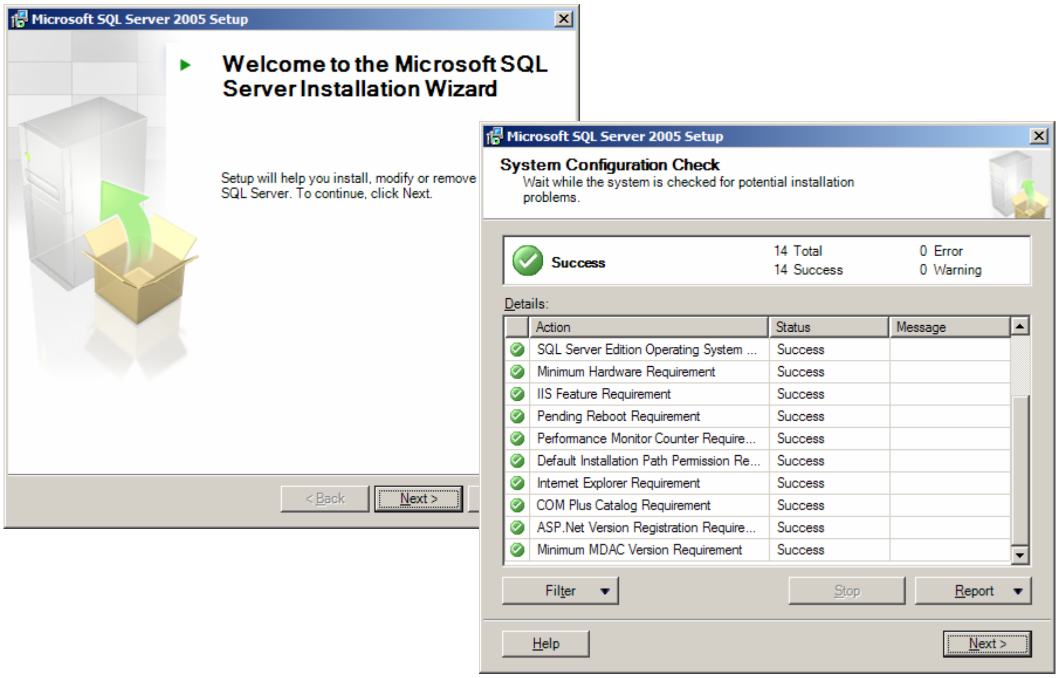
Insta
Microsoft SQL Server 2005 Setup
Installing Prerequisites
Installs software components required prior to installing SQL Server.

SQL Server Component Update will install the following components required for SQL Server Setup:

✓ Microsoft SQL Native Client
✓ Microsoft SQL Server 2005 Setup Support Files

The required components were installed successfully.

After the SQL Server prerequisites were completed, the main installation began.



Microsoft SQL Server 2005 Setup

Welcome to the Microsoft SQL Server Installation Wizard

Setup will help you install, modify or remove SQL Server. To continue, click Next.

< Back | Next >

Microsoft SQL Server 2005 Setup

System Configuration Check

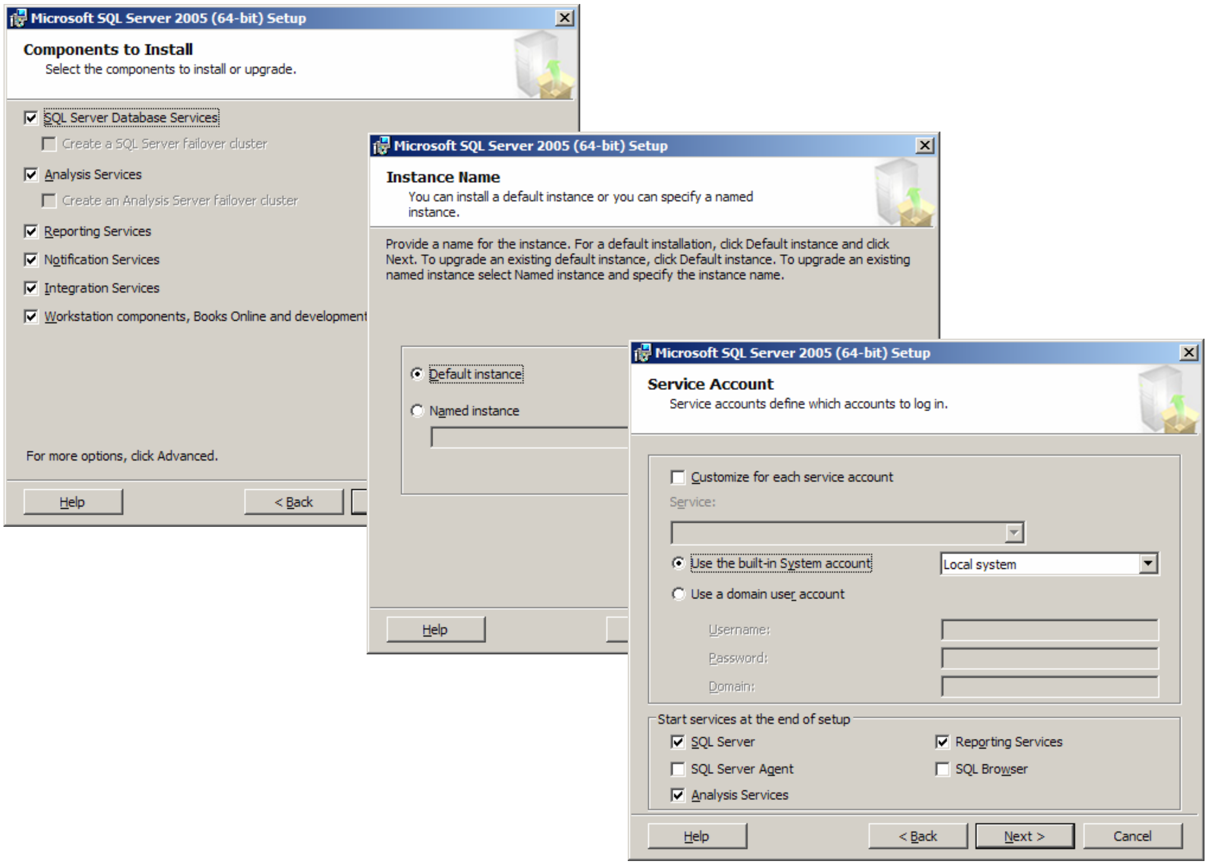
Wait while the system is checked for potential installation problems.

Success — 14 Total, 14 Success, 0 Error, 0 Warning

Details:

Action	Status	Message
SQL Server Edition Operating System ...	Success	
Minimum Hardware Requirement	Success	
IIS Feature Requirement	Success	
Pending Reboot Requirement	Success	
Performance Monitor Counter Require...	Success	
Default Installation Path Permission Re...	Success	
Internet Explorer Requirement	Success	
COM Plus Catalog Requirement	Success	
ASP.Net Version Registration Require...	Success	
Minimum MDAC Version Requirement	Success	

All the SQL Server components were installed. Most of the other defaults were chosen.



Microsoft SQL Server 2005 (64-bit) Setup

Components to Install

Select the components to install or upgrade.

- ☑ SQL Server Database Services
  - □ Create a SQL Server failover cluster
- ☑ Analysis Services
  - □ Create an Analysis Server failover cluster
- ☑ Reporting Services
- ☑ Notification Services
- ☑ Integration Services
- ☑ Workstation components, Books Online and development

For more options, click Advanced.

Microsoft SQL Server 2005 (64-bit) Setup

Instance Name

You can install a default instance or you can specify a named instance.

Provide a name for the instance. For a default installation, click Default instance and click Next. To upgrade an existing default instance, click Default instance. To upgrade an existing named instance select Named instance and specify the instance name.

- ● Default instance
- ○ Named instance

Microsoft SQL Server 2005 (64-bit) Setup

Service Account

Service accounts define which accounts to log in.

□ Customize for each service account

Service:

● Use the built-in System account: Local system

○ Use a domain user account

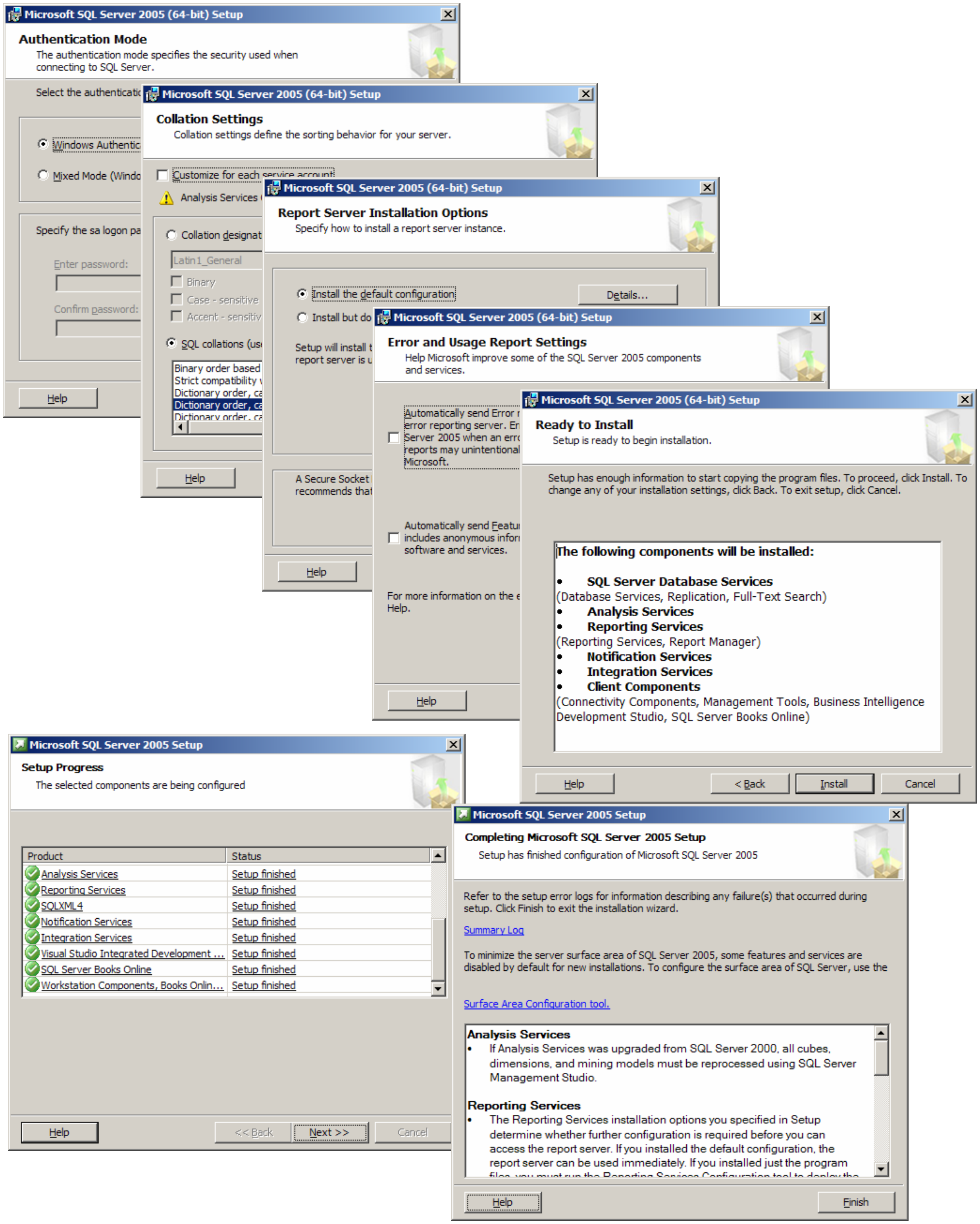
Username:

Password:

Domain:

Start services at the end of setup

☑ SQL Server	☑ Reporting Services
□ SQL Server Agent	□ SQL Browser
☑ Analysis Services	



Microsoft SQL Server 2005 (64-bit) Setup

Authentication Mode

The authentication mode specifies the security used when connecting to SQL Server.

Select the authenticati

● Windows Authentic

○ Mixed Mode (Windo

Specify the sa logon pa

Enter password:

Confirm password:

Help

Microsoft SQL Server 2005 (64-bit) Setup

Collation Settings

Collation settings define the sorting behavior for your server.

□ Customize for each service account

⚠ Analysis Services

○ Collation designat

Latin1_General

□ Binary

□ Case - sensitive

□ Accent - sensitiv

● SQL collations (us

Binary order based
Strict compatibility
Dictionary order, ca
Dictionary order, ca
Dictionary order, ca

Help

Microsoft SQL Server 2005 (64-bit) Setup

Report Server Installation Options

Specify how to install a report server instance.

● Install the default configuration

Details...

○ Install but do

Setup will install t
report server is u

A Secure Socket
recommends that

Help

Microsoft SQL Server 2005 (64-bit) Setup

Error and Usage Report Settings

Help Microsoft improve some of the SQL Server 2005 components and services.

□ Automatically send Error r
error reporting server. Er
Server 2005 when an err
reports may unintentional
Microsoft.

□ Automatically send Featu
includes anonymous infor
software and services.

For more information on the e
Help.

Help

Microsoft SQL Server 2005 (64-bit) Setup

Ready to Install

Setup is ready to begin installation.

Setup has enough information to start copying the program files. To proceed, click Install. To change any of your installation settings, click Back. To exit setup, click Cancel.

The following components will be installed:

- **SQL Server Database Services**
(Database Services, Replication, Full-Text Search)
- **Analysis Services**
- **Reporting Services**
(Reporting Services, Report Manager)
- **Notification Services**
- **Integration Services**
- **Client Components**
(Connectivity Components, Management Tools, Business Intelligence Development Studio, SQL Server Books Online)

Help | < Back | Install | Cancel

Microsoft SQL Server 2005 Setup

Setup Progress

The selected components are being configured

Product	Status
Analysis Services	Setup finished
Reporting Services	Setup finished
SQLXML4	Setup finished
Notification Services	Setup finished
Integration Services	Setup finished
Visual Studio Integrated Development ...	Setup finished
SQL Server Books Online	Setup finished
Workstation Components, Books Onlin...	Setup finished

Help | << Back | Next >> | Cancel

Microsoft SQL Server 2005 Setup

Completing Microsoft SQL Server 2005 Setup

Setup has finished configuration of Microsoft SQL Server 2005

Refer to the setup error logs for information describing any failure(s) that occurred during setup. Click Finish to exit the installation wizard.

Summary Log

To minimize the server surface area of SQL Server 2005, some features and services are disabled by default for new installations. To configure the surface area of SQL Server, use the

Surface Area Configuration tool.

Analysis Services

- If Analysis Services was upgraded from SQL Server 2000, all cubes, dimensions, and mining models must be reprocessed using SQL Server Management Studio.

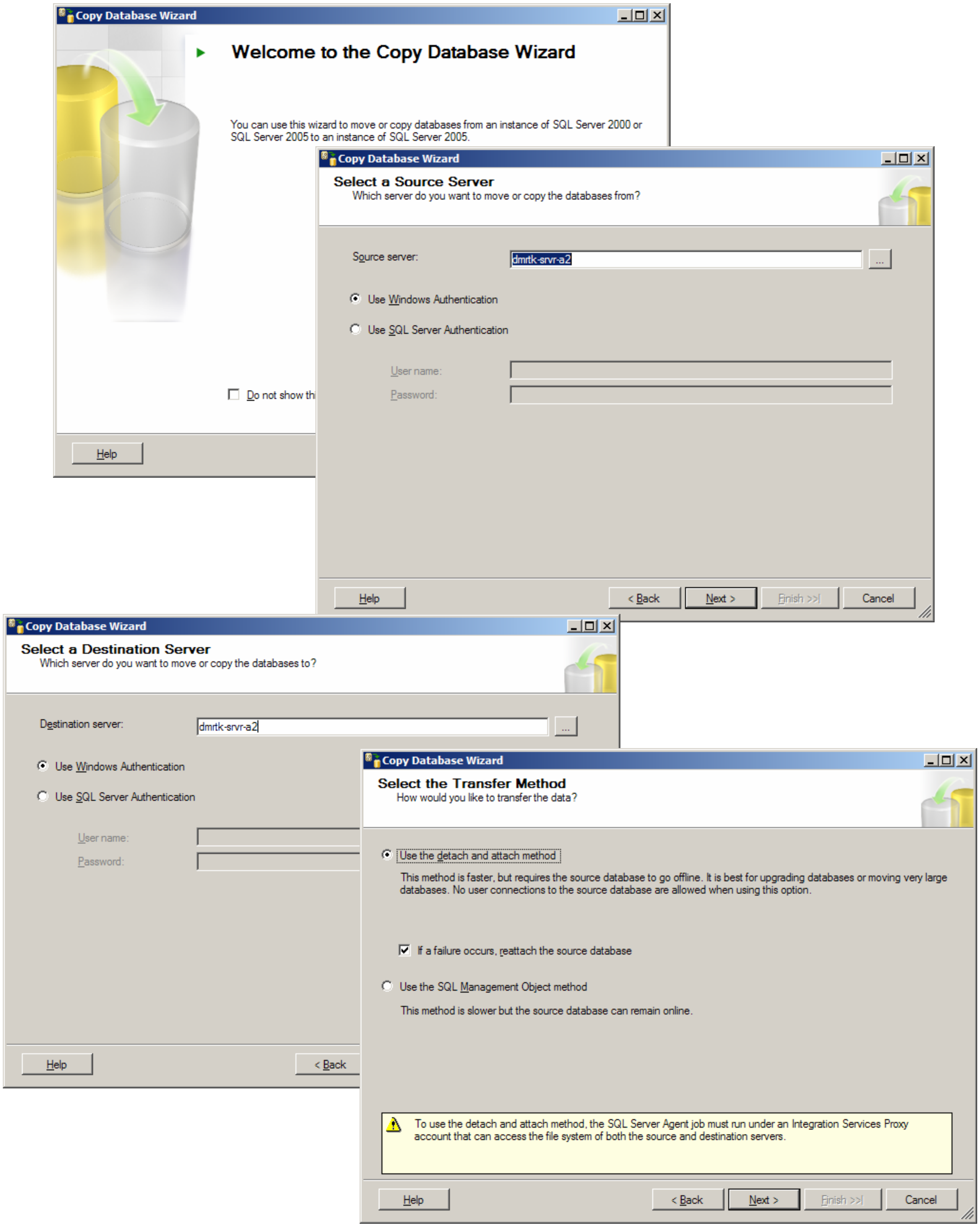
Reporting Services

- The Reporting Services installation options you specified in Setup determine whether further configuration is required before you can access the report server. If you installed the default configuration, the report server can be used immediately. If you installed just the program

Help | Finish

The installation completed successfully. After the installation, the system was rebooted. SQL Server 2005 Service Pack 2 was installed after the reboot.

The sample AdventureWorks databases were installed into the default SQL Server file location. The Copy Database Wizard was used from within SQL Server Management Studio to copy the AdventureWorks database and AdventureWorksDW (data warehouse) to the iSCSI target volumes “Q” and “R”. Volume “Q” was used for the data and volume “R” was used for the SQL logs. The source and destination server were the same, but the destination file location was set to the iSCSI target volumes.



Copy Database Wizard

Welcome to the Copy Database Wizard

You can use this wizard to move or copy databases from an instance of SQL Server 2000 or SQL Server 2005 to an instance of SQL Server 2005.

☐ Do not show th

Copy Database Wizard

Select a Source Server

Which server do you want to move or copy the databases from?

Source server: dmrtk-srvr-a2

● Use Windows Authentication

○ Use SQL Server Authentication

User name:

Password:

Copy Database Wizard

Select a Destination Server

Which server do you want to move or copy the databases to?

Destination server: dmrtk-srvr-a2

● Use Windows Authentication

○ Use SQL Server Authentication

User name:

Password:

Copy Database Wizard

Select the Transfer Method

How would you like to transfer the data?

● Use the detach and attach method

This method is faster, but requires the source database to go offline. It is best for upgrading databases or moving very large databases. No user connections to the source database are allowed when using this option.

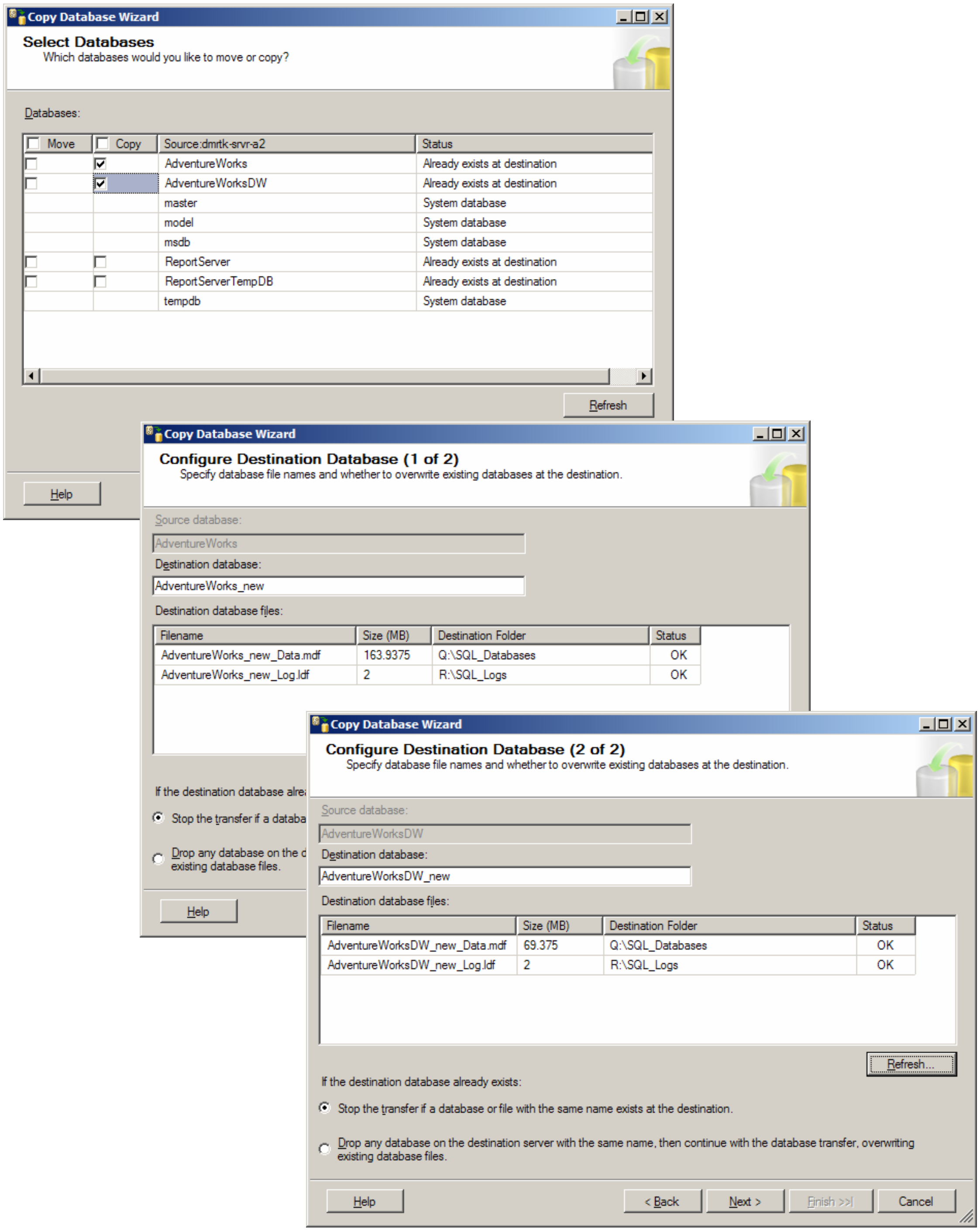
☑ If a failure occurs, reattach the source database

○ Use the SQL Management Object method

This method is slower but the source database can remain online.

⚠ To use the detach and attach method, the SQL Server Agent job must run under an Integration Services Proxy account that can access the file system of both the source and destination servers.

The wizard prompts for the file locations. The source files were in the default location from installation. The destination files were the iSCSI target volumes. Two databases, the AdventureWorks and AdventureWorksDW were copied. The data files were copied to the “Q” volume and the logs were copied to the “R” volume.



Copy Database Wizard

Select Databases
Which databases would you like to move or copy?

Databases:

□ Move	□ Copy	Source:dmrtk-srvr-a2	Status
□	☑	AdventureWorks	Already exists at destination
□	☑	AdventureWorksDW	Already exists at destination
		master	System database
		model	System database
		msdb	System database
□	□	ReportServer	Already exists at destination
□	□	ReportServerTempDB	Already exists at destination
		tempdb	System database

Copy Database Wizard

Configure Destination Database (1 of 2)
Specify database file names and whether to overwrite existing databases at the destination.

Source database: AdventureWorks

Destination database: AdventureWorks_new

Destination database files:

Filename	Size (MB)	Destination Folder	Status
AdventureWorks_new_Data.mdf	163.9375	Q:\SQL_Databases	OK
AdventureWorks_new_Log.ldf	2	R:\SQL_Logs	OK

If the destination database alre

● Stop the transfer if a databa

○ Drop any database on the d existing database files.

Copy Database Wizard

Configure Destination Database (2 of 2)
Specify database file names and whether to overwrite existing databases at the destination.

Source database: AdventureWorksDW

Destination database: AdventureWorksDW_new

Destination database files:

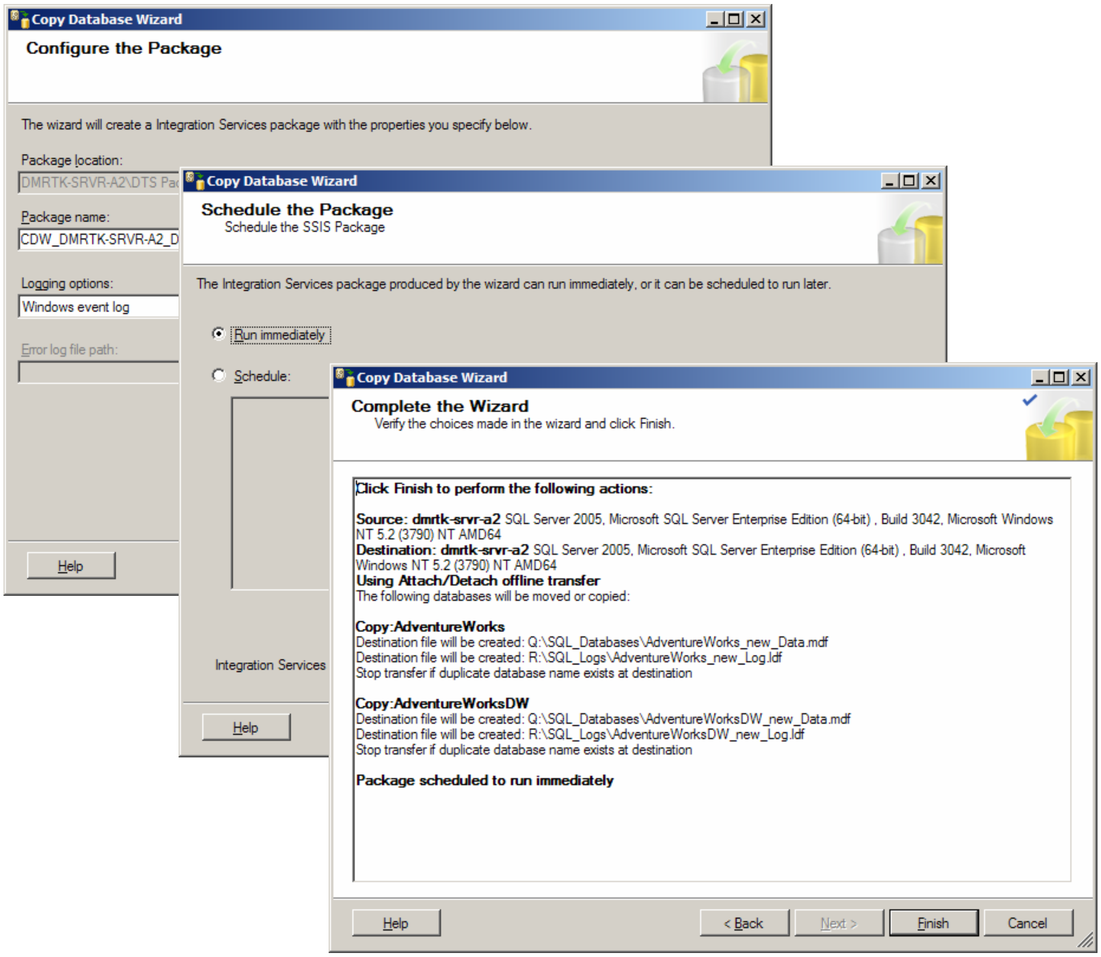
Filename	Size (MB)	Destination Folder	Status
AdventureWorksDW_new_Data.mdf	69.375	Q:\SQL_Databases	OK
AdventureWorksDW_new_Log.ldf	2	R:\SQL_Logs	OK

If the destination database already exists:

● Stop the transfer if a database or file with the same name exists at the destination.

○ Drop any database on the destination server with the same name, then continue with the database transfer, overwriting existing database files.

The Integration Services package was configured and run immediately with the SQL Server Agent service account.



Configure the Package

The wizard will create a Integration Services package with the properties you specify below.

Package location: DMRTK-SRVR-A2\DTS Pa

Package name: CDW_DMRTK-SRVR-A2_D

Logging options: Windows event log

Error log file path:

Schedule the Package
Schedule the SSIS Package

The Integration Services package produced by the wizard can run immediately, or it can be scheduled to run later.

● Run immediately

○ Schedule:

Integration Services

Complete the Wizard
Verify the choices made in the wizard and click Finish.

Click Finish to perform the following actions:

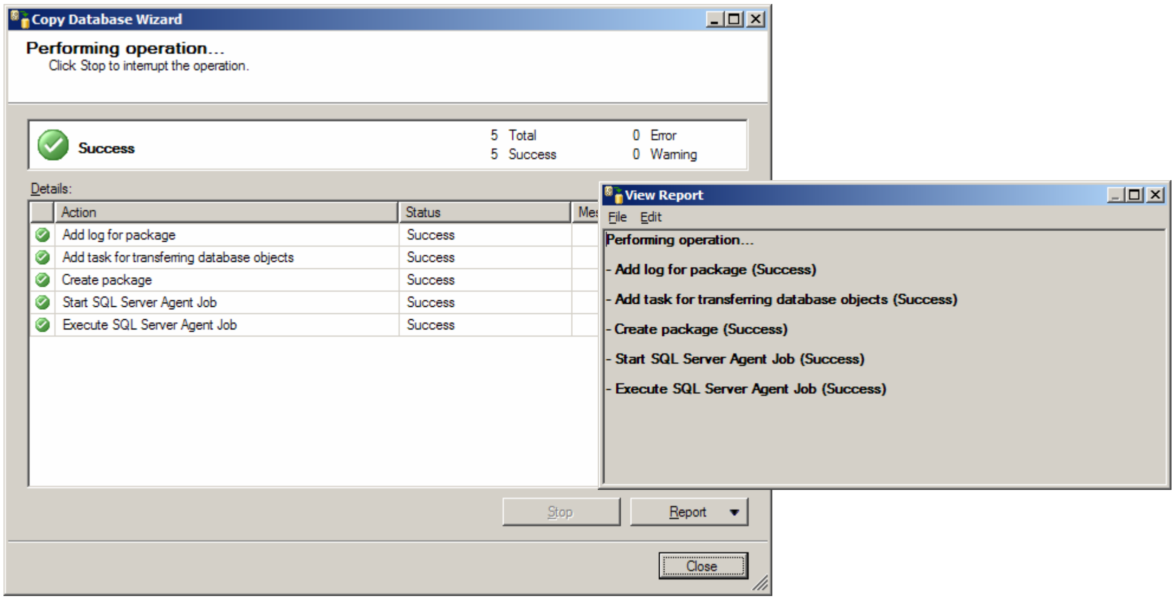
Source: dmrtk-srvr-a2 SQL Server 2005, Microsoft SQL Server Enterprise Edition (64-bit) , Build 3042, Microsoft Windows NT 5.2 (3790) NT AMD64
Destination: dmrtk-srvr-a2 SQL Server 2005, Microsoft SQL Server Enterprise Edition (64-bit) , Build 3042, Microsoft Windows NT 5.2 (3790) NT AMD64
Using Attach/Detach offline transfer
The following databases will be moved or copied:

Copy:AdventureWorks
Destination file will be created: Q:\SQL_Databases\AdventureWorks_new_Data.mdf
Destination file will be created: R:\SQL_Logs\AdventureWorks_new_Log.ldf
Stop transfer if duplicate database name exists at destination

Copy:AdventureWorksDW
Destination file will be created: Q:\SQL_Databases\AdventureWorksDW_new_Data.mdf
Destination file will be created: R:\SQL_Logs\AdventureWorksDW_new_Log.ldf
Stop transfer if duplicate database name exists at destination

Package scheduled to run immediately

The copy was completed successfully to the iSCSI target volumes using SQL Server services.



Performing operation...
Click Stop to interrupt the operation.

Success

5	Total	0	Error
5	Success	0	Warning

Details:

Action	Status	Mes
Add log for package	Success	
Add task for transfering database objects	Success	
Create package	Success	
Start SQL Server Agent Job	Success	
Execute SQL Server Agent Job	Success	

Performing operation...

- Add log for package (Success)

- Add task for transferring database objects (Success)

- Create package (Success)

- Start SQL Server Agent Job (Success)

- Execute SQL Server Agent Job (Success)

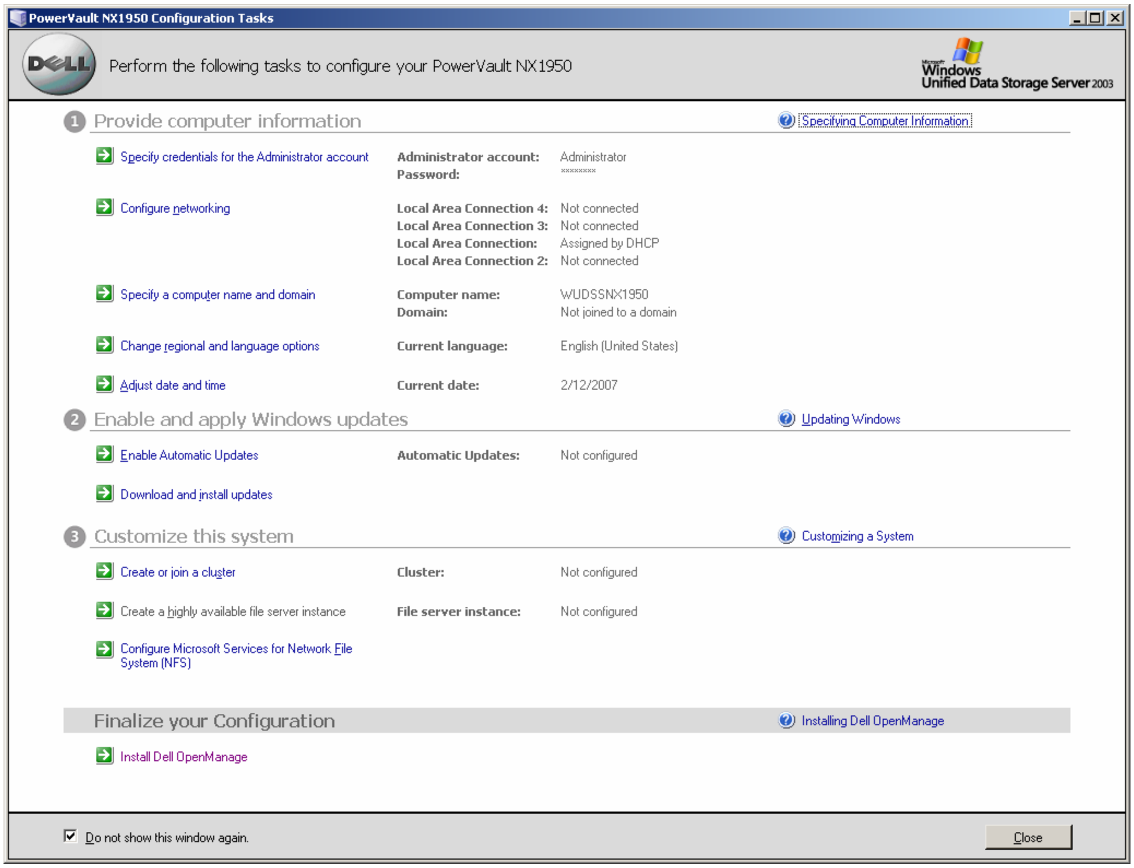
Dell™ PowerVault™ NX1950 Networked Storage Solution

The Dell PowerVault NX1950 is a networked storage system that features Microsoft Unified Data Storage Server (WUDSS). Optimized for performance and interoperability, the system supports both file (sharing) and block (disk) access to storage resources over Ethernet networks through the inclusion of the iSCSI protocol. The PowerVault NX1950 comes bundled with advanced software capabilities that include snapshots and remote replication and is configurable for clustering to maintain high system and data availability. The PowerVault NX1950 can be expanded by simply adding up to two additional expansion enclosures for a total of 45 drives and 13.5TB capacity, to support growing business needs.

Target Configuration Steps

1. Configure Network Settings for iSCSI Target Device

The Dell PowerVault NX1950 is configured to use DHCP for its default network settings. The basic unit is designed for multi-path operations and is equipped with four RJ45 Ethernet connectors. The initial configuration screen shows the basic settings.



PowerVault NX1950 Configuration Tasks

Perform the following tasks to configure your PowerVault NX1950

1 Provide computer information — Specifying Computer Information

Specify credentials for the Administrator account
Administrator account: Administrator
Password: ********

Configure networking
Local Area Connection 4: Not connected
Local Area Connection 3: Not connected
Local Area Connection: Assigned by DHCP
Local Area Connection 2: Not connected

Specify a computer name and domain
Computer name: WUDSSNX1950
Domain: Not joined to a domain

Change regional and language options
Current language: English (United States)

Adjust date and time
Current date: 2/12/2007

2 Enable and apply Windows updates — Updating Windows

Enable Automatic Updates
Automatic Updates: Not configured

Download and install updates

3 Customize this system — Customizing a System

Create or join a cluster
Cluster: Not configured

Create a highly available file server instance
File server instance: Not configured

Configure Microsoft Services for Network File System (NFS)

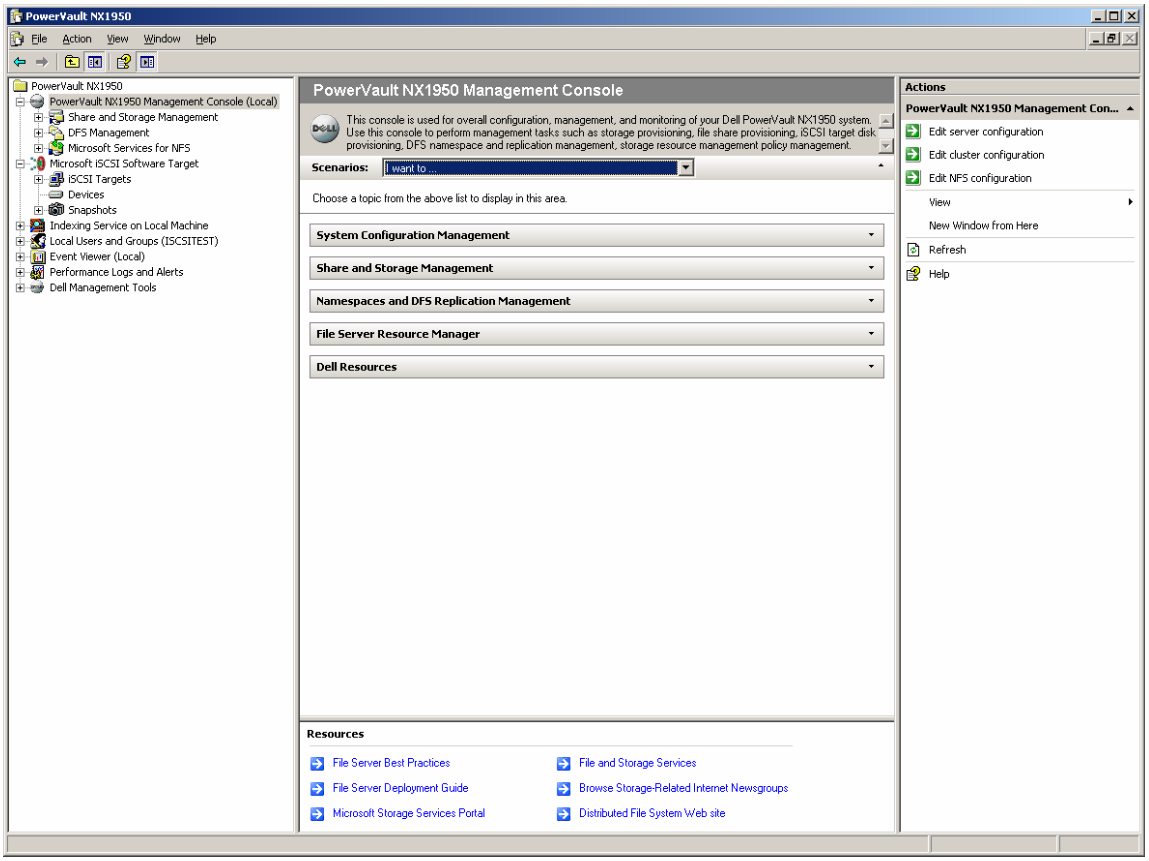
Finalize your Configuration — Installing Dell OpenManage

Install Dell OpenManage

☑ Do not show this window again.

2. Launch Management Console

All the storage management functions for the Dell PowerVault NX1950 are performed from the management console, shown below.


PowerVault NX1950
File Action View Window Help
PowerVault NX1950
PowerVault NX1950 Management Console (Local)
Share and Storage Management
DFS Management
Microsoft Services for NFS
Microsoft iSCSI Software Target
iSCSI Targets
Devices
Snapshots
Indexing Service on Local Machine
Local Users and Groups (ISCSITEST)
Event Viewer (Local)
Performance Logs and Alerts
Dell Management Tools
PowerVault NX1950 Management Console
Scenarios:
I want to ...
System Configuration Management
Share and Storage Management
Namespaces and DFS Replication Management
File Server Resource Manager
Dell Resources
Resources
File Server Best Practices
File Server Deployment Guide
Microsoft Storage Services Portal
File and Storage Services
Browse Storage-Related Internet Newsgroups
Distributed File System Web site
Actions
PowerVault NX1950 Management Con...
Edit server configuration
Edit cluster configuration
Edit NFS configuration
View
New Window from Here
Refresh
Help

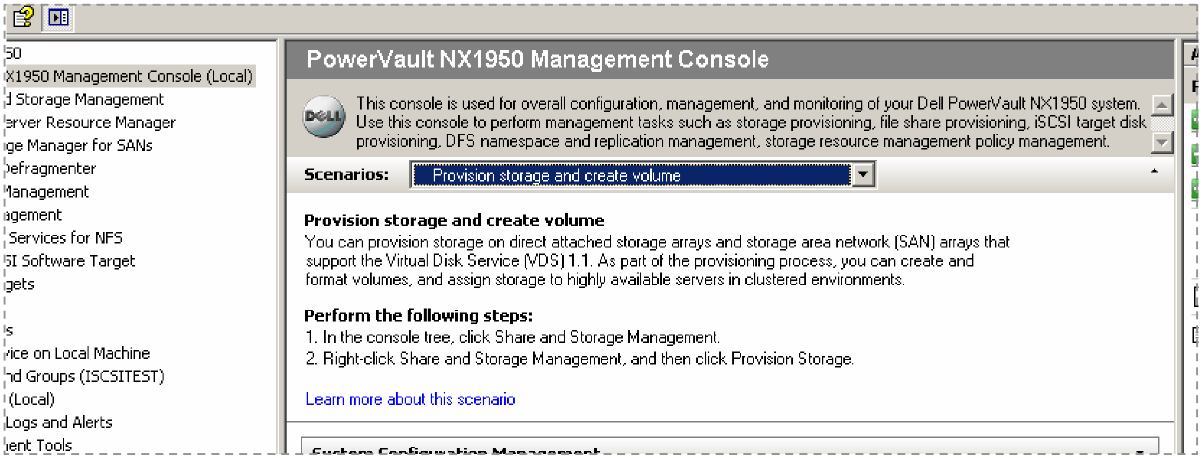
This console is used for overall configuration, management, and monitoring of your Dell PowerVault NX1950 system. Use this console to perform management tasks such as storage provisioning, file share provisioning, iSCSI target disk provisioning, DFS namespace and replication management, storage resource management policy management.

Choose a topic from the above list to display in this area.

At the top of the center section of the management console, several scenarios are available that help step the administrator through each of the processes.

3. Create LUNs on Disk Array

To create the LUNs on the Disk Array, the administrator selects the “Provision Storage and Create Volume” scenario from the upper section of the management console. This directs the administrator in the appropriate steps to take.



This console is used for overall configuration, management, and monitoring of your Dell PowerVault NX1950 system. Use this console to perform management tasks such as storage provisioning, file share provisioning, iSCSI target disk provisioning, DFS namespace and replication management, storage resource management policy management.

Provision storage and create volume

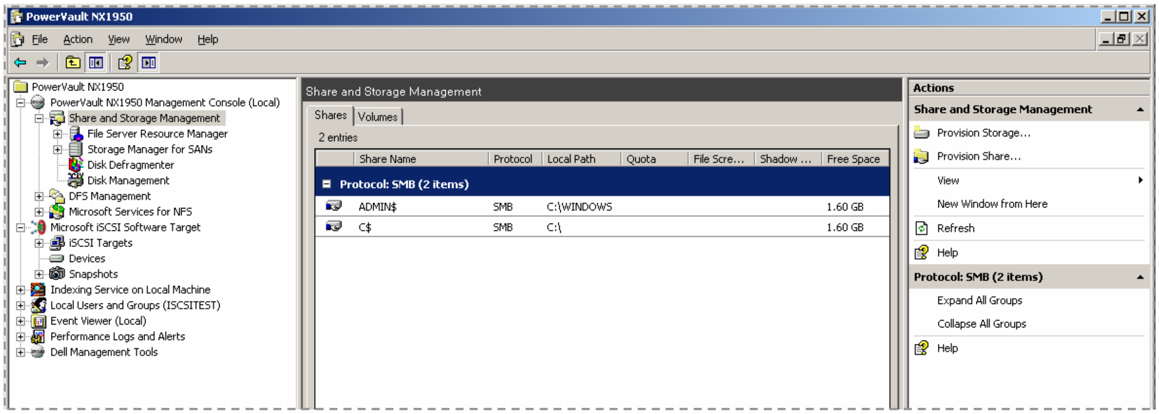
You can provision storage on direct attached storage arrays and storage area network (SAN) arrays that support the Virtual Disk Service (VDS) 1.1. As part of the provisioning process, you can create and format volumes, and assign storage to highly available servers in clustered environments.

Perform the following steps:

1. In the console tree, click Share and Storage Management.
2. Right-click Share and Storage Management, and then click Provision Storage.

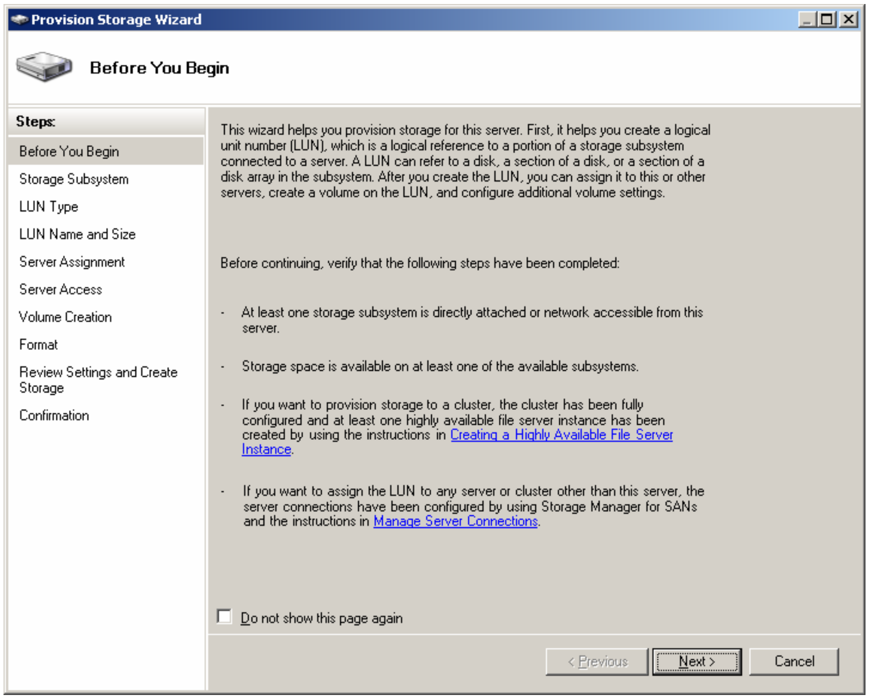
Learn more about this scenario

The right-side panel of the management console is context sensitive, and changes based on the item selected on the left side of the panel. Highlighting "Share and Storage Management" on the left panel console tree brings the "Provision Storage" wizard into view on the right side.



Share Name	Protocol	Local Path	Quota	File Scre...	Shadow ...	Free Space
Protocol: SMB (2 items)						
ADMIN$	SMB	C:\WINDOWS				1.60 GB
C$	SMB	C:\				1.60 GB

Selecting the "Provision Storage" action on the right side initializes the wizard for this function. The wizard allows the administrator to step through the provisioning process. Notice that the left side of the wizard lists each of the main steps in the process.



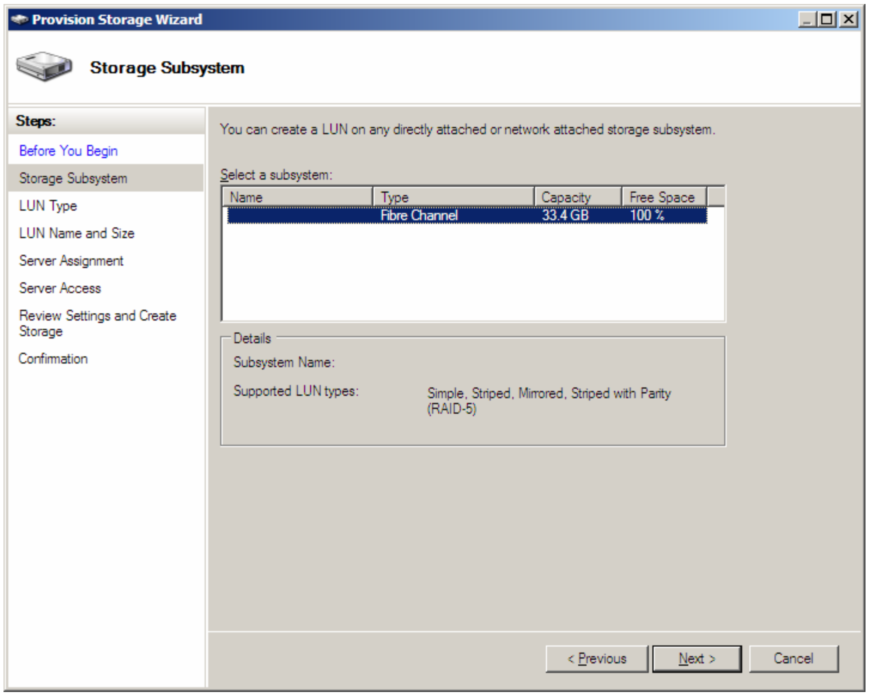
This wizard helps you provision storage for this server. First, it helps you create a logical unit number (LUN), which is a logical reference to a portion of a storage subsystem connected to a server. A LUN can refer to a disk, a section of a disk, or a section of a disk array in the subsystem. After you create the LUN, you can assign it to this or other servers, create a volume on the LUN, and configure additional volume settings.

Before continuing, verify that the following steps have been completed:

- At least one storage subsystem is directly attached or network accessible from this server.
- Storage space is available on at least one of the available subsystems.
- If you want to provision storage to a cluster, the cluster has been fully configured and at least one highly available file server instance has been created by using the instructions in Creating a Highly Available File Server Instance.
- If you want to assign the LUN to any server or cluster other than this server, the server connections have been configured by using Storage Manager for SANs and the instructions in Manage Server Connections.

□ Do not show this page again

The storage subsystem must be selected and in this case there is only one subsystem to select. It is of type "Fibre Channel" because the internal interface to the disk subsystem is listed as Fibre Channel even if SAS is used. This will be changed in the next version.



You can create a LUN on any directly attached or network attached storage subsystem.

Select a subsystem:

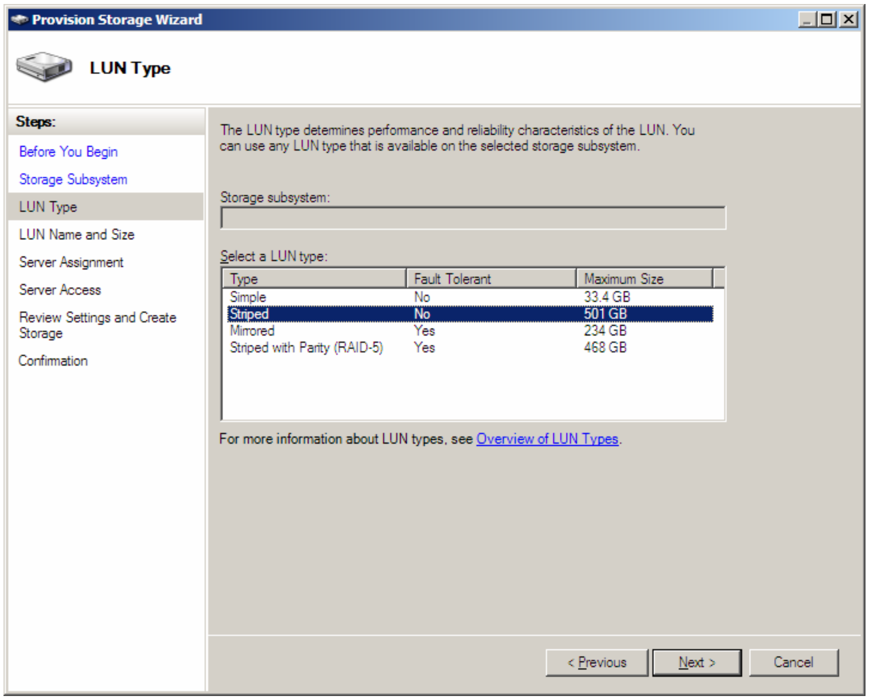
Name	Type	Capacity	Free Space
	Fibre Channel	33.4 GB	100 %

Details

Subsystem Name:

Supported LUN types: Simple, Striped, Mirrored, Striped with Parity (RAID-5)

The LUN type must be chosen from among the various types of LUNs available. In this example, we have chosen a “striped” LUN type. Each type of LUN has a maximum size that depends on the type.



The LUN type determines performance and reliability characteristics of the LUN. You can use any LUN type that is available on the selected storage subsystem.

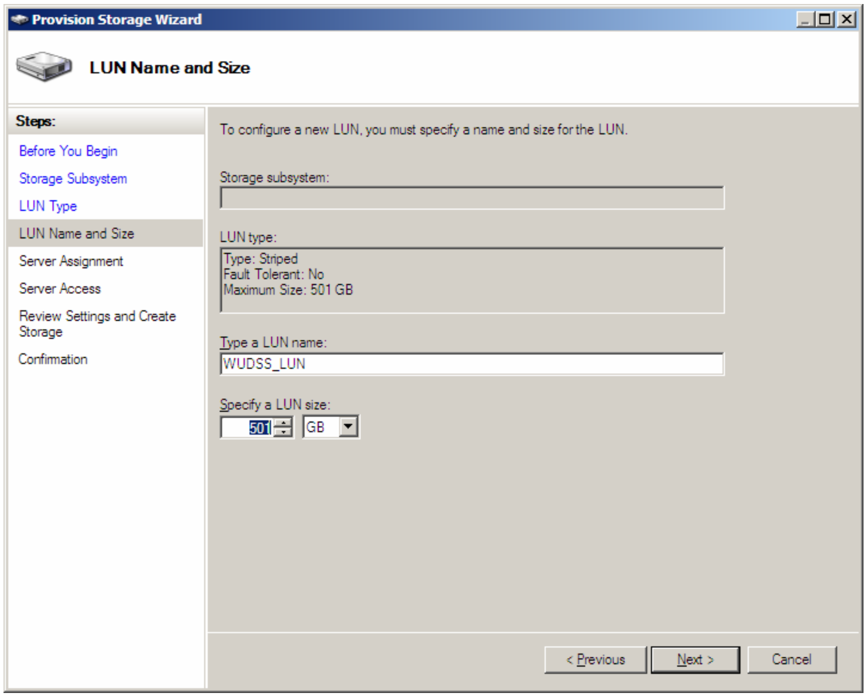
Storage subsystem:

Select a LUN type:

Type	Fault Tolerant	Maximum Size
Simple	No	33.4 GB
Striped	No	501 GB
Mirrored	Yes	234 GB
Striped with Parity (RAID-5)	Yes	468 GB

For more information about LUN types, see Overview of LUN Types.

Note – It is important at this point to note that the storage solution LUN size should not be confused with the size of the iSCSI target. The iSCSI target will be configured in a later step and is associated with the storage needed for a particular application on the host server. It is recommended that the LUN size on the storage hardware be as large as reasonably possible to allow the storage subsystem to optimize the use of the physical disks underlying the LUN that is created. In this case, as shown below, we are choosing to create one LUN at the maximum size available for this hardware. The iSCSI targets created later will fit into this one LUN, based on the needs of the host application.



To configure a new LUN, you must specify a name and size for the LUN.

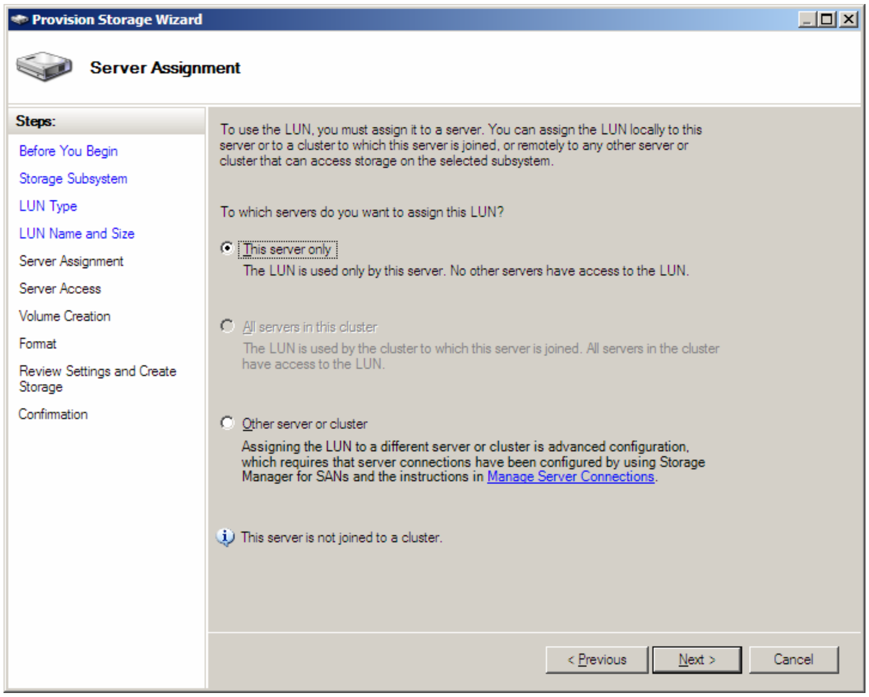
Storage subsystem:

LUN type:
Type: Striped
Fault Tolerant: No
Maximum Size: 501 GB

Type a LUN name: WUDSS_LUN

Specify a LUN size: 501 GB

The LUN created will be assigned to this internal storage server only. In a later step, iSCSI targets will be created that will be assigned to external application servers.



To use the LUN, you must assign it to a server. You can assign the LUN locally to this server or to a cluster to which this server is joined, or remotely to any other server or cluster that can access storage on the selected subsystem.

To which servers do you want to assign this LUN?

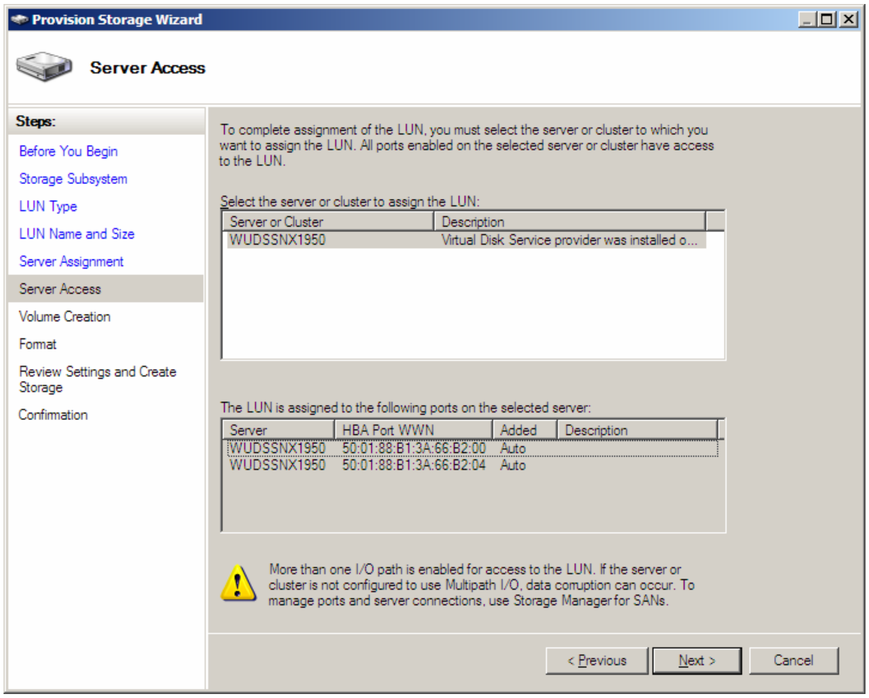
● This server only
The LUN is used only by this server. No other servers have access to the LUN.

○ All servers in this cluster
The LUN is used by the cluster to which this server is joined. All servers in the cluster have access to the LUN.

○ Other server or cluster
Assigning the LUN to a different server or cluster is advanced configuration, which requires that server connections have been configured by using Storage Manager for SANs and the instructions in Manage Server Connections.

This server is not joined to a cluster.

The name of this server needs to be provided for the assignment.



To complete assignment of the LUN, you must select the server or cluster to which you want to assign the LUN. All ports enabled on the selected server or cluster have access to the LUN.

Select the server or cluster to assign the LUN:

Server or Cluster	Description
WUDSSNX1950	Virtual Disk Service provider was installed o...

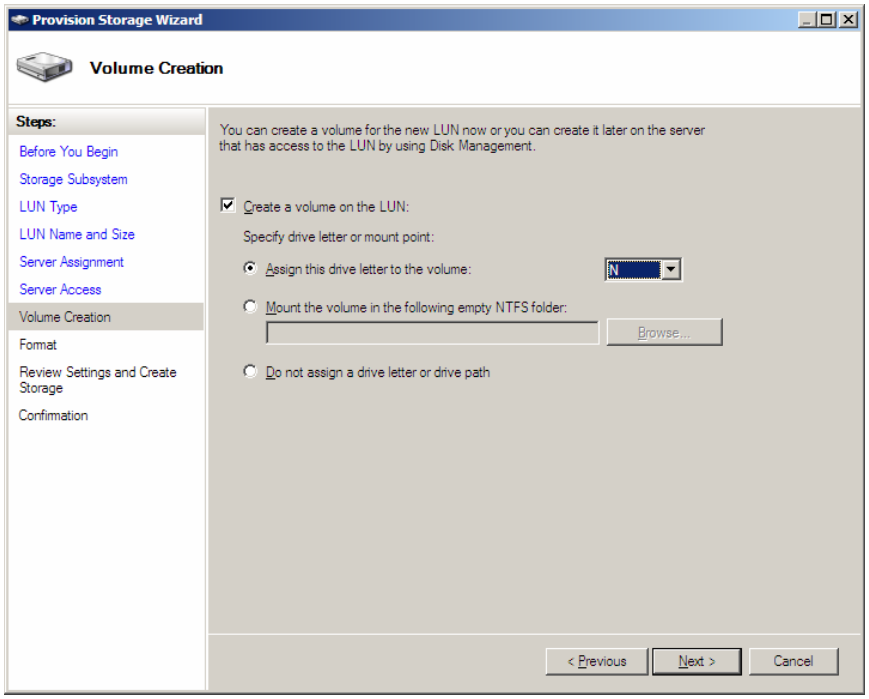
The LUN is assigned to the following ports on the selected server:

Server	HBA Port WWN	Added	Description
WUDSSNX1950	50:01:88:B1:3A:66:B2:00	Auto	
WUDSSNX1950	50:01:88:B1:3A:66:B2:04	Auto	

More than one I/O path is enabled for access to the LUN. If the server or cluster is not configured to use Multipath I/O, data corruption can occur. To manage ports and server connections, use Storage Manager for SANs.

4. Make LUNs Ready for Use

Because this storage solution is running on a Microsoft Windows-based platform, the remaining steps would be familiar to a Windows administrator. This can be an advantage in environments where Windows is prevalent as it reduces specialized training needed for managing the storage devices. These include assigning a drive letter for the internal server, providing a volume name, etc. The wizard prompts for these items then provides a summary screen before performing all the necessary tasks to provision the storage.



You can create a volume for the new LUN now or you can create it later on the server that has access to the LUN by using Disk Management.

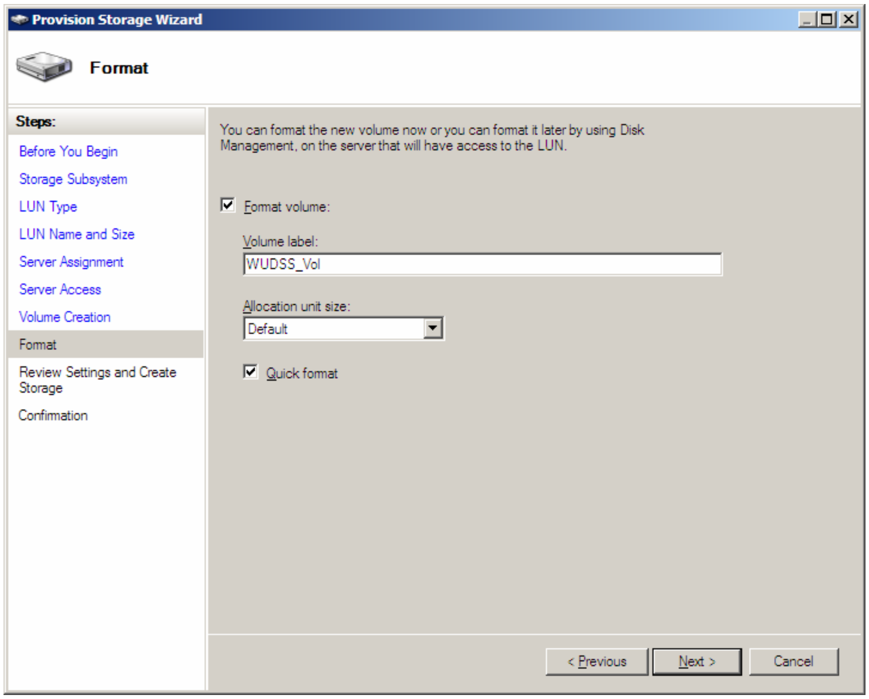
☑ Create a volume on the LUN:

Specify drive letter or mount point:

● Assign this drive letter to the volume: N

○ Mount the volume in the following empty NTFS folder:

○ Do not assign a drive letter or drive path



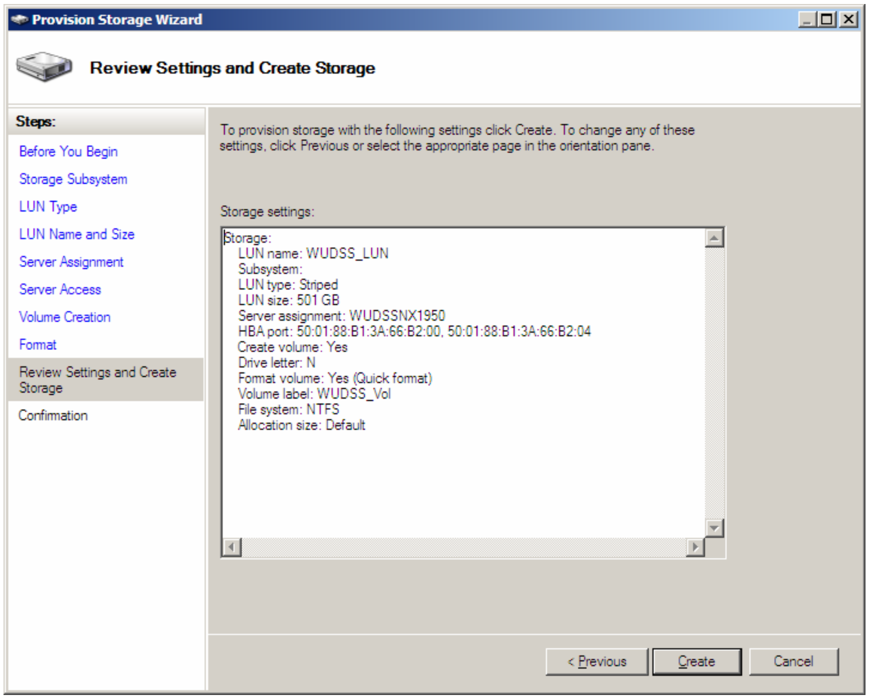
You can format the new volume now or you can format it later by using Disk Management, on the server that will have access to the LUN.

☑ Format volume:

Volume label: WUDSS_Vol

Allocation unit size: Default

☑ Quick format

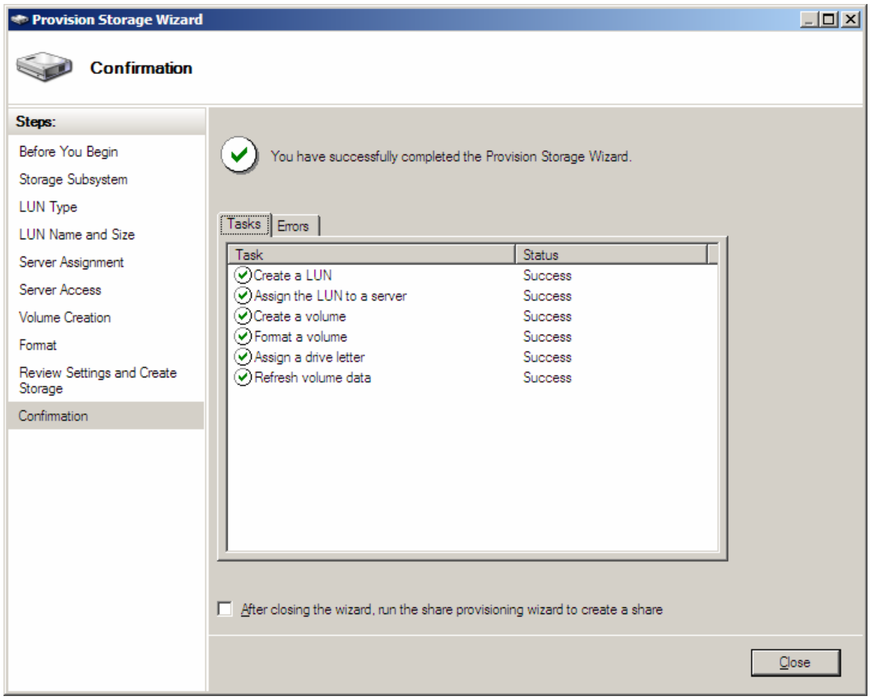


To provision storage with the following settings click Create. To change any of these settings, click Previous or select the appropriate page in the orientation pane.

Storage settings:

```
Storage:
   LUN name: WUDSS_LUN
   Subsystem:
   LUN type: Striped
   LUN size: 501 GB
   Server assignment: WUDSSNX1950
   HBA port: 50:01:88:B1:3A:66:B2:00, 50:01:88:B1:3A:66:B2:04
   Create volume: Yes
   Drive letter: N
   Format volume: Yes (Quick format)
   Volume label: WUDSS_Vol
   File system: NTFS
   Allocation size: Default
```

After a short while, the following screen indicates a successful provisioning operation.

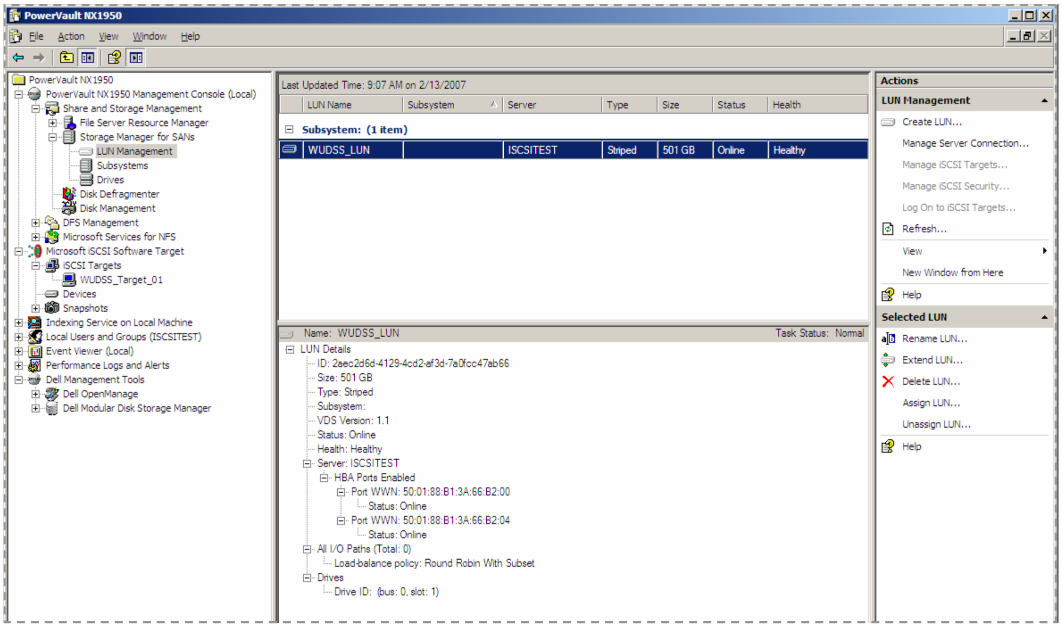


You have successfully completed the Provision Storage Wizard.

Task	Status
✓ Create a LUN	Success
✓ Assign the LUN to a server	Success
✓ Create a volume	Success
✓ Format a volume	Success
✓ Assign a drive letter	Success
✓ Refresh volume data	Success

☐ After closing the wizard, run the share provisioning wizard to create a share

The LUN has now been created and is ready for use. The next step will create iSCSI targets and associate them with this newly-created LUN. This implementation of WUDSS uses the Microsoft Virtual Disk Service (VDS) internally on this server. The LUN can also be viewed in the Storage Manager for SANs section of the management console, as shown below.



Last Updated Time: 9:07 AM on 2/13/2007

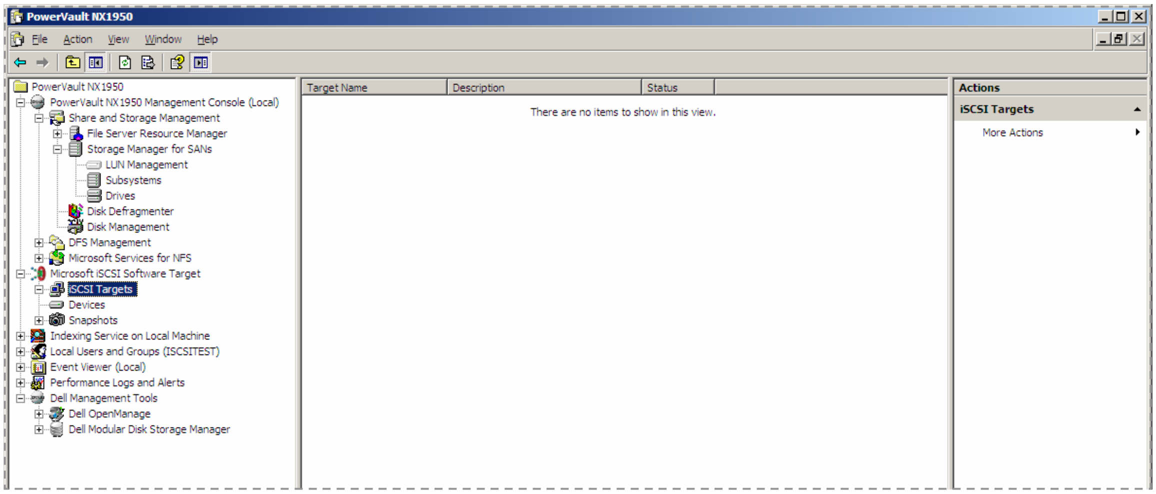
LUN Name	Subsystem	Server	Type	Size	Status	Health
Subsystem: (1 item)						
WUDSS_LUN		ISCSITEST	Striped	501 GB	Online	Healthy

Name: WUDSS_LUN Task Status: Normal

```
LUN Details
    ID: 2aec2d6d-4129-4cd2-af3d-7a0fcc47ab66
    Size: 501 GB
    Type: Striped
    Subsystem:
    VDS Version: 1.1
    Status: Online
    Health: Healthy
    Server: ISCSITEST
        HBA Ports Enabled
            Port WWN: 50:01:88:B1:3A:66:B2:00
                Status: Online
            Port WWN: 50:01:88:B1:3A:66:B2:04
                Status: Online
    All I/O Paths (Total: 0)
        Load-balance policy: Round Robin With Subset
    Drives
        Drive ID:  (bus: 0, slot: 1)
```

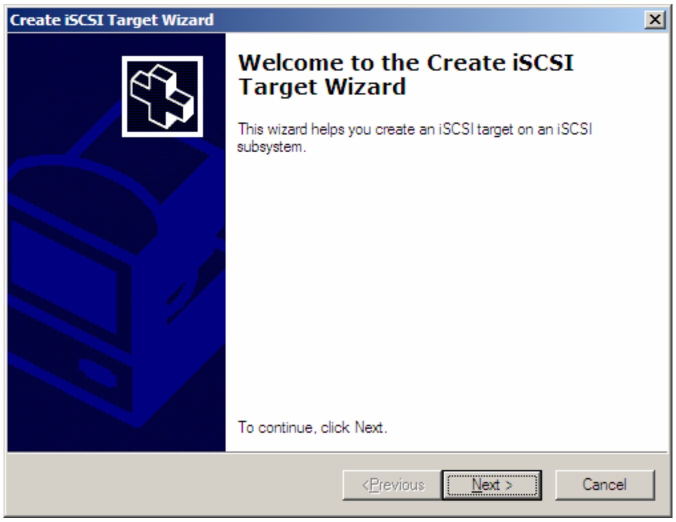
5. Create iSCSI Targets

Moving to the iSCSI target section of the management console, a wizard can be triggered (using the right-mouse click) that begins the iSCSI target creation process.


PowerVault NX1950
File Action View Window Help
PowerVault NX1950
PowerVault NX1950 Management Console (Local)
Share and Storage Management
File Server Resource Manager
Storage Manager for SANs
LUN Management
Subsystems
Drives
Disk Defragmenter
Disk Management
DFS Management
Microsoft Services for NFS
Microsoft iSCSI Software Target
iSCSI Targets
Devices
Snapshots
Indexing Service on Local Machine
Local Users and Groups (ISCSITEST)
Event Viewer (Local)
Performance Logs and Alerts
Dell Management Tools
Dell OpenManage
Dell Modular Disk Storage Manager
Target Name
Description
Status
Actions
iSCSI Targets
More Actions

There are no items to show in this view.

The iSCSI target wizard is launched. In this case, we will create two iSCSI targets. Each target will be made available to a different application on the host server. The target itself in the Microsoft-based iSCSI target solutions merely defines the path that the iSCSI storage traffic will use from the iSCSI initiator. The actual storage used by the target will be defined in a later step when the virtual disks are created.

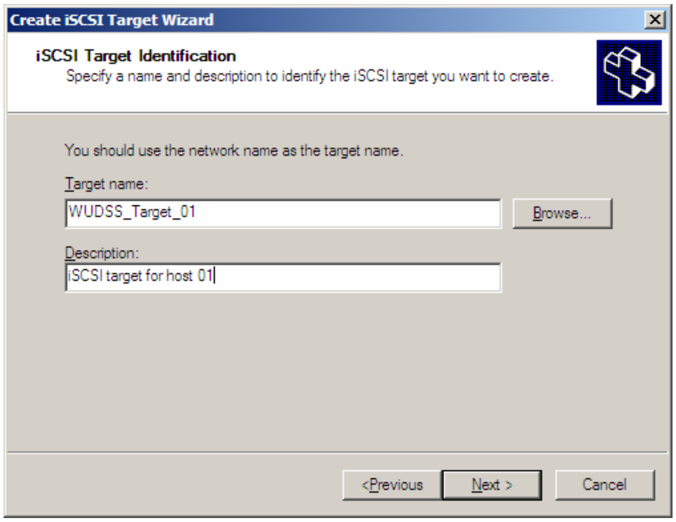


Welcome to the Create iSCSI Target Wizard

This wizard helps you create an iSCSI target on an iSCSI subsystem.

To continue, click Next.

Each iSCSI target needs a name and optional description, which are supplied below.



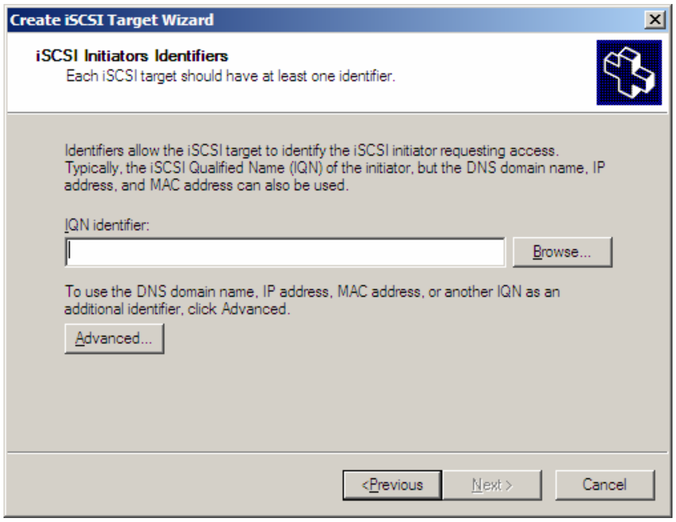
iSCSI Target Identification
Specify a name and description to identify the iSCSI target you want to create.

You should use the network name as the target name.

Target name: WUDSS_Target_01

Description: iSCSI target for host 01

Each iSCSI target needs to be associated with an iSCSI initiator. The iSCSI initiator is the host that is requesting access to the storage represented by the iSCSI target name. The wizard prompts for the iSCSI Qualified Name (IQN) of the iSCSI initiator or provides alternate ways to identify the iSCSI initiator. In this case, we will choose to identify the iSCSI initiator by its IP address.



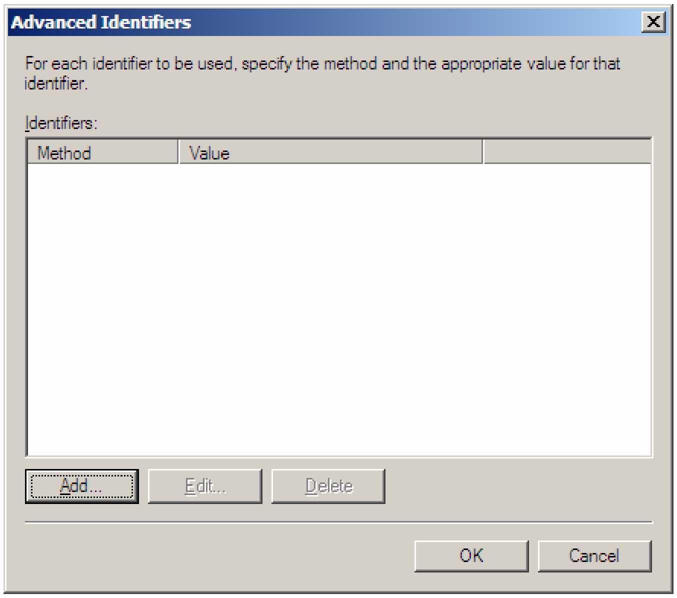
iSCSI Initiators Identifiers
Each iSCSI target should have at least one identifier.

Identifiers allow the iSCSI target to identify the iSCSI initiator requesting access. Typically, the iSCSI Qualified Name (IQN) of the initiator, but the DNS domain name, IP address, and MAC address can also be used.

IQN identifier:

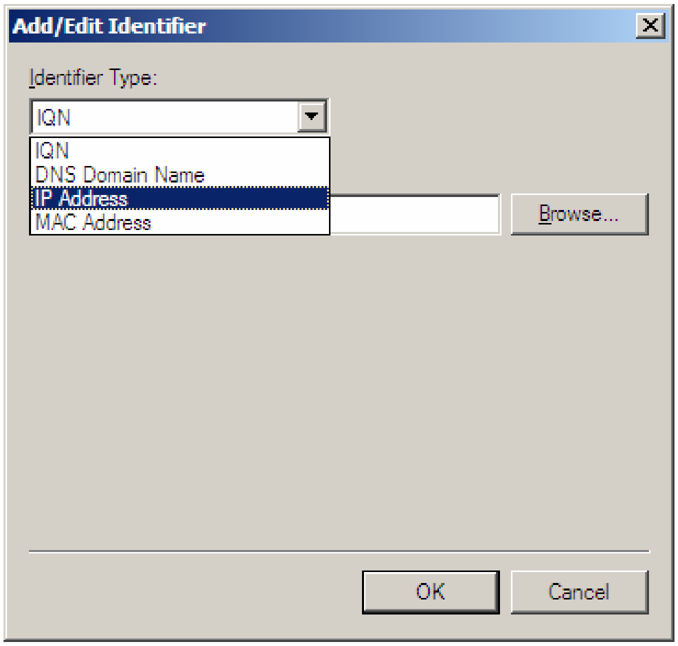
To use the DNS domain name, IP address, MAC address, or another IQN as an additional identifier, click Advanced.

Clicking “Advanced” allows us to choose alternate methods of identification.

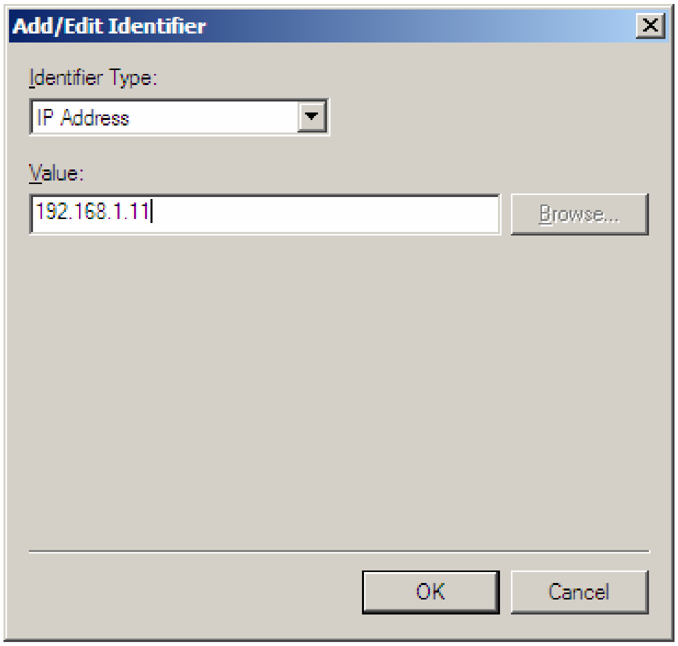


For each identifier to be used, specify the method and the appropriate value for that identifier.

Clicking "Add" allows the type of identifier to be entered and the specific identifying information to be entered.



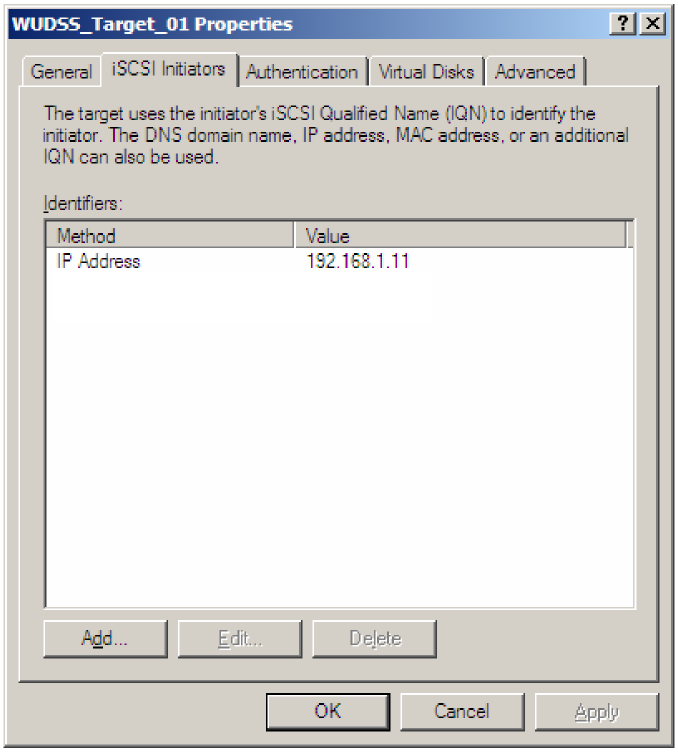
Identifier Type: IQN



Add/Edit Identifier

Identifier Type: IP Address

Value: 192.168.1.11



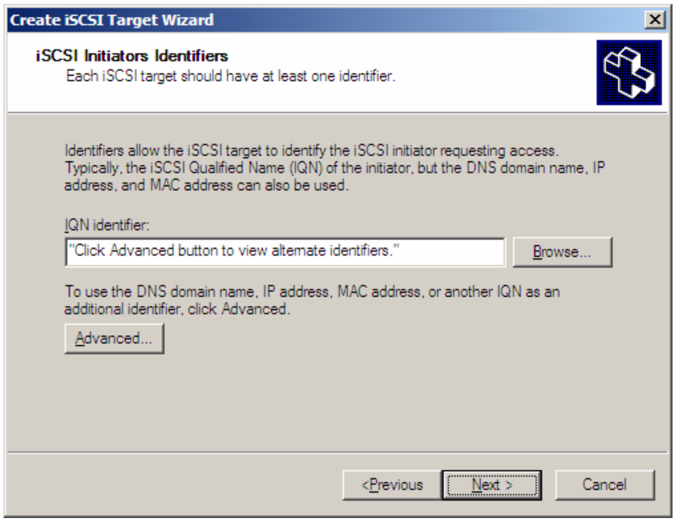
WUDSS_Target_01 Properties

The target uses the initiator's iSCSI Qualified Name (IQN) to identify the initiator. The DNS domain name, IP address, MAC address, or an additional IQN can also be used.

Identifiers:

Method	Value
IP Address	192.168.1.11

After identifying the iSCSI initiator, we are ready to proceed.



Create iSCSI Target Wizard

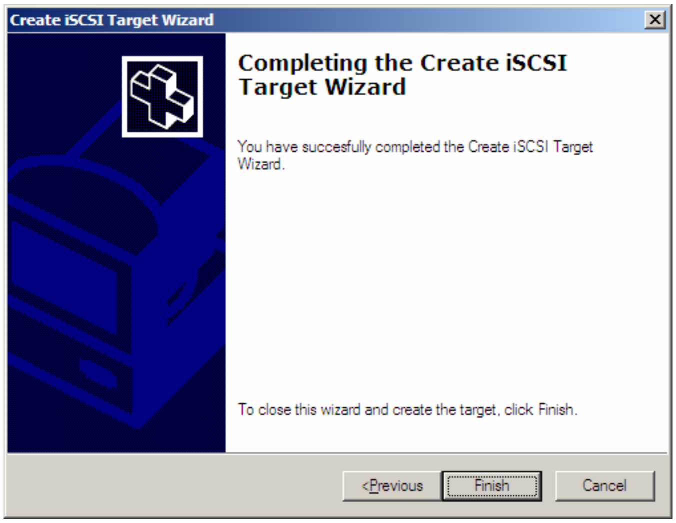
iSCSI Initiators Identifiers

Each iSCSI target should have at least one identifier.

Identifiers allow the iSCSI target to identify the iSCSI initiator requesting access. Typically, the iSCSI Qualified Name (IQN) of the initiator, but the DNS domain name, IP address, and MAC address can also be used.

IQN identifier: "Click Advanced button to view alternate identifiers."

To use the DNS domain name, IP address, MAC address, or another IQN as an additional identifier, click Advanced.



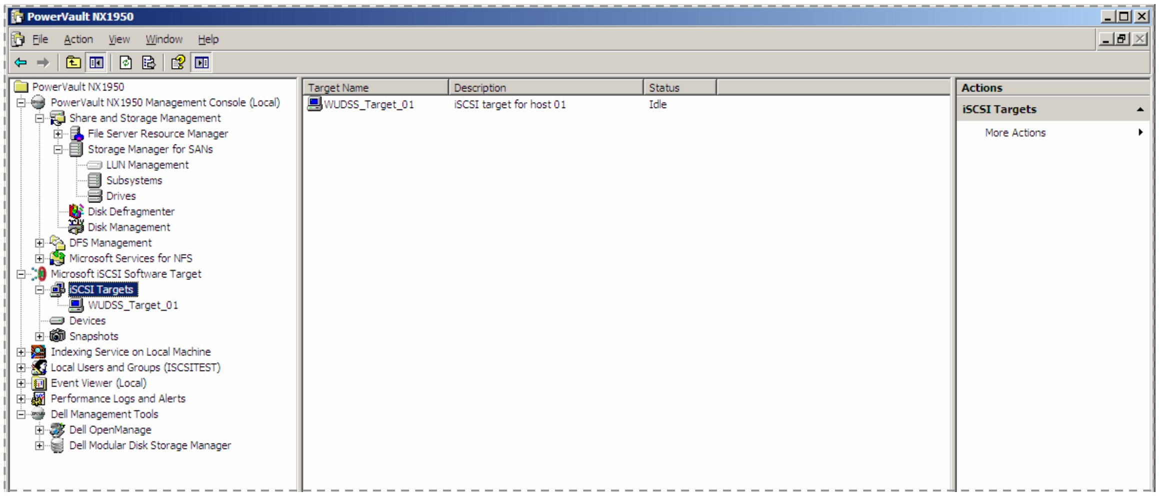
Create iSCSI Target Wizard

Completing the Create iSCSI Target Wizard

You have succesfully completed the Create iSCSI Target Wizard.

To close this wizard and create the target, click Finish.

The management console now shows the newly created iSCSI target.

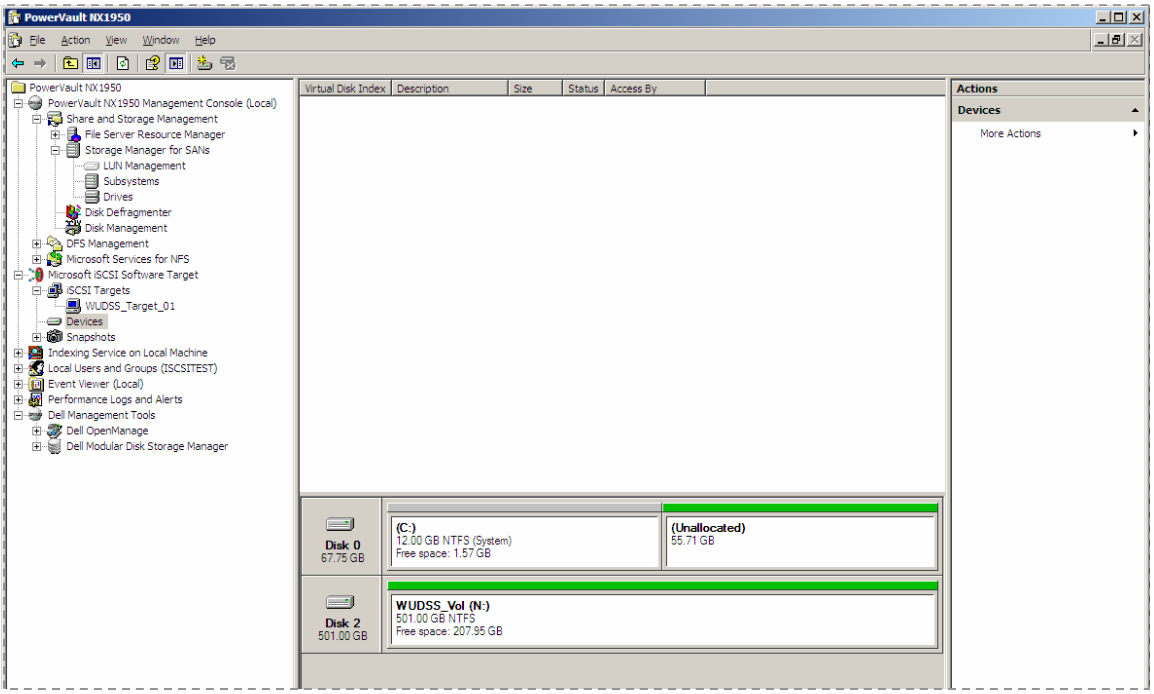


PowerVault NX1950

```
PowerVault NX1950
  PowerVault NX1950 Management Console (Local)
    Share and Storage Management
      File Server Resource Manager
      Storage Manager for SANs
        LUN Management
        Subsystems
        Drives
      Disk Defragmenter
      Disk Management
    DFS Management
    Microsoft Services for NFS
  Microsoft iSCSI Software Target
    iSCSI Targets
      WUDSS_Target_01
    Devices
    Snapshots
  Indexing Service on Local Machine
  Local Users and Groups (ISCSITEST)
  Event Viewer (Local)
  Performance Logs and Alerts
  Dell Management Tools
    Dell OpenManage
    Dell Modular Disk Storage Manager
```

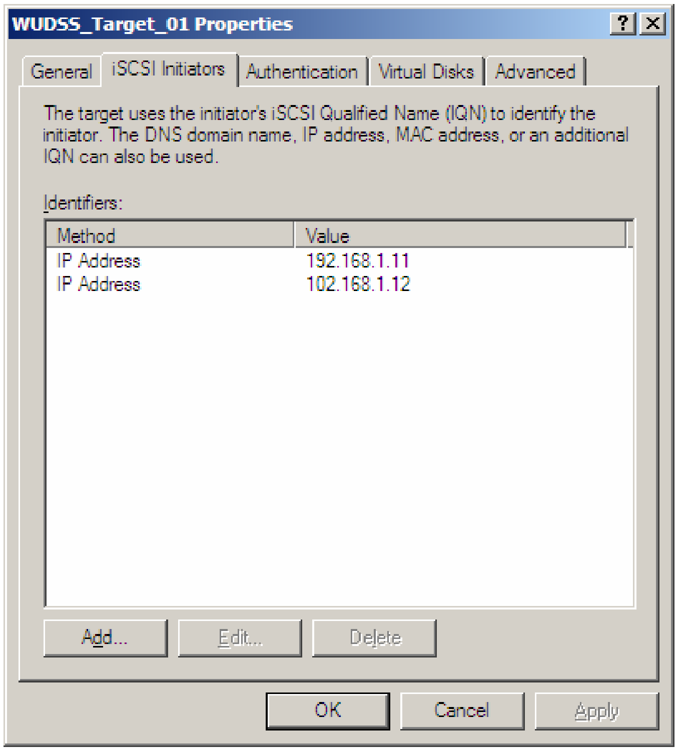
Target Name	Description	Status
WUDSS_Target_01	iSCSI target for host 01	Idle

The management console also shows the underlying devices available for the iSCSI targets. The storage that will be used by the iSCSI initiators (application hosts) will be defined in a later step when the virtual disks are created.



6. Create Multi-path I/O for iSCSI Targets (optional)

For a Microsoft-based target solution, multiple paths to the target device are created by providing multiple iSCSI initiator identifiers for the same target. Multiple paths to an iSCSI target can be creating by adding sessions to the iSCSI target (Microsoft MPIO) or adding additional connections to the iSCSI target (Multiple Connections per Session). In the example below, we use MS MPIO and add a second IP address that is to be associated with the same iSCSI initiator, so that there are two IP addresses that can access the target. These two addresses are associated with two Ethernet ports on the same host server.



The target uses the initiator's iSCSI Qualified Name (IQN) to identify the initiator. The DNS domain name, IP address, MAC address, or an additional IQN can also be used.

Identifiers:

Method	Value
IP Address	192.168.1.11
IP Address	102.168.1.12

Other steps will need to be taken on the iSCSI initiator side to complete the multi-path configuration.

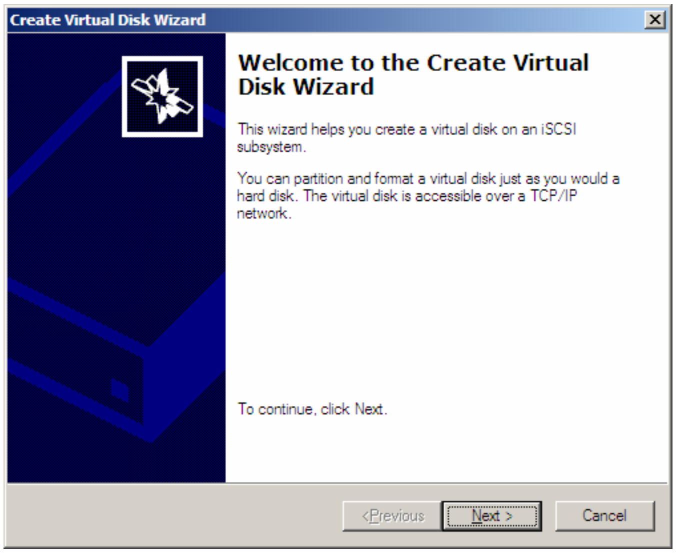
7. Configure Security for iSCSI Targets (optional)

CHAP can be configured with a password also known as the “CHAP secret”. The CHAP secret provides an additional level of security between the iSCSI initiator and target. The CHAP secret is provided on the “Authentication” tab of the target properties.

8. Make iSCSI Targets Ready for Use for iSCSI Initiators

Virtual disks need to be created on the iSCSI targets for Microsoft-based iSCSI target solutions. These virtual disks represent the storage volumes that the iSCSI initiators will use. The maximum capacity represented by all the virtual disks on a given iSCSI target on a Microsoft-based iSCSI target solution is two terabytes (2 TB) per target. In this example, we create a 100 GB and 200 GB virtual disk on the iSCSI target. These two virtual disks will be viewed as volumes by the iSCSI initiators over the TCP/IP network.

By right-clicking on the target name, the “Create Virtual Disk” wizard is launched.


Create Virtual Disk Wizard

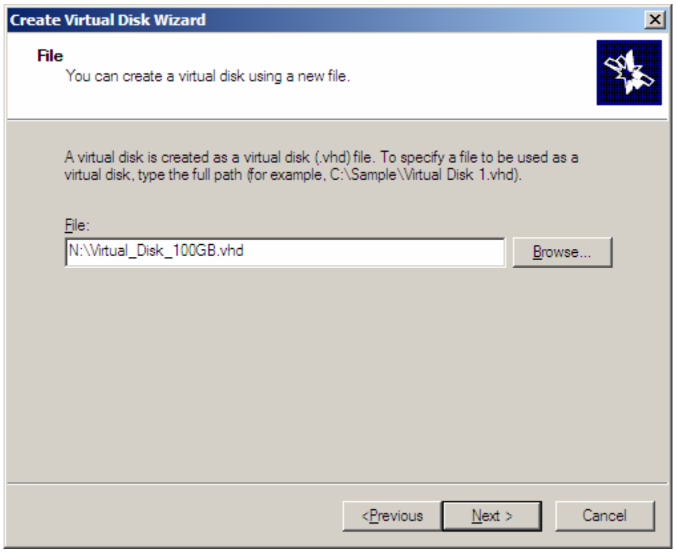
Welcome to the Create Virtual Disk Wizard

This wizard helps you create a virtual disk on an iSCSI subsystem.

You can partition and format a virtual disk just as you would a hard disk. The virtual disk is accessible over a TCP/IP network.

To continue, click Next.

The virtual disk is created on the internal disk volume that is available to the iSCSI target. In this case, it is the “N” volume.

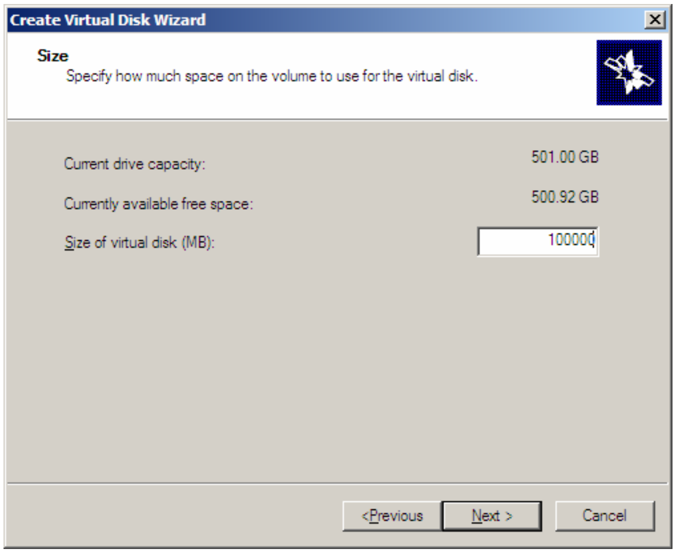

Create Virtual Disk Wizard

File
You can create a virtual disk using a new file.

A virtual disk is created as a virtual disk (.vhd) file. To specify a file to be used as a virtual disk, type the full path (for example, C:\Sample\Virtual Disk 1.vhd).

File: N:\Virtual_Disk_100GB.vhd

The size of the virtual disk depends on the needs of the application on the host server. For this virtual disk, we choose a size of 100 GB from the available 501 GB on this volume.

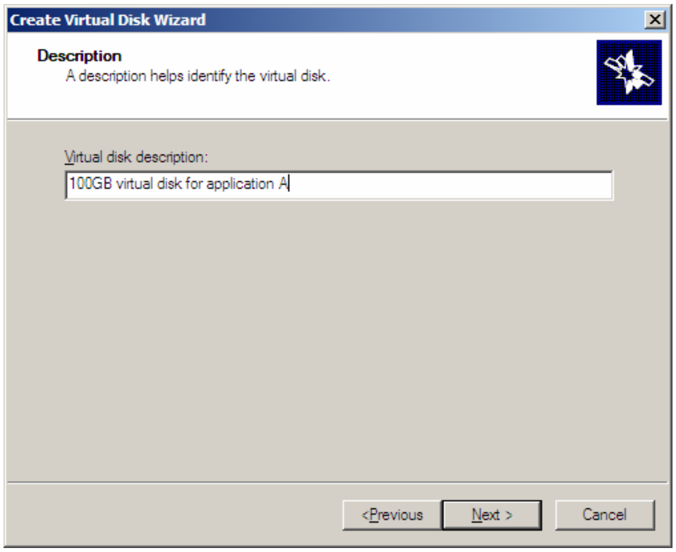

Create Virtual Disk Wizard
Size
Specify how much space on the volume to use for the virtual disk.

Current drive capacity: 501.00 GB

Currently available free space: 500.92 GB

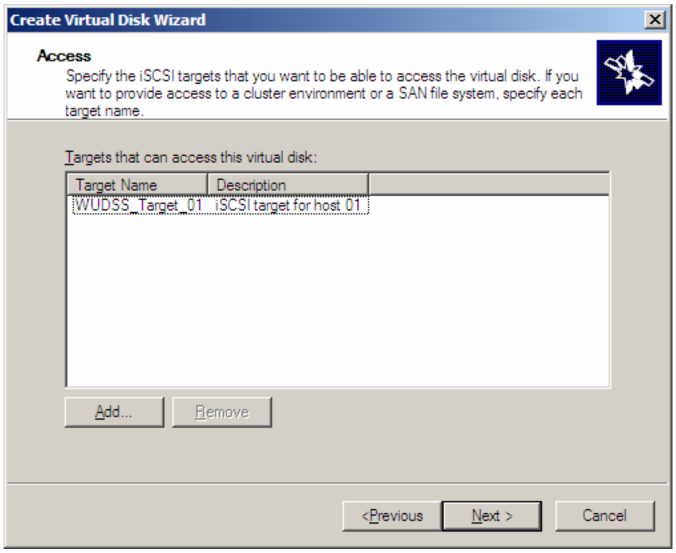
Size of virtual disk (MB): 100000

A description, although optional, is useful for better management.


Create Virtual Disk Wizard
Description
A description helps identify the virtual disk.

Virtual disk description: 100GB virtual disk for application A

This virtual disk must be associated with an iSCSI target in order for the application host to use this storage as an iSCSI storage volume.



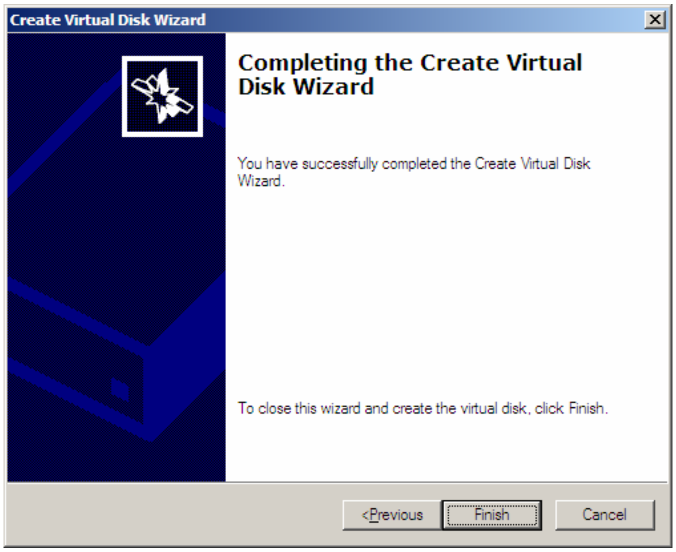
Access

Specify the iSCSI targets that you want to be able to access the virtual disk. If you want to provide access to a cluster environment or a SAN file system, specify each target name.

Targets that can access this virtual disk:

Target Name	Description
WUDSS_Target_01	iSCSI target for host 01

This completes the virtual disk configuration.

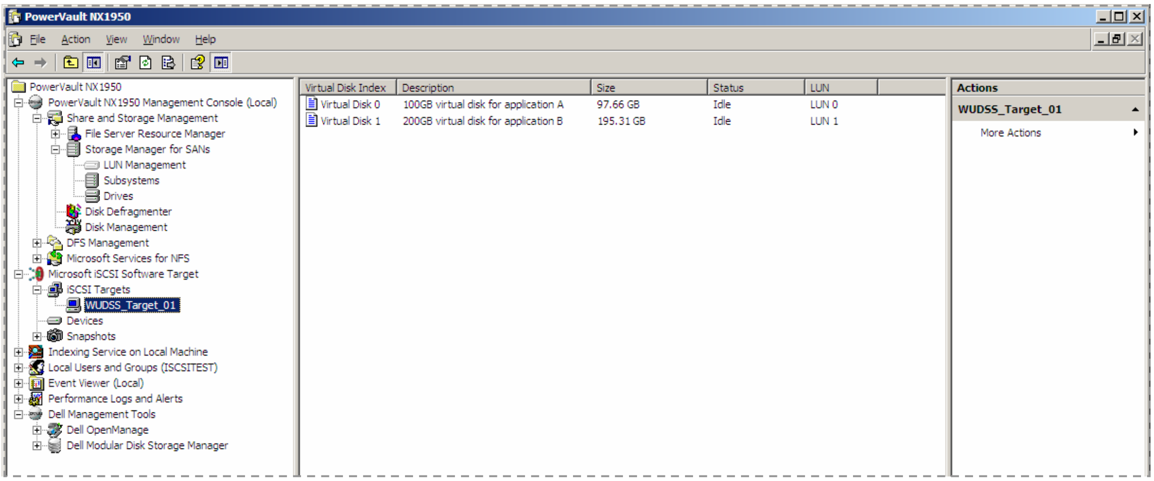


Completing the Create Virtual Disk Wizard

You have successfully completed the Create Virtual Disk Wizard.

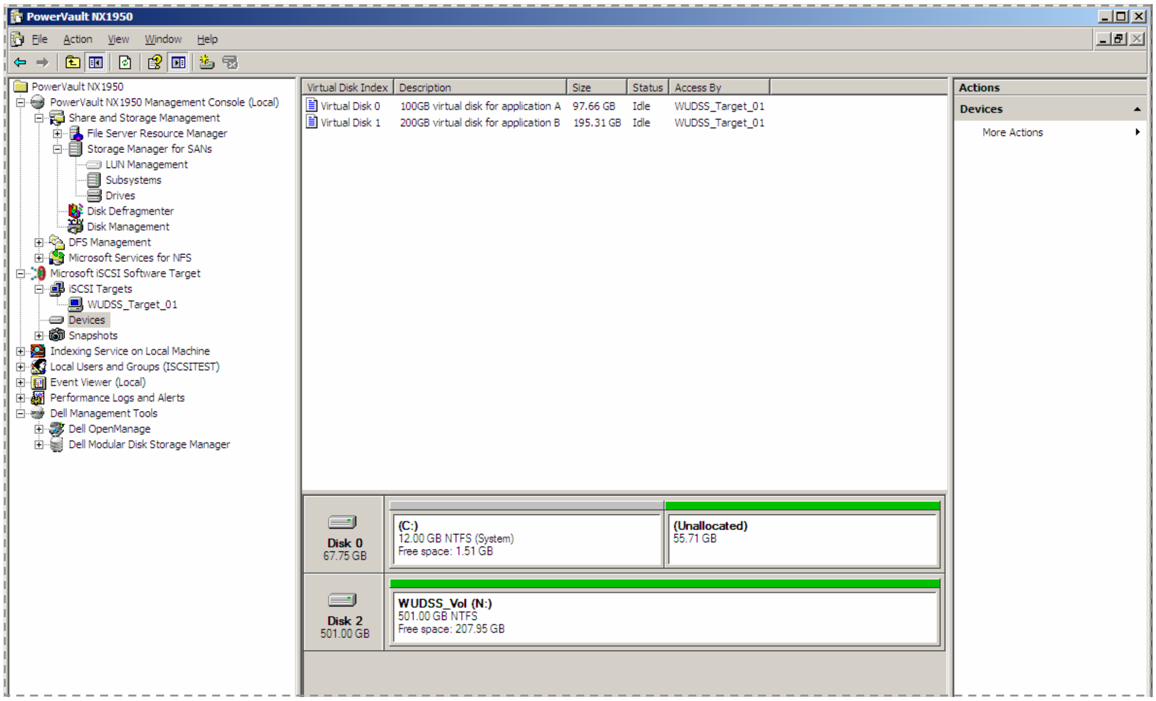
To close this wizard and create the virtual disk, click Finish.

We repeat this process to create a second virtual disk of size 200 GB. After configuring the virtual disks, the management console shows the virtual disks associated with the iSCSI target.


PowerVault NX1950
File Action View Window Help
PowerVault NX1950
PowerVault NX1950 Management Console (Local)
Share and Storage Management
File Server Resource Manager
Storage Manager for SANs
LUN Management
Subsystems
Drives
Disk Defragmenter
Disk Management
DFS Management
Microsoft Services for NFS
Microsoft iSCSI Software Target
iSCSI Targets
WUDSS_Target_01
Devices
Snapshots
Indexing Service on Local Machine
Local Users and Groups (ISCSITEST)
Event Viewer (Local)
Performance Logs and Alerts
Dell Management Tools
Dell OpenManage
Dell Modular Disk Storage Manager
Actions
WUDSS_Target_01
More Actions

Virtual Disk Index	Description	Size	Status	LUN
Virtual Disk 0	100GB virtual disk for application A	97.66 GB	Idle	LUN 0
Virtual Disk 1	200GB virtual disk for application B	195.31 GB	Idle	LUN 1

The iSCSI target device view shows the total volume size and the free space remaining on the device that is available for iSCSI targets.


PowerVault NX1950
File Action View Window Help
PowerVault NX1950
PowerVault NX1950 Management Console (Local)
Share and Storage Management
File Server Resource Manager
Storage Manager for SANs
LUN Management
Subsystems
Drives
Disk Defragmenter
Disk Management
DFS Management
Microsoft Services for NFS
Microsoft iSCSI Software Target
iSCSI Targets
WUDSS_Target_01
Devices
Snapshots
Indexing Service on Local Machine
Local Users and Groups (ISCSITEST)
Event Viewer (Local)
Performance Logs and Alerts
Dell Management Tools
Dell OpenManage
Dell Modular Disk Storage Manager
Actions
Devices
More Actions

Virtual Disk Index	Description	Size	Status	Access By
Virtual Disk 0	100GB virtual disk for application A	97.66 GB	Idle	WUDSS_Target_01
Virtual Disk 1	200GB virtual disk for application B	195.31 GB	Idle	WUDSS_Target_01

Disk 0
67.75 GB

(C:)
12.00 GB NTFS (System)
Free space: 1.51 GB

(Unallocated)
55.71 GB

Disk 2
501.00 GB

WUDSS_Vol (N:)
501.00 GB NTFS
Free space: 207.95 GB

The target side configuration is now complete.

Initiator Configuration Steps

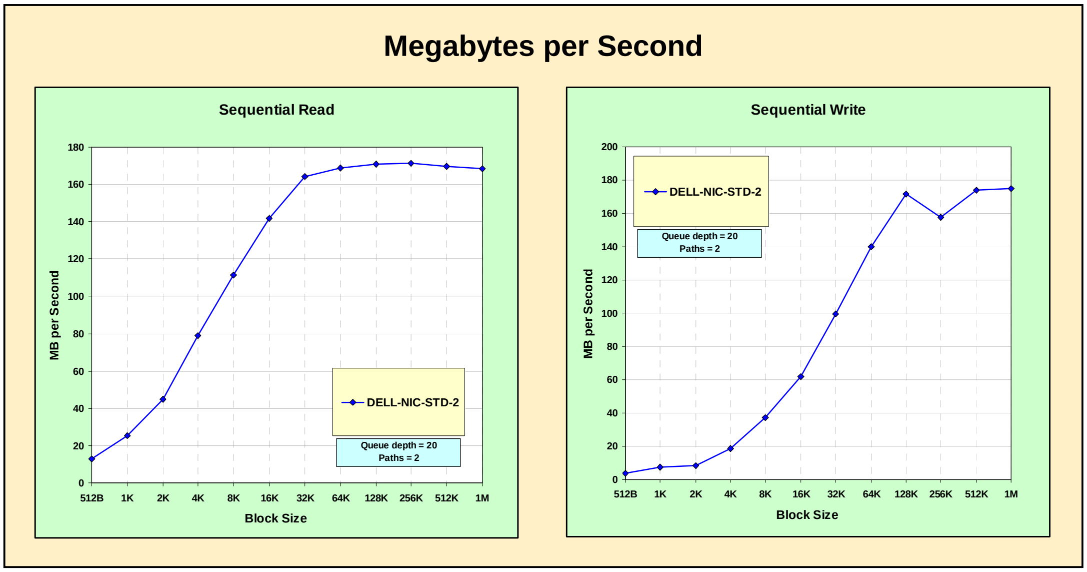
Configure Multi-path I/O from Application Host

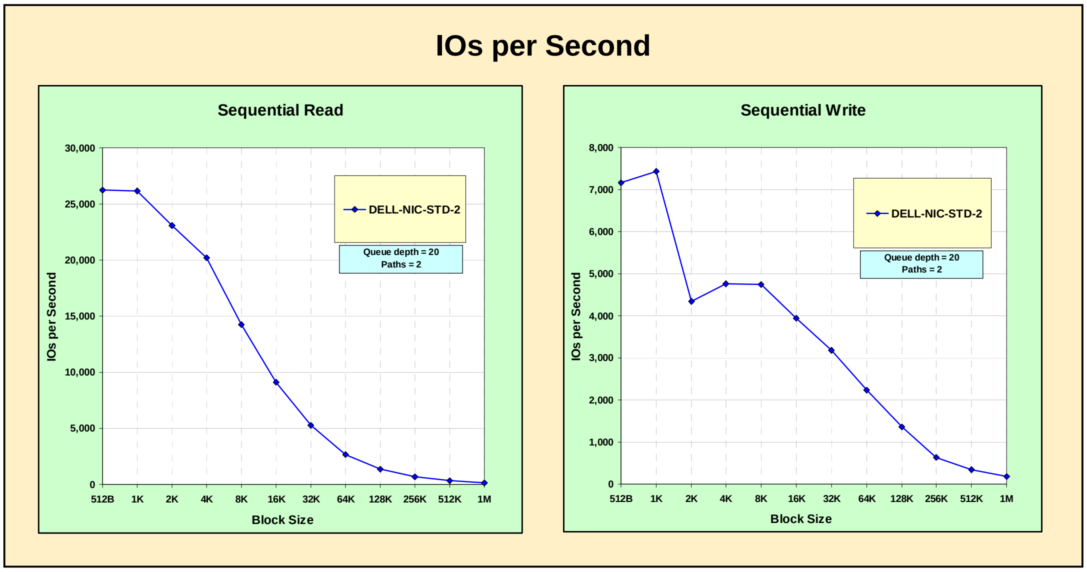
To configure multi-path iSCSI I/O for the initiator that uses the Dell NX1950 iSCSI targets, follow the directions for Microsoft Multi-path I/O from the Deployment section of this document above.

Basic Performance Results

The following performance data is not intended to be viewed as a comprehensive performance benchmark, but to provide a general performance overview for the Dell PowerVault NX1950 Networked Storage Solution.

Selected performance results are shown below, using a standard server-class network adapter, without receive-side scaling on the host. This configuration used two paths from one host, two I/O workers, simultaneously accessing two target volumes and a queue depth of 20. Each volume shared round-robin access across both paths.





EqualLogic® PS3800XV

The EqualLogic PS3800XV is an iSCSI target solution that includes a RISC-based, dual-controller disk subsystem with 15K RPM, 146GB SAS disk drives totaling 2.3 TB of raw capacity per module. It includes battery-backed and mirrored RAID cache, and its storage can be configured for RAID 5, RAID 10 or RAID 50.

EqualLogic's iSCSI SAN solutions encompass advanced automated and intelligent management features, which continuously load balance and optimize the SAN to meet applications performance and capacity needs. In addition to the fault tolerant and fully redundant design of the PS Series, they also include an extensive set of data protection features such as snapshots, remote replication and fast fail back, providing the tools needed to setup a robust yet simple Data Protection and Disaster Recovery strategy. The PS Series offer multiple models with different drive capacities and speeds allowing for an efficient set up of different pools of storage to enable appropriate service levels for individual applications. EqualLogic has early on joined Microsoft Simple SAN program to provide, affordable, enterprise class, SAN solutions that are easy to setup manage and scale.

Target Configuration Steps

To install the EqualLogic PS3800XV solution from factory settings, a computer must be connected via the supplied serial cable to the PS3800XV array. The Quick Start Guide steps the administrator through the process of connecting all the cables properly and running the Group Manager Setup Utility to perform the basic system configuration.

EqualLogic also provides a Host Integration Tools CDROM that provides the VDS and MPIO drivers and the auto-snapshot manager to use with the EqualLogic array. These were installed from the CD on the iSCSI initiator hosts. If the EqualLogic Multi-path Device Specific Module (DSM) is installed, a system reboot will be required. The multi-path DSM is required for multi-path operations.

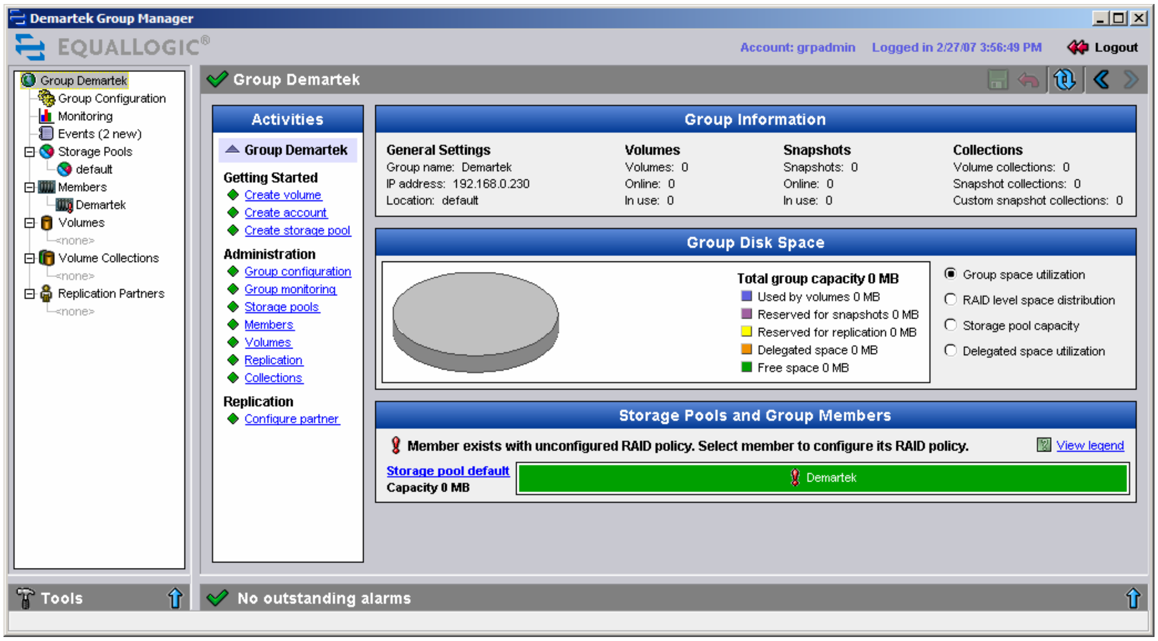
1. Configure Network Settings for iSCSI Target Device

The Group Manager Setup Utility, run from a computer connected via serial cable or Ethernet connection to the PS3800XV array, asks the administrator to specify the IP address and related network settings for the primary Ethernet connection and the name of the logical group and its IP address. The utility program HyperTerminal was used to communicate with the array.

```
Enter the network configuration for the array:

 Member name []: Demartek
 Network interface [eth0]:
 IP address for network interface []: 192.168.0.231
 Netmask [255.255.255.0]:
 Default gateway [192.17.2.1]: 192.168.0.1

Enter the name and IP address of the group that the array will join.

 Group name []: Demartek
 Group IP address []: 192.168.0.230
```

2. Launch Management Console

The management console is first launched via a 32-bit web browser. After logout, an option is displayed that provides a stand-alone JAVA application to use for the management console.



Demartek Group Manager

EQUALLOGIC®

Account: grpadmin   Logged in 2/27/07 3:56:49 PM   Logout

- Group Demartek
  - Group Configuration
  - Monitoring
  - Events (2 new)
  - Storage Pools
    - default
  - Members
    - Demartek
  - Volumes
    - <none>
  - Volume Collections
    - <none>
  - Replication Partners
    - <none>

Group Demartek

Activities

Group Demartek

Getting Started
- Create volume
- Create account
- Create storage pool

Administration
- Group configuration
- Group monitoring
- Storage pools
- Members
- Volumes
- Replication
- Collections

Replication
- Configure partner

Group Information

General Settings	Volumes	Snapshots	Collections
Group name: Demartek	Volumes: 0	Snapshots: 0	Volume collections: 0
IP address: 192.168.0.230	Online: 0	Online: 0	Snapshot collections: 0
Location: default	In use: 0	In use: 0	Custom snapshot collections: 0

Group Disk Space

Total group capacity 0 MB
- Used by volumes 0 MB
- Reserved for snapshots 0 MB
- Reserved for replication 0 MB
- Delegated space 0 MB
- Free space 0 MB

● Group space utilization
○ RAID level space distribution
○ Storage pool capacity
○ Delegated space utilization

Storage Pools and Group Members

Member exists with unconfigured RAID policy. Select member to configure its RAID policy.   View legend

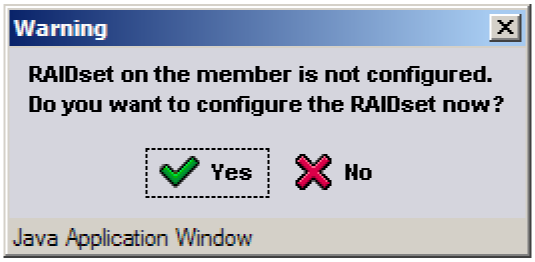
Storage pool default
Capacity 0 MB
Demartek

Tools

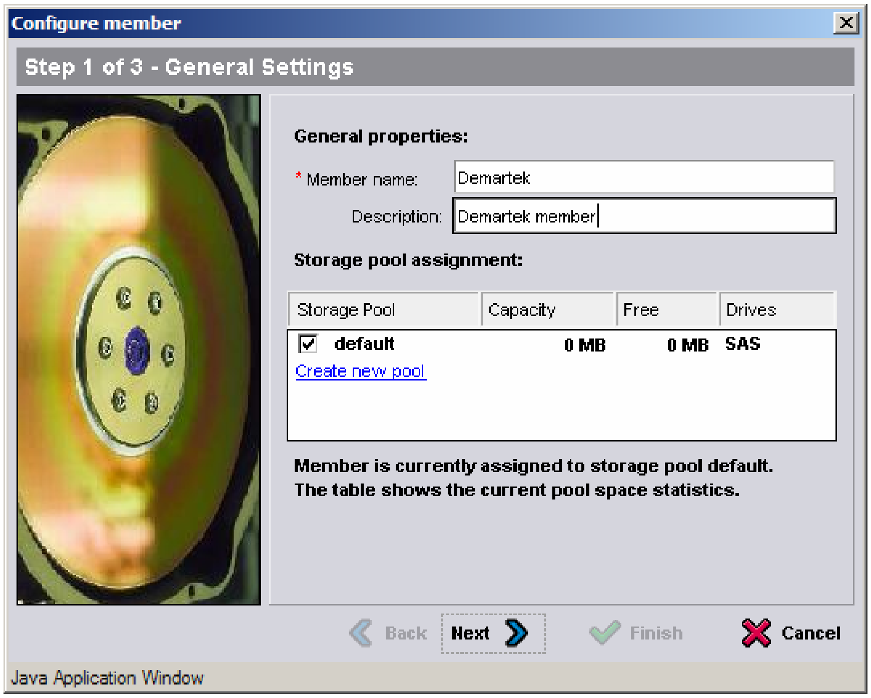
No outstanding alarms

3. Create Volumes on Disk Array

Before Volumes can be created on the array, the RAID policy must be set. The Quick Start Guide provides the step-by-step instructions to set the RAID policy.



RAIDset on the member is not configured.
Do you want to configure the RAIDset now?



General properties:

* Member name: Demartek

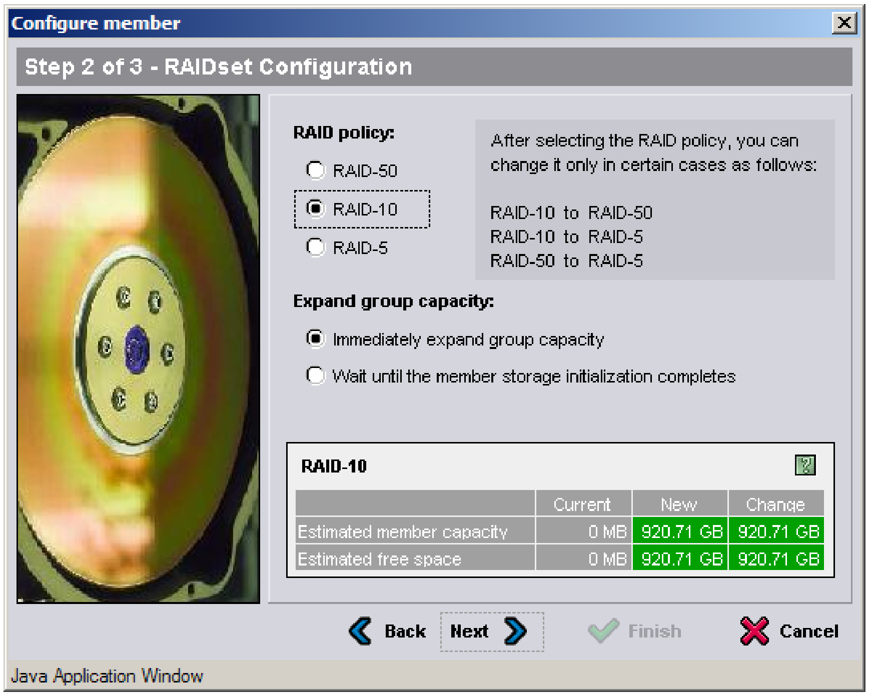
Description: Demartek member

Storage pool assignment:

Storage Pool	Capacity	Free	Drives
☑ default	0 MB	0 MB	SAS

Create new pool

Member is currently assigned to storage pool default.
The table shows the current pool space statistics.



Configure member

Step 2 of 3 - RAIDset Configuration

RAID policy:

○ RAID-50

● RAID-10

○ RAID-5

After selecting the RAID policy, you can change it only in certain cases as follows:

RAID-10 to RAID-50
RAID-10 to RAID-5
RAID-50 to RAID-5

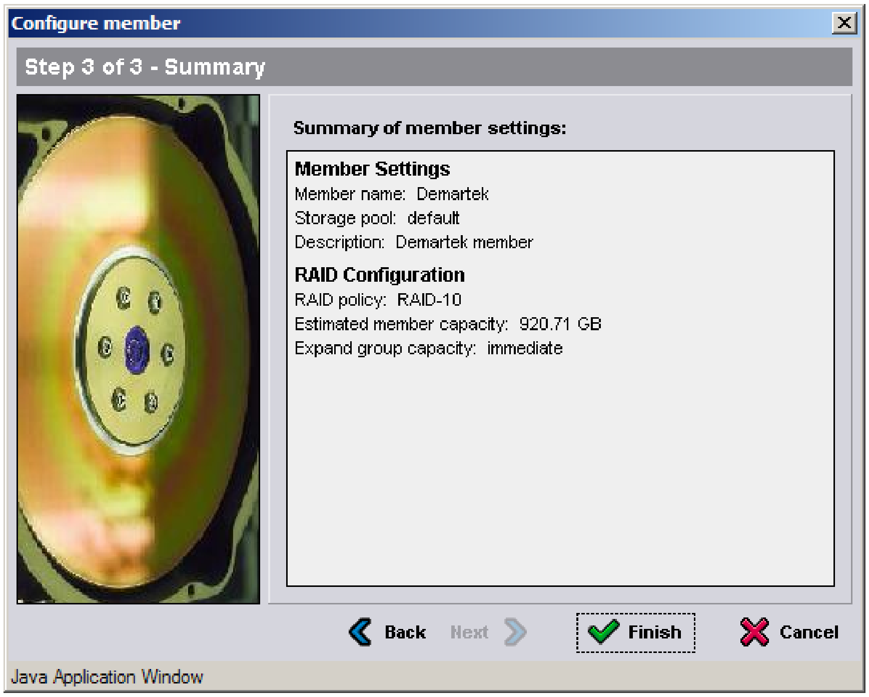
Expand group capacity:

● Immediately expand group capacity

○ Wait until the member storage initialization completes

RAID-10

	Current	New	Change
Estimated member capacity	0 MB	920.71 GB	920.71 GB
Estimated free space	0 MB	920.71 GB	920.71 GB



Configure member

Step 3 of 3 - Summary

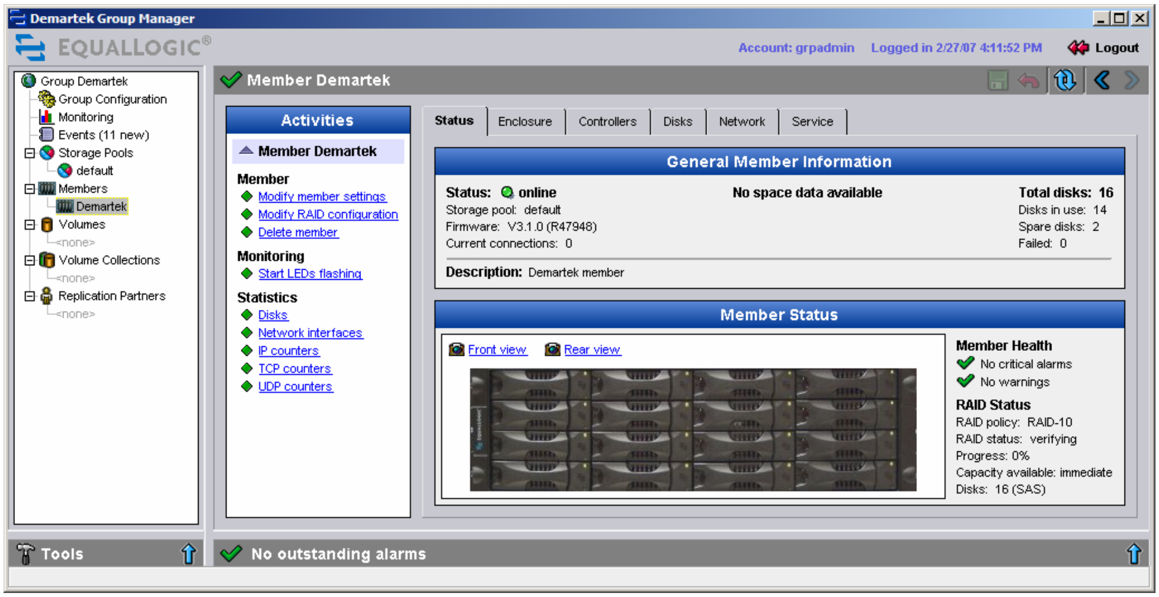
Summary of member settings:

Member Settings

Member name: Demartek
Storage pool: default
Description: Demartek member

RAID Configuration

RAID policy: RAID-10
Estimated member capacity: 920.71 GB
Expand group capacity: immediate



General Member Information

Status: online
Storage pool: default
Firmware: V3.1.0 (R47948)
Current connections: 0

No space data available

Total disks: 16
Disks in use: 14
Spare disks: 2
Failed: 0

Description: Demartek member

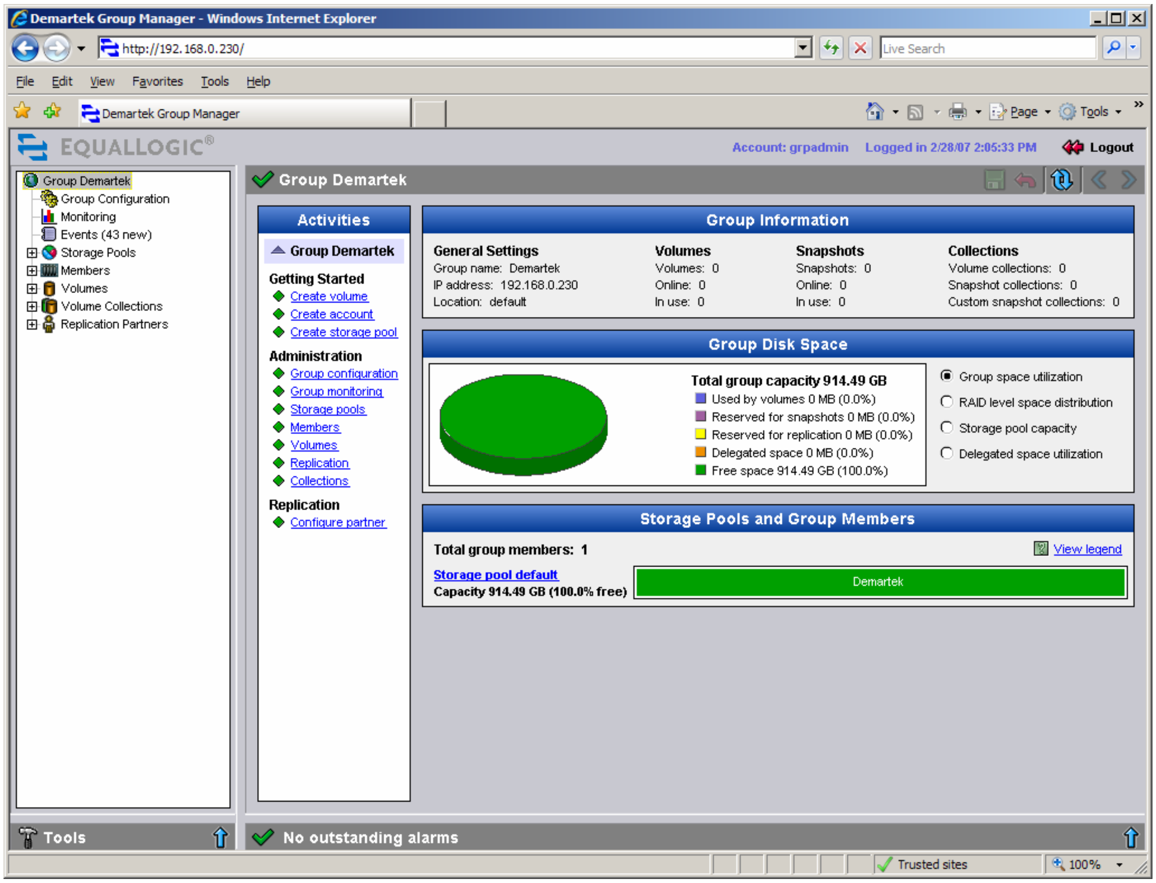
Member Status

Member Health
✓ No critical alarms
✓ No warnings

RAID Status
RAID policy: RAID-10
RAID status: verifying
Progress: 0%
Capacity available: immediate
Disks: 16 (SAS)

The array began to apply the RAID policy of RAID-10 across all disks.

Volumes are created using the “Activities” panel of the management console.



Group Information

General Settings
Group name: Demartek
IP address: 192.168.0.230
Location: default

Volumes
Volumes: 0
Online: 0
In use: 0

Snapshots
Snapshots: 0
Online: 0
In use: 0

Collections
Volume collections: 0
Snapshot collections: 0
Custom snapshot collections: 0

Group Disk Space

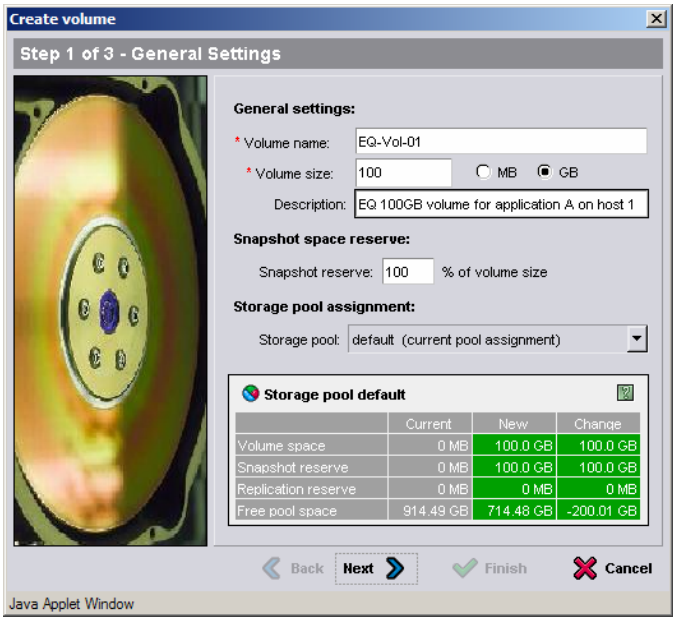
Total group capacity 914.49 GB
Used by volumes 0 MB (0.0%)
Reserved for snapshots 0 MB (0.0%)
Reserved for replication 0 MB (0.0%)
Delegated space 0 MB (0.0%)
Free space 914.49 GB (100.0%)

● Group space utilization
○ RAID level space distribution
○ Storage pool capacity
○ Delegated space utilization

Storage Pools and Group Members

Total group members: 1

Storage pool default
Capacity 914.49 GB (100.0% free)



Create volume

Step 1 of 3 - General Settings

General settings:

* Volume name: EQ-Vol-01

* Volume size: 100 ○ MB ● GB

Description: EQ 100GB volume for application A on host 1

Snapshot space reserve:

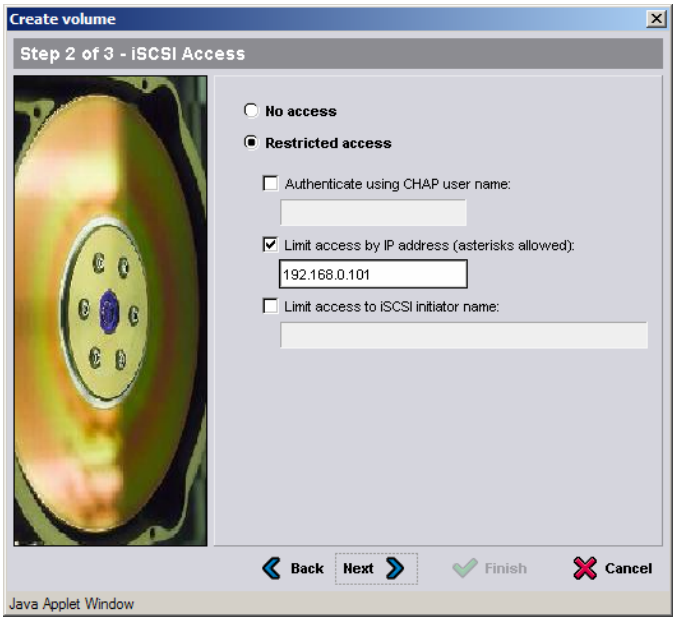
Snapshot reserve: 100 % of volume size

Storage pool assignment:

Storage pool: default (current pool assignment)

Storage pool default

	Current	New	Change
Volume space	0 MB	100.0 GB	100.0 GB
Snapshot reserve	0 MB	100.0 GB	100.0 GB
Replication reserve	0 MB	0 MB	0 MB
Free pool space	914.49 GB	714.48 GB	-200.01 GB



Create volume

Step 2 of 3 - iSCSI Access

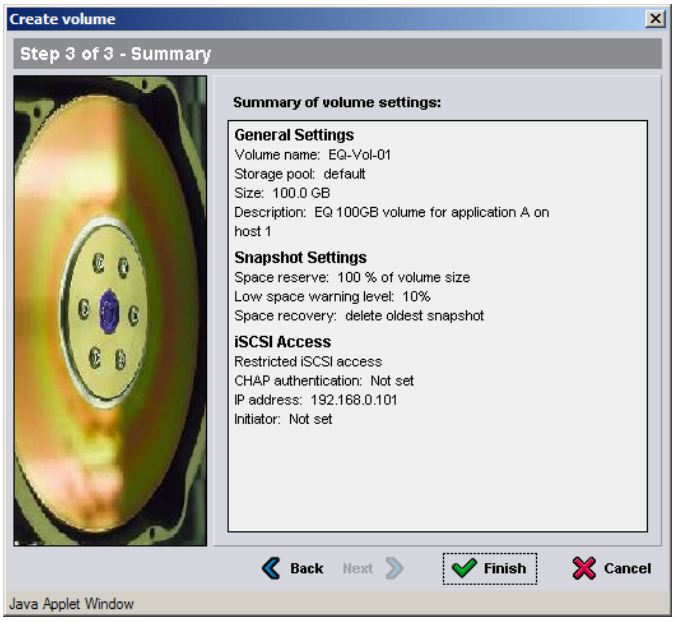
○ No access

● Restricted access

☐ Authenticate using CHAP user name:

☑ Limit access by IP address (asterisks allowed): 192.168.0.101

☐ Limit access to iSCSI initiator name:

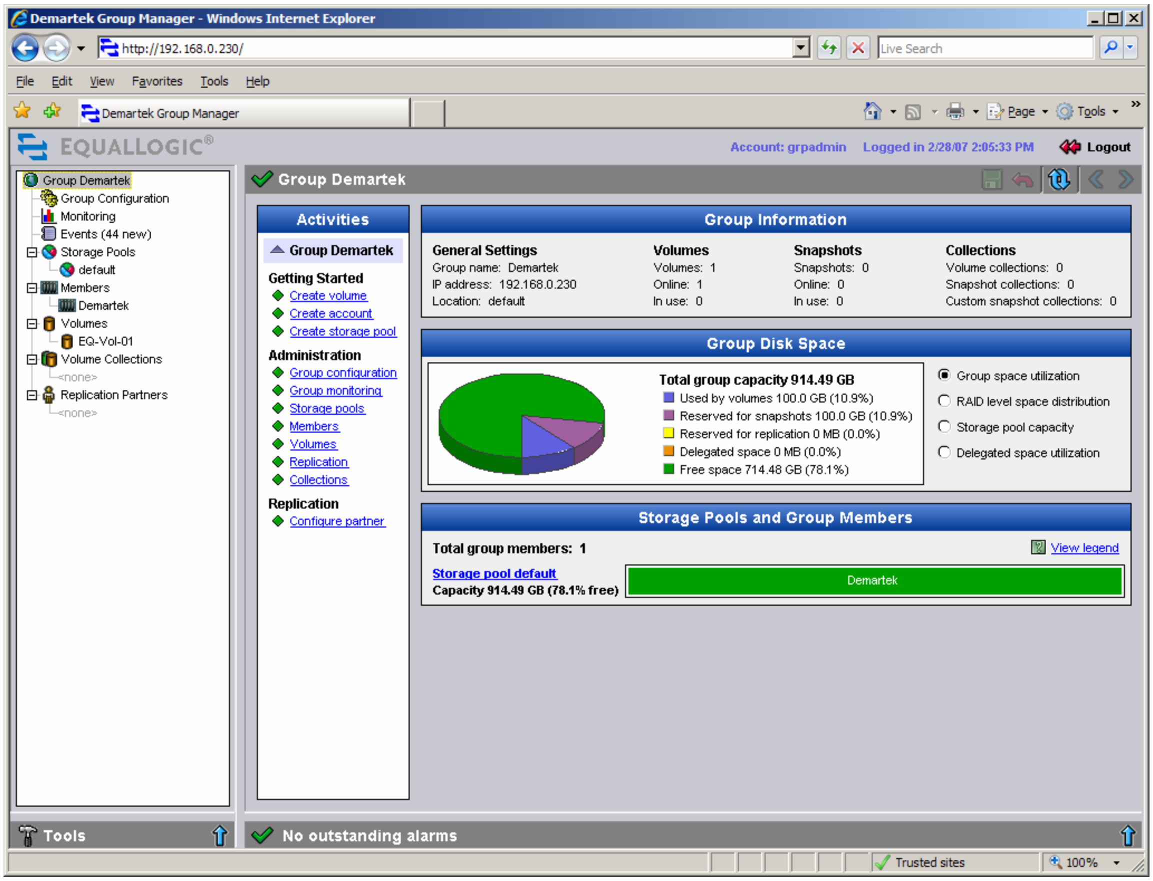


Summary of volume settings:

General Settings
Volume name: EQ-Vol-01
Storage pool: default
Size: 100.0 GB
Description: EQ 100GB volume for application A on host 1

Snapshot Settings
Space reserve: 100 % of volume size
Low space warning level: 10%
Space recovery: delete oldest snapshot

iSCSI Access
Restricted iSCSI access
CHAP authentication: Not set
IP address: 192.168.0.101
Initiator: Not set



Account: grpadmin Logged in 2/28/07 2:05:33 PM

Group Demartek

Group Information

General Settings	Volumes	Snapshots	Collections
Group name: Demartek	Volumes: 1	Snapshots: 0	Volume collections: 0
IP address: 192.168.0.230	Online: 1	Online: 0	Snapshot collections: 0
Location: default	In use: 0	In use: 0	Custom snapshot collections: 0

Group Disk Space

Total group capacity 914.49 GB
🟦 Used by volumes 100.0 GB (10.9%)
🟪 Reserved for snapshots 100.0 GB (10.9%)
🟨 Reserved for replication 0 MB (0.0%)
🟧 Delegated space 0 MB (0.0%)
🟩 Free space 714.48 GB (78.1%)

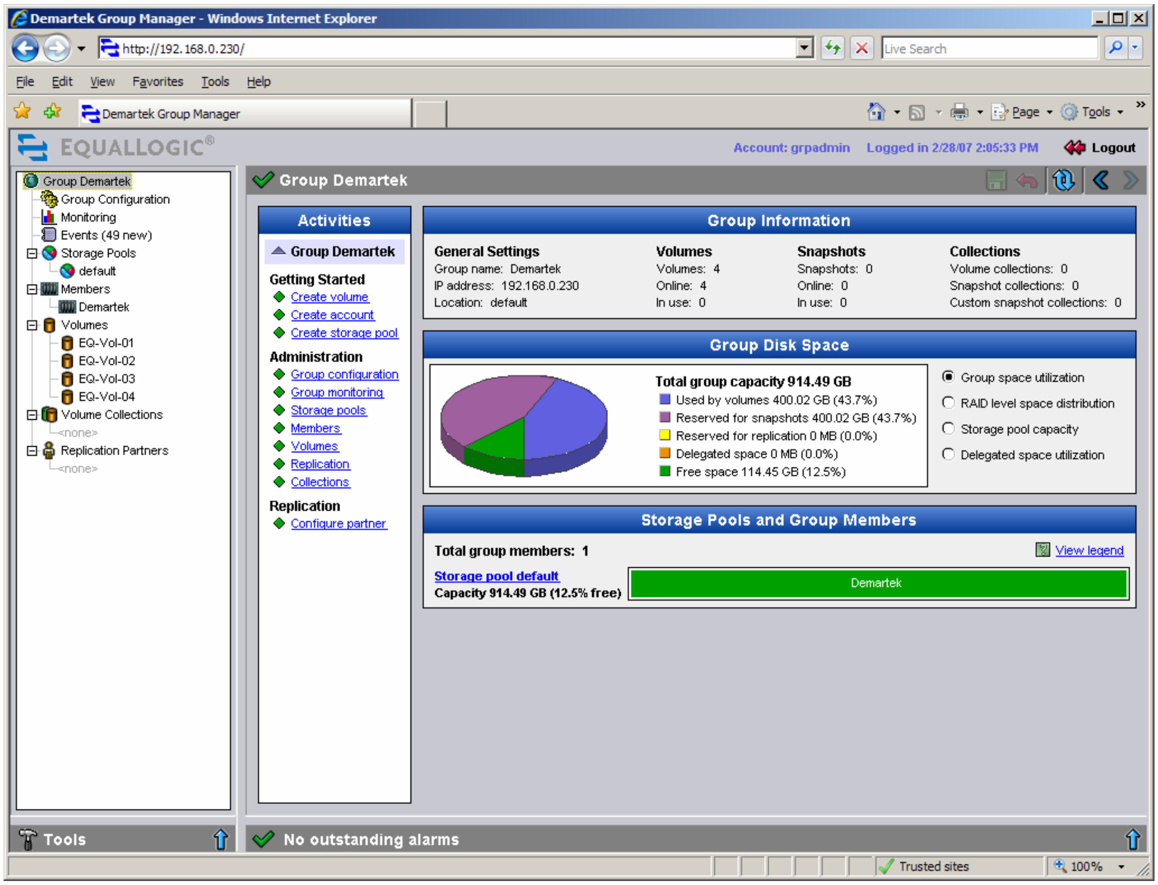
● Group space utilization
○ RAID level space distribution
○ Storage pool capacity
○ Delegated space utilization

Storage Pools and Group Members

Total group members: 1

Storage pool default
Capacity 914.49 GB (78.1% free)

Four volumes were created.



Group Information

General Settings
Group name: Demartek
IP address: 192.168.0.230
Location: default

Volumes
Volumes: 4
Online: 4
In use: 0

Snapshots
Snapshots: 0
Online: 0
In use: 0

Collections
Volume collections: 0
Snapshot collections: 0
Custom snapshot collections: 0

Group Disk Space

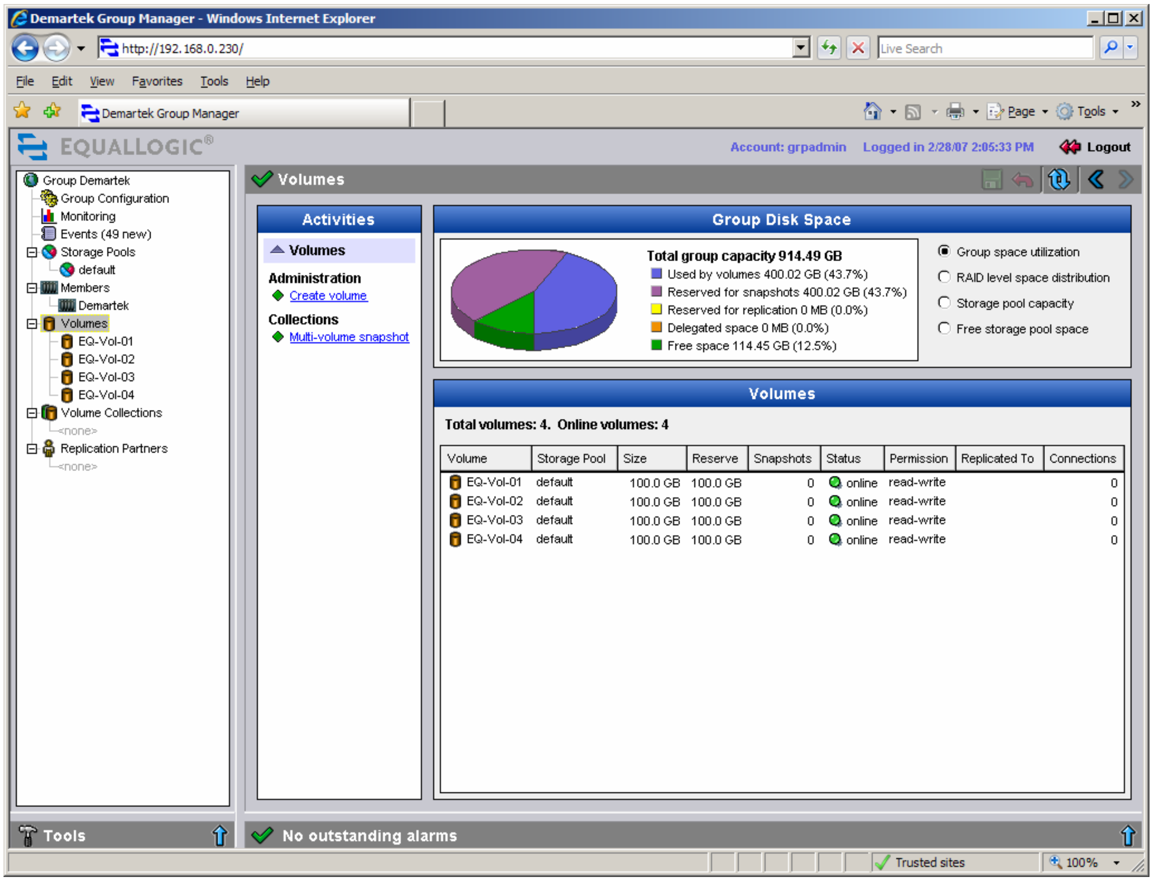
Total group capacity 914.49 GB
- 🟦 Used by volumes 400.02 GB (43.7%)
- 🟪 Reserved for snapshots 400.02 GB (43.7%)
- 🟨 Reserved for replication 0 MB (0.0%)
- 🟧 Delegated space 0 MB (0.0%)
- 🟩 Free space 114.45 GB (12.5%)

● Group space utilization
○ RAID level space distribution
○ Storage pool capacity
○ Delegated space utilization

Storage Pools and Group Members

Total group members: 1

Storage pool default
Capacity 914.49 GB (12.5% free)
Demartek



Account: grpadmin Logged in 2/28/07 2:05:33 PM

Group Disk Space

Total group capacity 914.49 GB
- 🟦 Used by volumes 400.02 GB (43.7%)
- 🟪 Reserved for snapshots 400.02 GB (43.7%)
- 🟨 Reserved for replication 0 MB (0.0%)
- 🟧 Delegated space 0 MB (0.0%)
- 🟩 Free space 114.45 GB (12.5%)

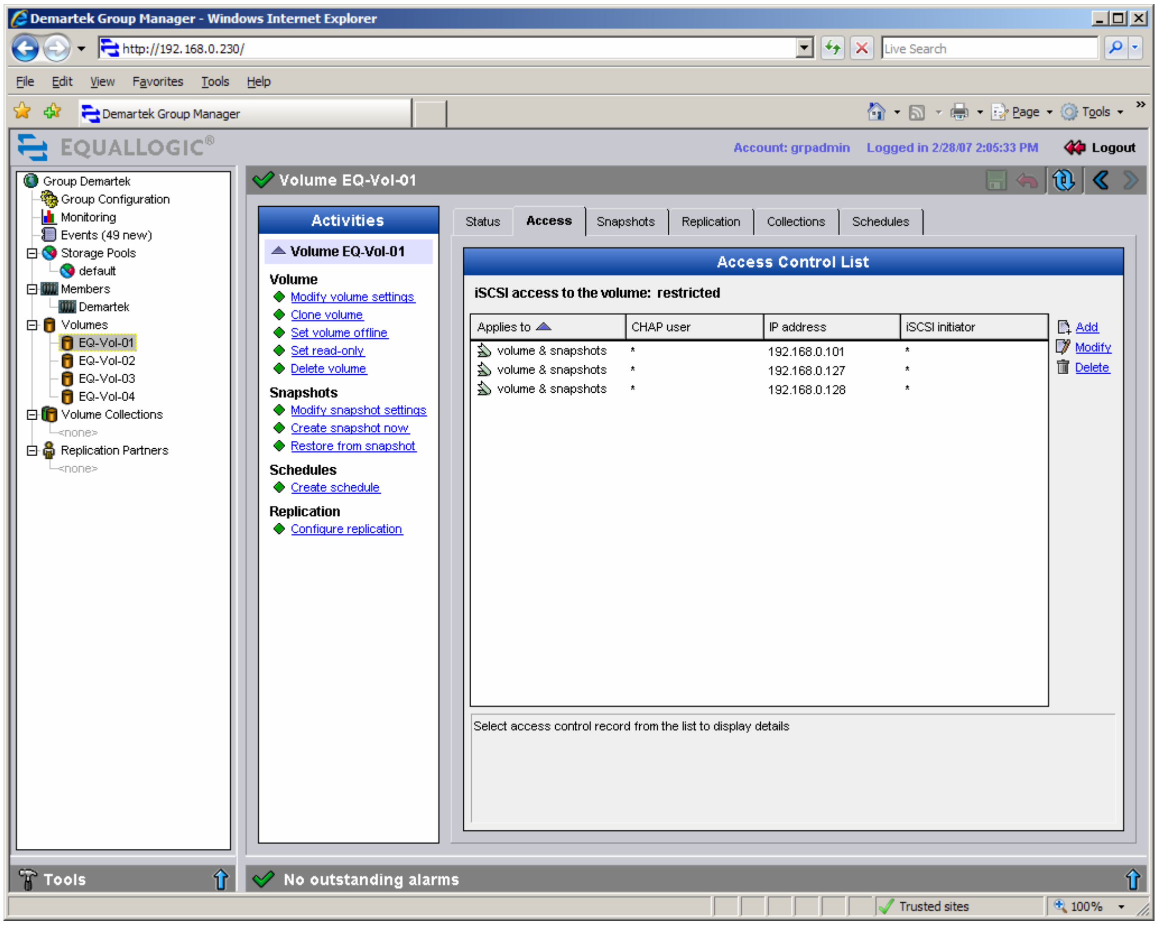
● Group space utilization
○ RAID level space distribution
○ Storage pool capacity
○ Free storage pool space

Volumes

Total volumes: 4. Online volumes: 4

Volume	Storage Pool	Size	Reserve	Snapshots	Status	Permission	Replicated To	Connections
EQ-Vol-01	default	100.0 GB	100.0 GB	0	online	read-write		0
EQ-Vol-02	default	100.0 GB	100.0 GB	0	online	read-write		0
EQ-Vol-03	default	100.0 GB	100.0 GB	0	online	read-write		0
EQ-Vol-04	default	100.0 GB	100.0 GB	0	online	read-write		0

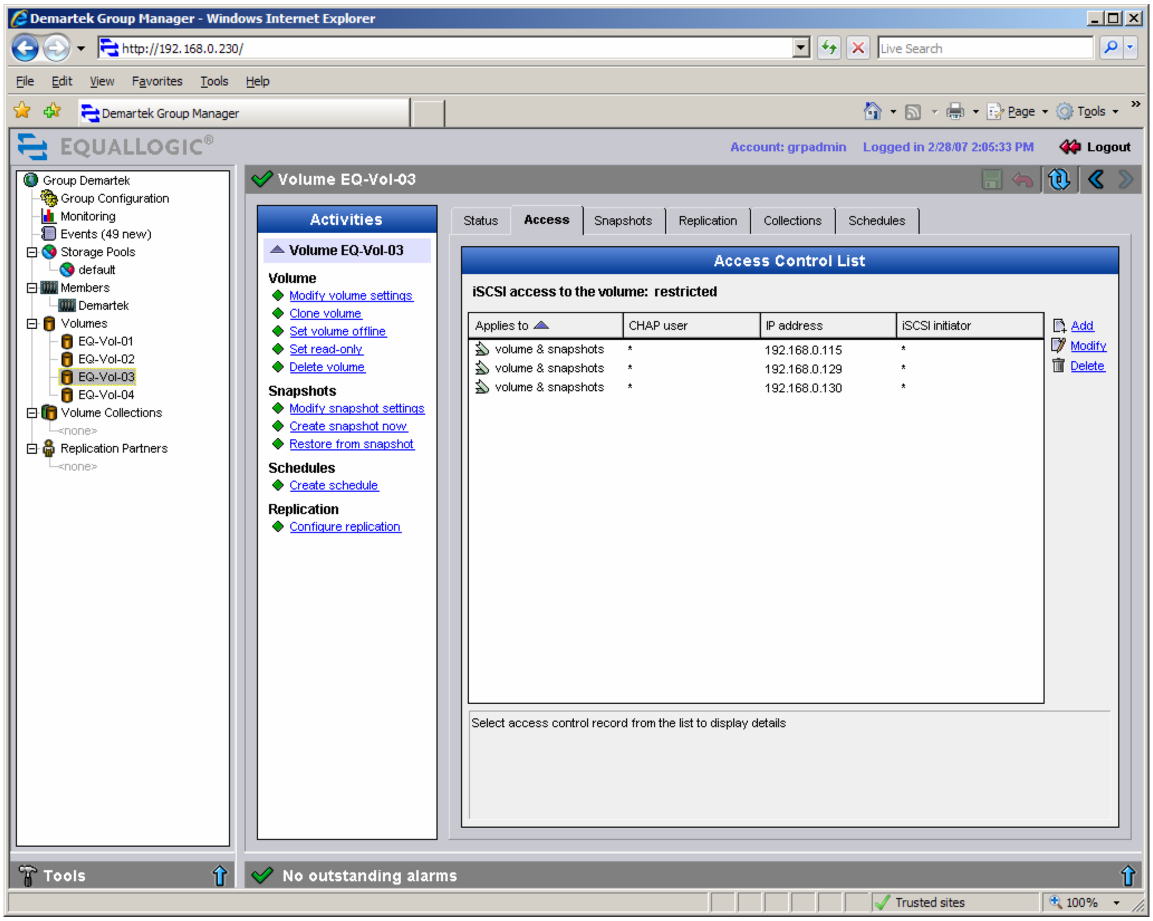
No outstanding alarms



iSCSI access to the volume: restricted

Applies to	CHAP user	IP address	iSCSI initiator
volume & snapshots	*	192.168.0.101	*
volume & snapshots	*	192.168.0.127	*
volume & snapshots	*	192.168.0.128	*

Select access control record from the list to display details



Access Control List

iSCSI access to the volume: restricted

Applies to	CHAP user	IP address	iSCSI initiator
volume & snapshots	*	192.168.0.115	*
volume & snapshots	*	192.168.0.129	*
volume & snapshots	*	192.168.0.130	*

Select access control record from the list to display details

4. Make Volumes Ready for Use

The Volumes are ready for use as soon as the LUNs are created in the previous step.

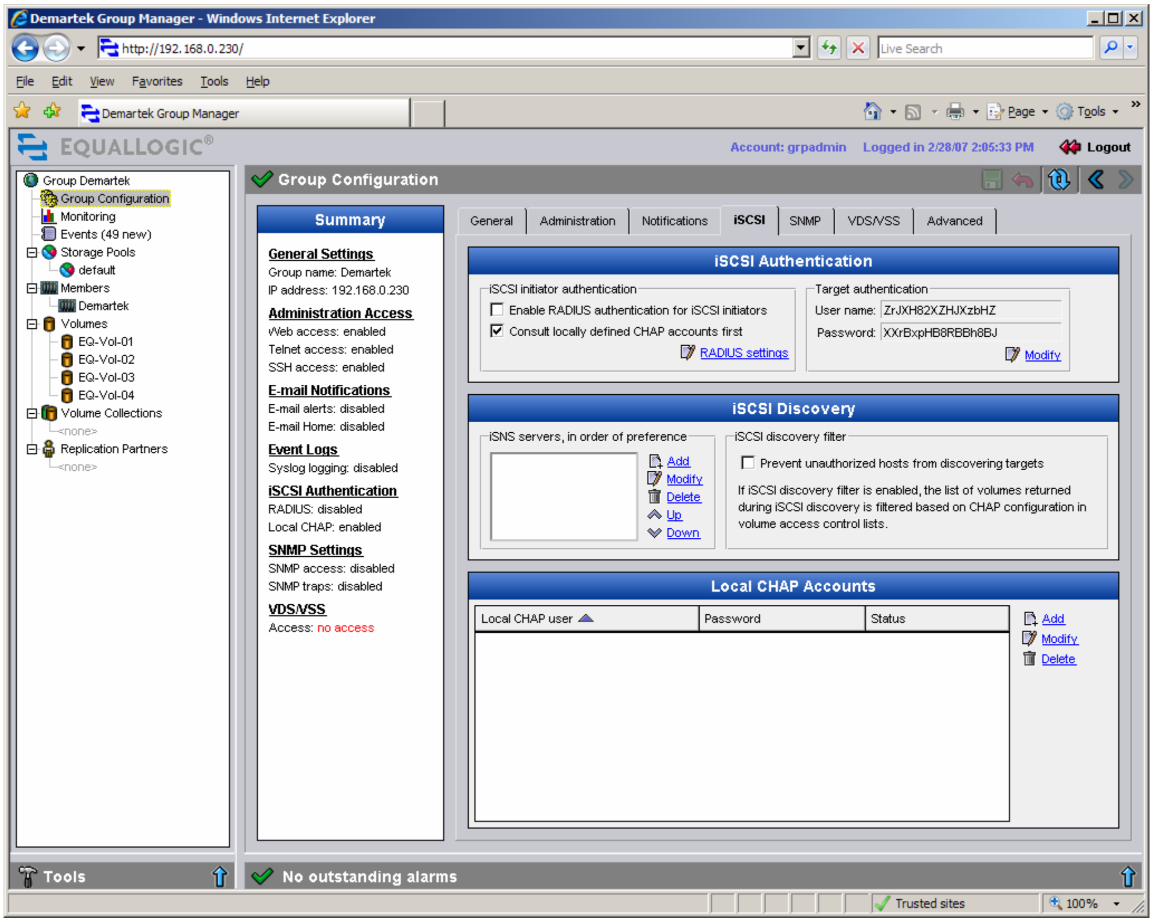
5. Create iSCSI Targets

The targets are created when the iSCSI initiator addresses are supplied in the LUN creation step above. Access can be restricted to iSCSI initiators by their CHAP credentials, IP address, IQN or any combination of those three parameters.

6. Create Multi-path I/O for iSCSI Targets (optional)

The EqualLogic system will use multi-path I/O if at least two of its network interfaces have been enabled, and the iSCSI initiator is configured to use multi-path I/O. The EqualLogic system will automatically choose the paths to use for each I/O session. The EqualLogic system may vary the paths chosen between I/O sessions. When the iSCSI initiator is configuring multiple paths to the EqualLogic system, the iSCSI initiator will only see the "group" IP address. The EqualLogic system will handle the multi-pathing behind the "group" address.

7. Configure Security for iSCSI Targets (optional)



Summary

General Settings
Group name: Demartek
IP address: 192.168.0.230

Administration Access
Web access: enabled
Telnet access: enabled
SSH access: enabled

E-mail Notifications
E-mail alerts: disabled
E-mail Home: disabled

Event Logs
Syslog logging: disabled

iSCSI Authentication
RADIUS: disabled
Local CHAP: enabled

SNMP Settings
SNMP access: disabled
SNMP traps: disabled

VDS/VSS
Access: no access

iSCSI Authentication

iSCSI initiator authentication
☐ Enable RADIUS authentication for iSCSI initiators
☑ Consult locally defined CHAP accounts first
RADIUS settings

Target authentication
User name: ZrJXH82XZHJXzbHZ
Password: XXrBxpHB8RBBh8BJ
Modify

iSCSI Discovery

iSNS servers, in order of preference
Add
Modify
Delete
Up
Down

iSCSI discovery filter
☐ Prevent unauthorized hosts from discovering targets

If iSCSI discovery filter is enabled, the list of volumes returned during iSCSI discovery is filtered based on CHAP configuration in volume access control lists.

Local CHAP Accounts

Local CHAP user	Password	Status

Add
Modify
Delete

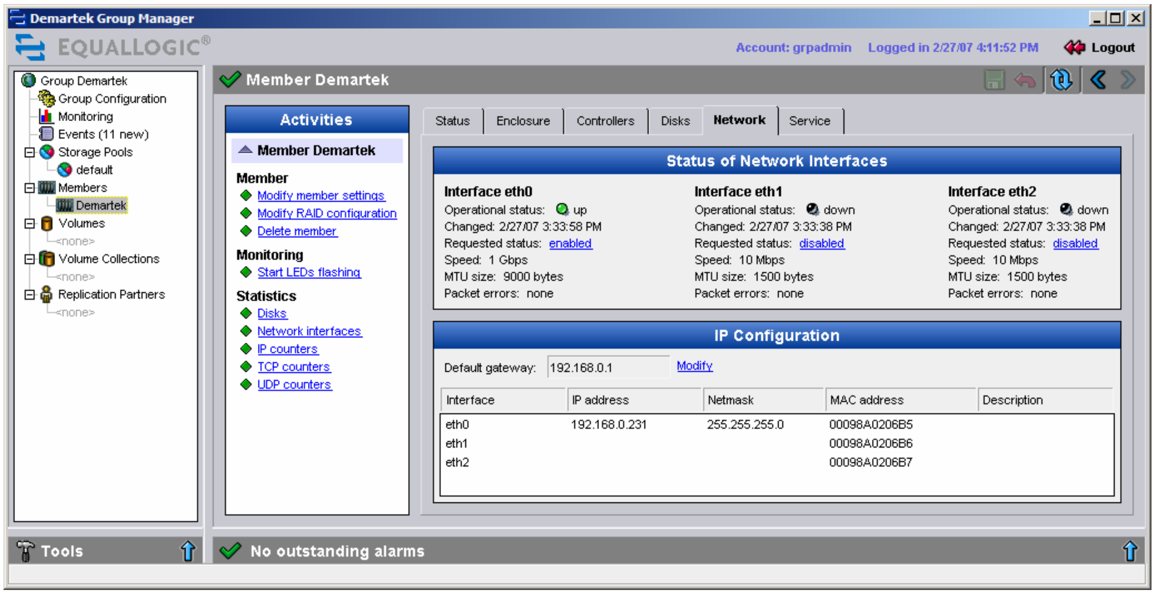
8. Make iSCSI Targets Ready for Use for iSCSI Initiators

No further steps are required to make the iSCSI targets ready to be accessed by the iSCSI initiators.

Initiator Configuration Steps

1. Configure Multi-path I/O from Application Host

The management console provides the option to activate the other two network interfaces on the array. This was done by enabling and modifying the settings of the two network interfaces that were not activated in the earlier steps.



Status of Network Interfaces

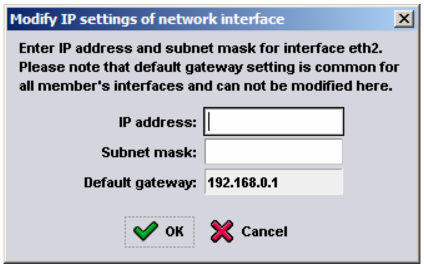
Interface eth0	Interface eth1	Interface eth2
Operational status: up	Operational status: down	Operational status: down
Changed: 2/27/07 3:33:58 PM	Changed: 2/27/07 3:33:38 PM	Changed: 2/27/07 3:33:38 PM
Requested status: enabled	Requested status: disabled	Requested status: disabled
Speed: 1 Gbps	Speed: 10 Mbps	Speed: 10 Mbps
MTU size: 9000 bytes	MTU size: 1500 bytes	MTU size: 1500 bytes
Packet errors: none	Packet errors: none	Packet errors: none

IP Configuration

Default gateway: 192.168.0.1 Modify

Interface	IP address	Netmask	MAC address	Description
eth0	192.168.0.231	255.255.255.0	00098A0206B5	
eth1			00098A0206B6	
eth2			00098A0206B7	

Each of the unassigned network interfaces, *eth1* and *eth2*, were assigned an address and activated. All three network interfaces must use the same subnet mask and default gateway.

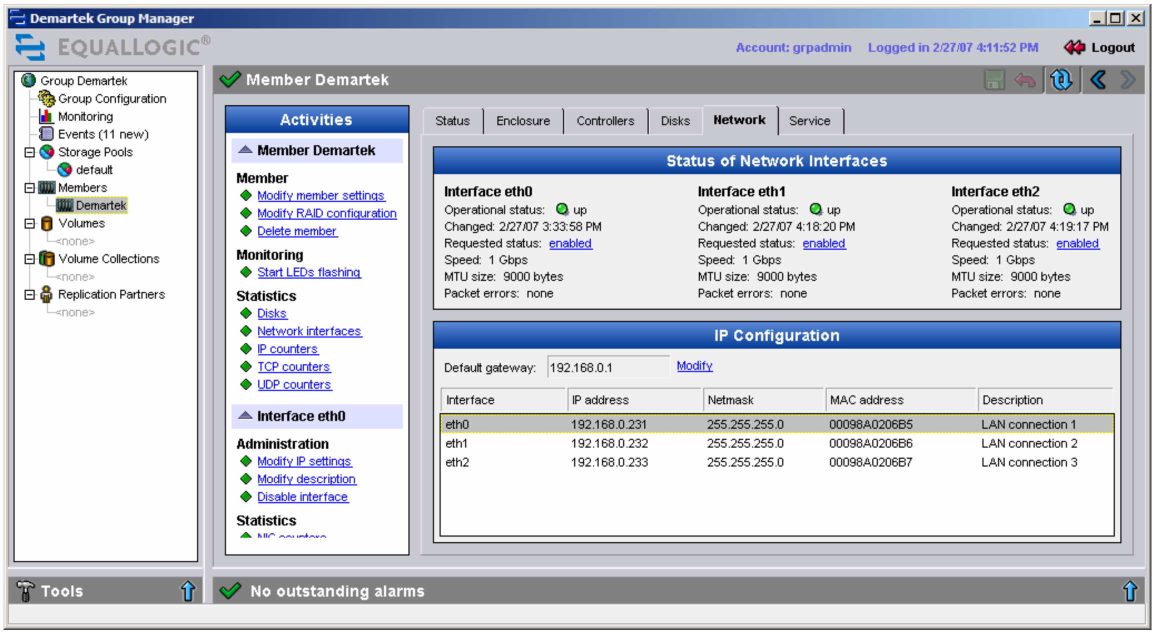

Modify IP settings of network interface

Enter IP address and subnet mask for interface eth2. Please note that default gateway setting is common for all member's interfaces and can not be modified here.

IP address:

Subnet mask:

Default gateway: 192.168.0.1



Demartek Group Manager

EQUALLOGIC®

Account: grpadmin Logged in 2/27/07 4:11:52 PM Logout

- Group Demartek
  - Group Configuration
  - Monitoring
  - Events (11 new)
  - Storage Pools
    - default
  - Members
    - Demartek
  - Volumes
    - <none>
  - Volume Collections
    - <none>
  - Replication Partners
    - <none>

Member Demartek

Activities

Member Demartek

Member
- Modify member settings
- Modify RAID configuration
- Delete member

Monitoring
- Start LEDs flashing

Statistics
- Disks
- Network interfaces
- IP counters
- TCP counters
- UDP counters

Interface eth0

Administration
- Modify IP settings
- Modify description
- Disable interface

Statistics
- NIC counters

Status | Enclosure | Controllers | Disks | **Network** | Service

Status of Network Interfaces

Interface eth0	Interface eth1	Interface eth2
Operational status: up	Operational status: up	Operational status: up
Changed: 2/27/07 3:33:58 PM	Changed: 2/27/07 4:18:20 PM	Changed: 2/27/07 4:19:17 PM
Requested status: enabled	Requested status: enabled	Requested status: enabled
Speed: 1 Gbps	Speed: 1 Gbps	Speed: 1 Gbps
MTU size: 9000 bytes	MTU size: 9000 bytes	MTU size: 9000 bytes
Packet errors: none	Packet errors: none	Packet errors: none

IP Configuration

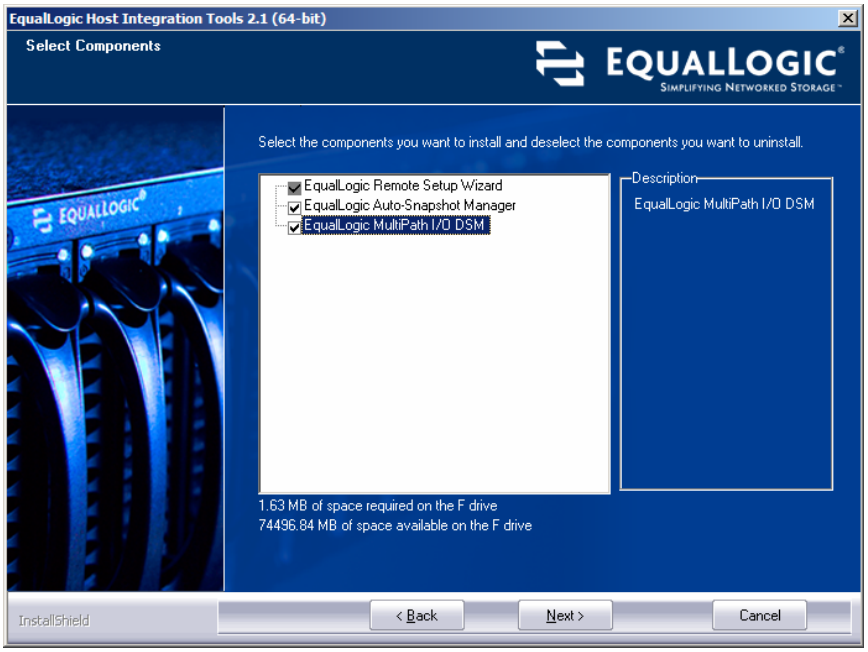
Default gateway: 192.168.0.1 Modify

Interface	IP address	Netmask	MAC address	Description
eth0	192.168.0.231	255.255.255.0	00098A0206B5	LAN connection 1
eth1	192.168.0.232	255.255.255.0	00098A0206B6	LAN connection 2
eth2	192.168.0.233	255.255.255.0	00098A0206B7	LAN connection 3

Tools

No outstanding alarms

The EqualLogic MPIO DSM (Device Specific Module) must also be installed onto the iSCSI initiator hosts. The DSM is available on the Host Integration Tools CDROM or from EqualLogic's website.



EqualLogic Host Integration Tools 2.1 (64-bit)

Select Components

EQUALLOGIC® SIMPLIFYING NETWORKED STORAGE™

Select the components you want to install and deselect the components you want to uninstall.

- ☑ EqualLogic Remote Setup Wizard
- ☑ EqualLogic Auto-Snapshot Manager
- ☑ EqualLogic MultiPath I/O DSM

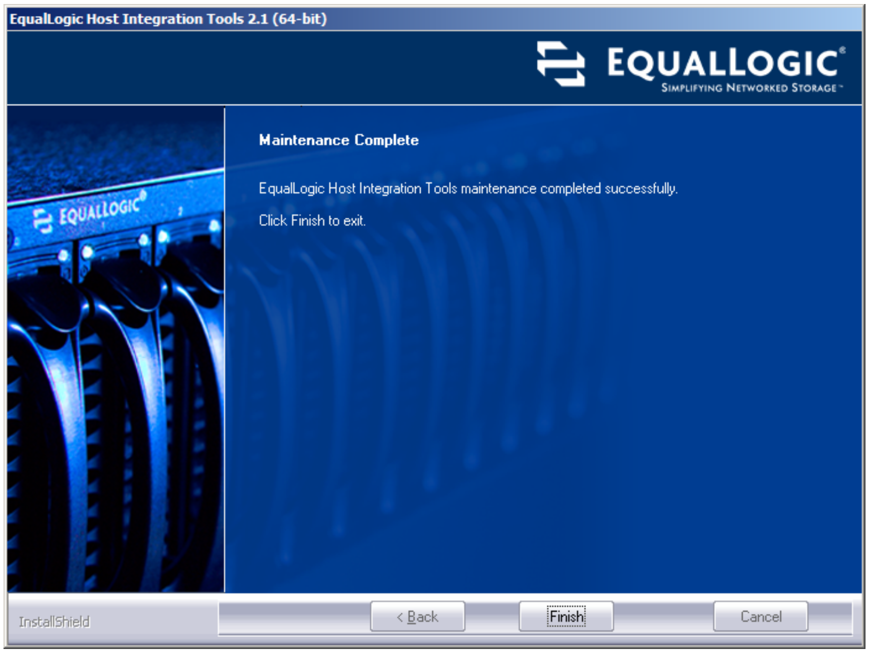
Description

EqualLogic MultiPath I/O DSM

1.63 MB of space required on the F drive
74496.84 MB of space available on the F drive

InstallShield

< Back Next > Cancel


EqualLogic Host Integration Tools 2.1 (64-bit)
EQUALLOGIC
SIMPLIFYING NETWORKED STORAGE
EQUALLOGIC
InstallShield
< Back
Finish
Cancel

Maintenance Complete

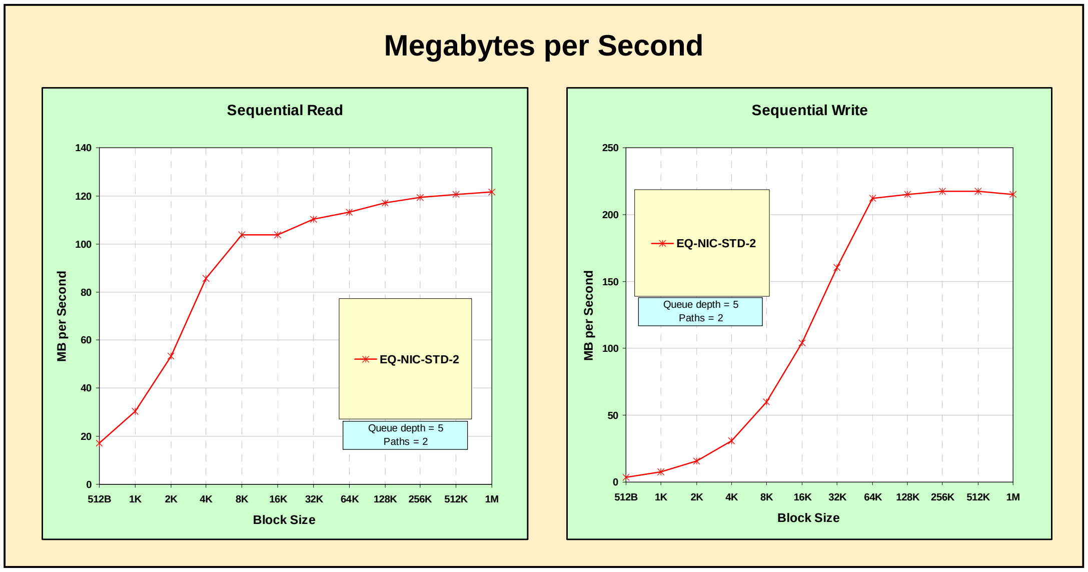
EqualLogic Host Integration Tools maintenance completed successfully.

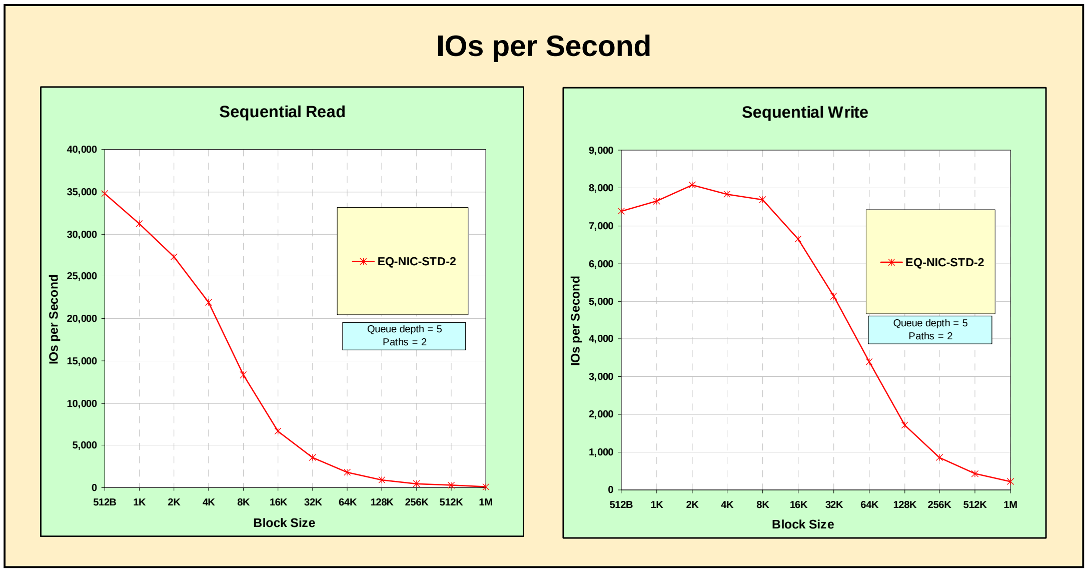
Click Finish to exit.

Basic Performance Results

The following performance data is not intended to be viewed as a comprehensive performance benchmark, but to provide a general performance overview for the EqualLogic PS3800XV Solution.

Selected performance results are shown below, using a standard server-class network adapter, with receive-side scaling on the host. This configuration used two paths from one host, two I/O workers, simultaneously accessing two target volumes and a queue depth of 5. Each volume shared round-robin access across both paths.





HDS TagmaStore™ AMS1000

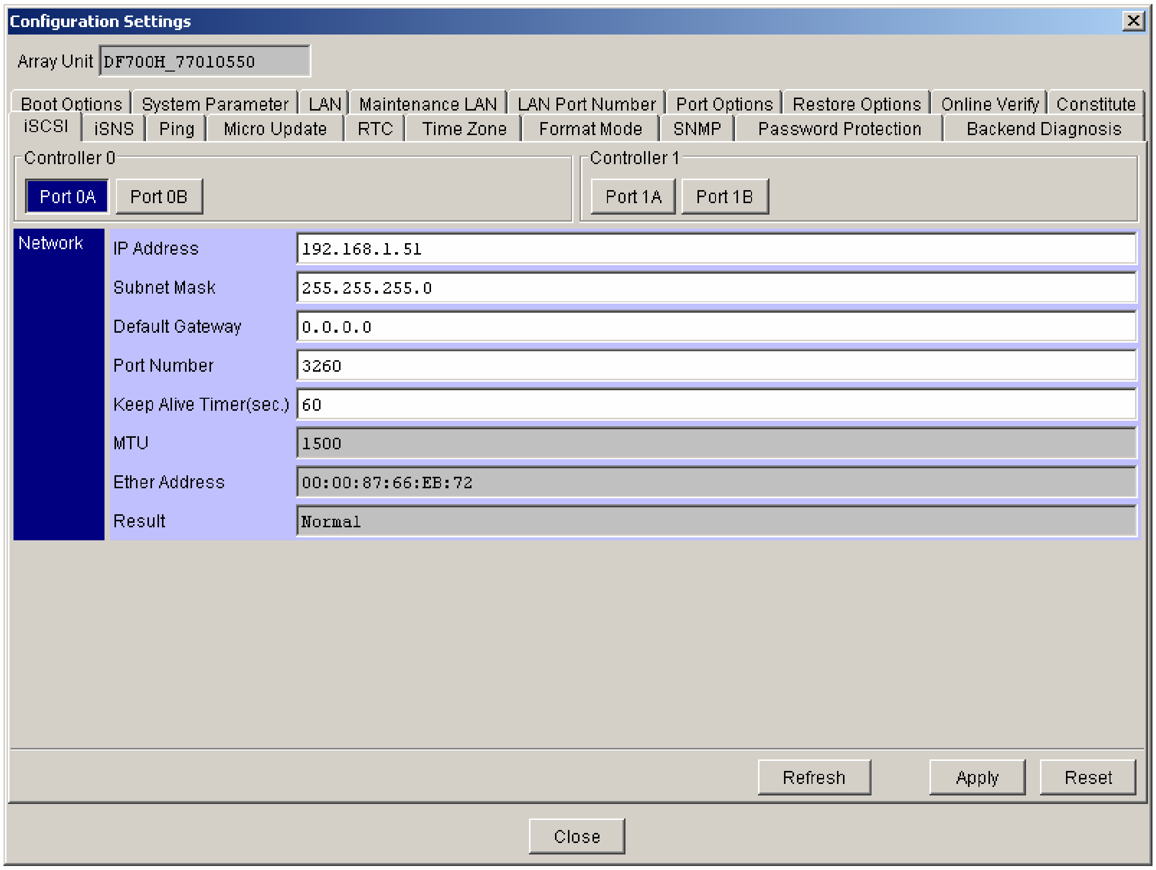
The HDS TagmaStore AMS1000 is an iSCSI target solution that includes a dual-controller disk subsystem with SATA and/or Fibre Channel disk drives with raw capacities up to more than 200 TB. It includes cache binding, cache partitioning and a variety of hardware copy and management functions. In the iSCSI configuration it supports RAID 1, RAID 1+0, RAID-5 and RAID-6. The AMS1000 supports iSCSI, Fibre Channel and NAS protocols with the additional benefit of supporting two protocols simultaneously.

Hitachi's Adaptable Modular Storage is enterprise class storage designed and priced to meet the needs of small and medium businesses. The AMS line supports FC and iSCSI protocols and consists of three models, AMS200, AMS500 and AMS1000 and cost effectively support storage needs from under one terabyte to over 300 terabytes with the AMS200 and AMS500 being upgradeable in the rack. The AMS models have many features unique to the modular market including: RAID 6 (dual parity for highest availability); modular volume migration (non disruptive movement of volumes within the storage array); cache partitioning (allotment of cache memory size to specific applications) as well as support for both Fibre Channel and Serial ATA disk drives. When combined with Plug and play kits for Microsoft Simple SAN, Windows servers attached to AMS storage models can easily manage their storage as well as their entire storage area network.

Target Configuration Steps

1. Configure Network Settings for iSCSI Target Ports

The AMS1000 is initially configured for access by the Storage Navigator Modular software. Change the Storage Navigator Modular setting from "Operation Mode" to "Maintenance Mode". Select the desired AMS1000 array. From the Array System viewer select "Tools/Configuration Settings/iSCSI tab" to change the network settings for the iSCSI ports.

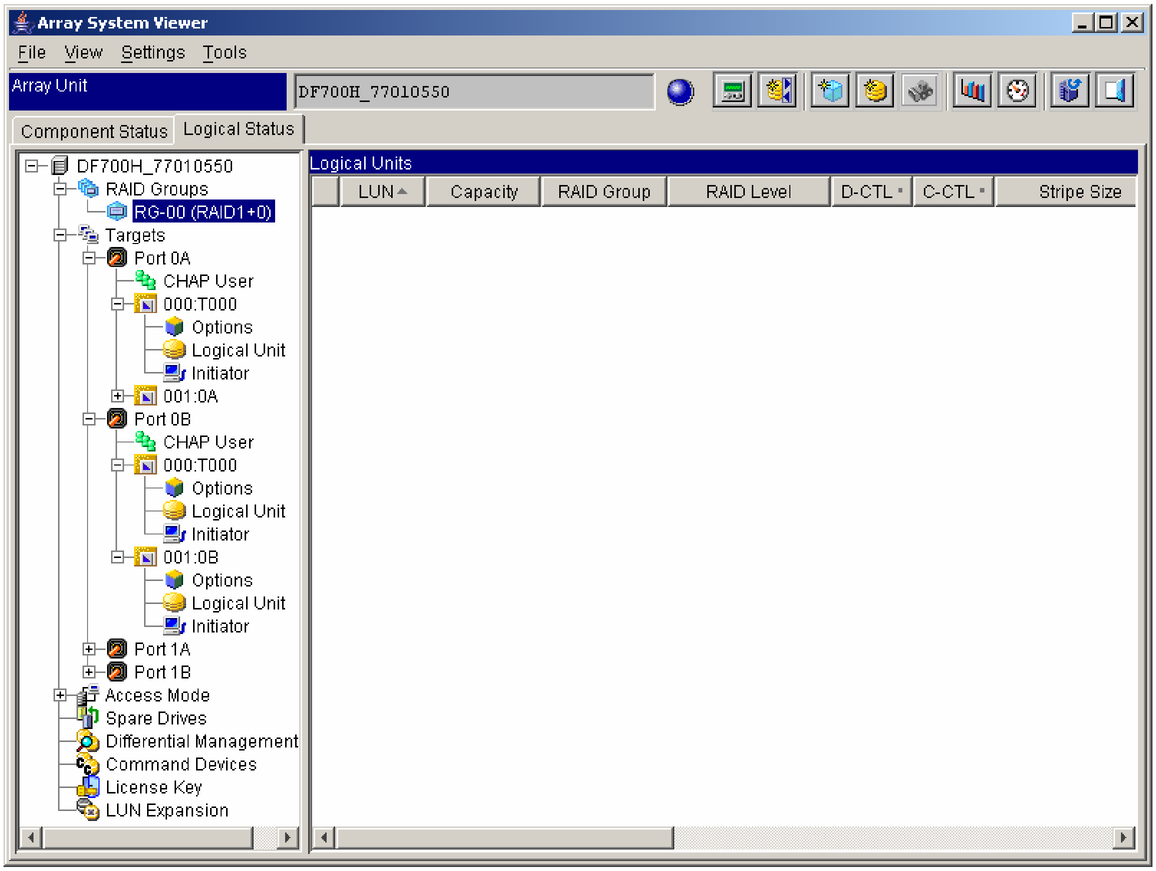


Array Unit DF700H_77010550

IP Address	192.168.1.51
Subnet Mask	255.255.255.0
Default Gateway	0.0.0.0
Port Number	3260
Keep Alive Timer(sec.)	60
MTU	1500
Ether Address	00:00:87:66:EB:72
Result	Normal

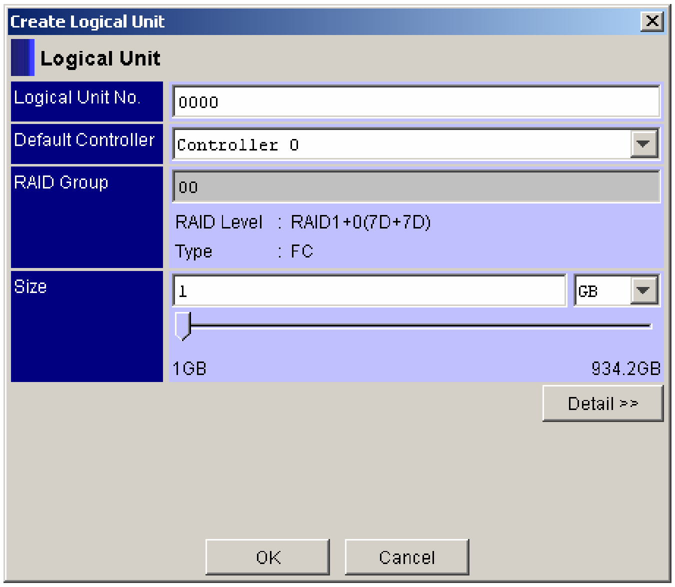
2. Launch Management Console

The AMS1000 management console, also known as Storage Navigator Modular, provides access to all array management functions.



3. Create LUNs on Disk Array

To create a LUN, the “Create Logical Unit” option is selected. This particular array was previously configured as a RAID 1+0 by the hardware field engineer.



Logical Unit No. 0000

Default Controller Controller 0

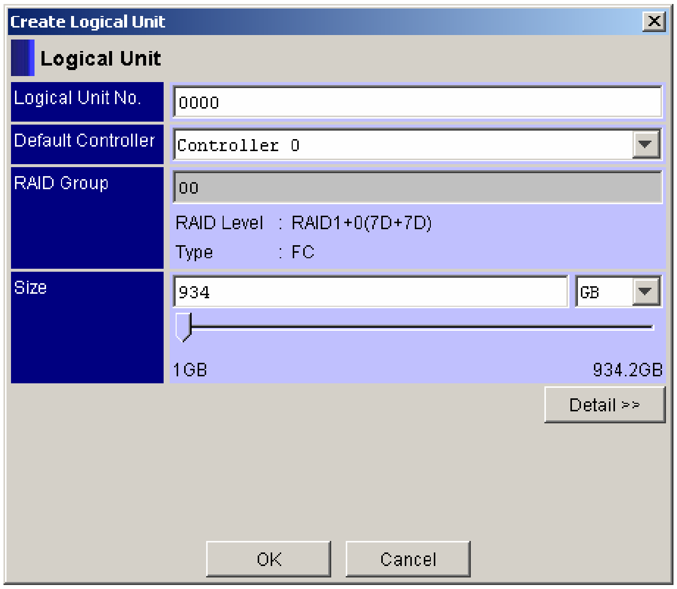
RAID Group 00

RAID Level : RAID1+0(7D+7D)

Type : FC

Size 1 GB

Note – It is important at this point to note that the storage solution LUN size should not be confused with the size of the iSCSI target. The iSCSI target will be configured in a later step and is associated with the storage needed for a particular application on the host server. It is recommended that the LUN size on the storage hardware be as large as reasonably possible to allow the storage subsystem to optimize the use of the physical disks underlying the LUN that is created. In this case, as shown below, we are choosing to create one LUN at the maximum size available for this hardware. The iSCSI targets created later will fit into this one LUN, based on the needs of the host application.



Create Logical Unit

Logical Unit

Logical Unit No.: 0000

Default Controller: Controller 0

RAID Group: 00

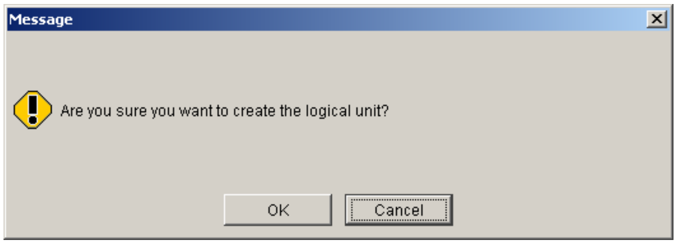
RAID Level : RAID1+0(7D+7D)

Type : FC

Size: 934 GB

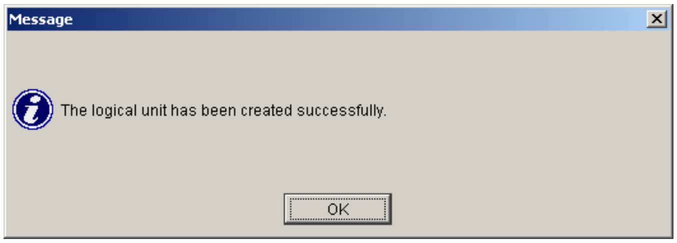
1GB 934.2GB

After the confirmation window appears and is accepted, the LUN is created.



Message

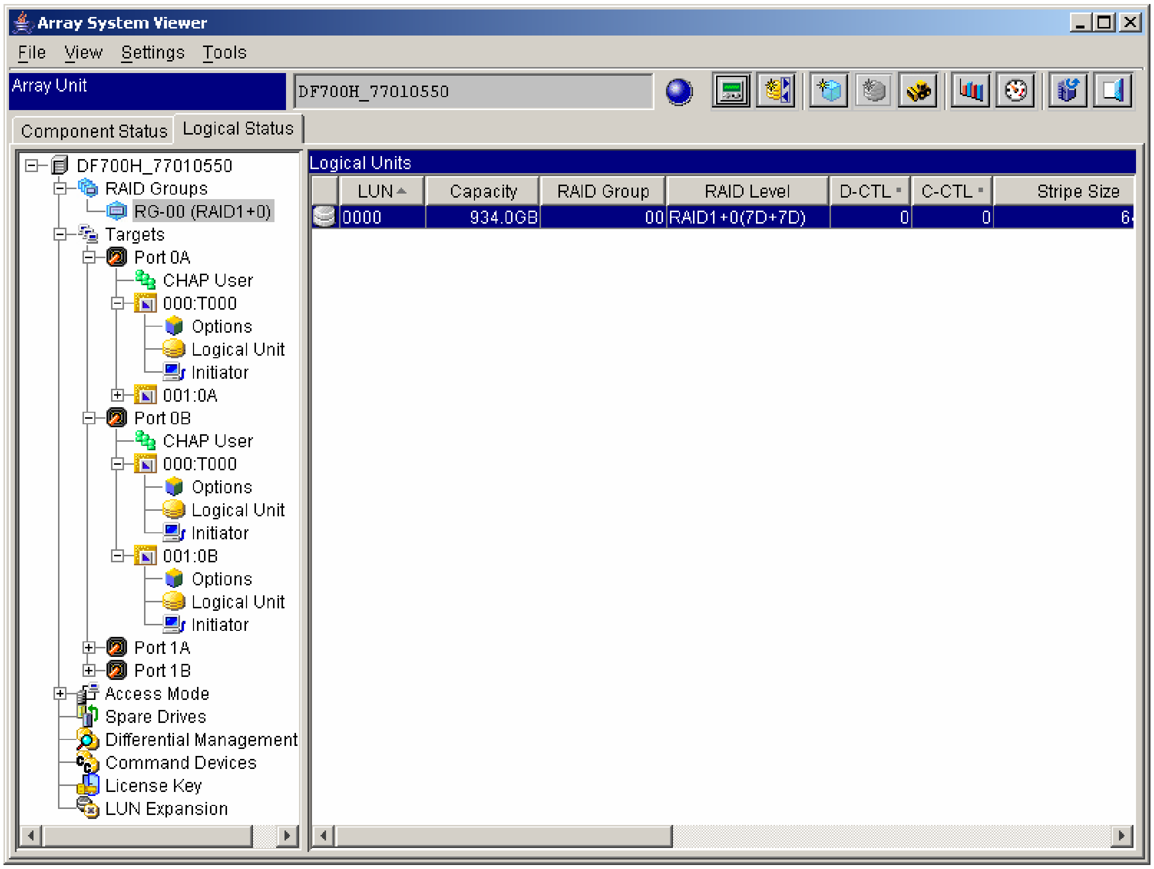
Are you sure you want to create the logical unit?



Message

The logical unit has been created successfully.

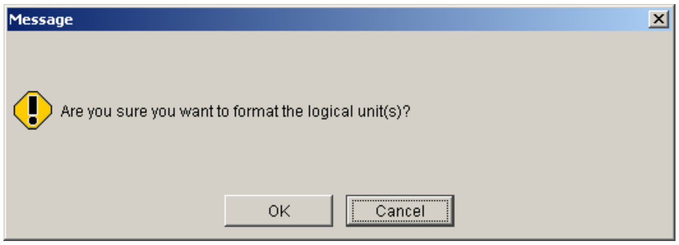
The management console shows the configuration.



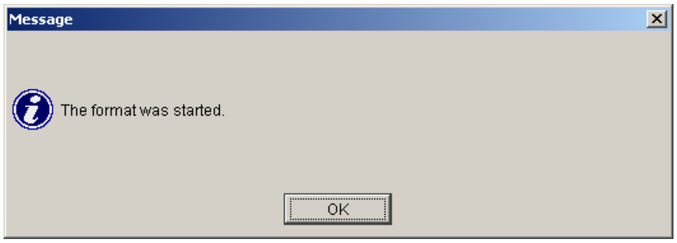
LUN	Capacity	RAID Group	RAID Level	D-CTL	C-CTL	Stripe Size
0000	934.0GB	00	RAID1+0(7D+7D)	0	0	6

4. Make LUNs Ready for Use

The LUN must be formatted before it can be used by the hosts requiring storage. The format process runs in the background in the array and the LUN can be presented to hosts while the format operation is taking place.



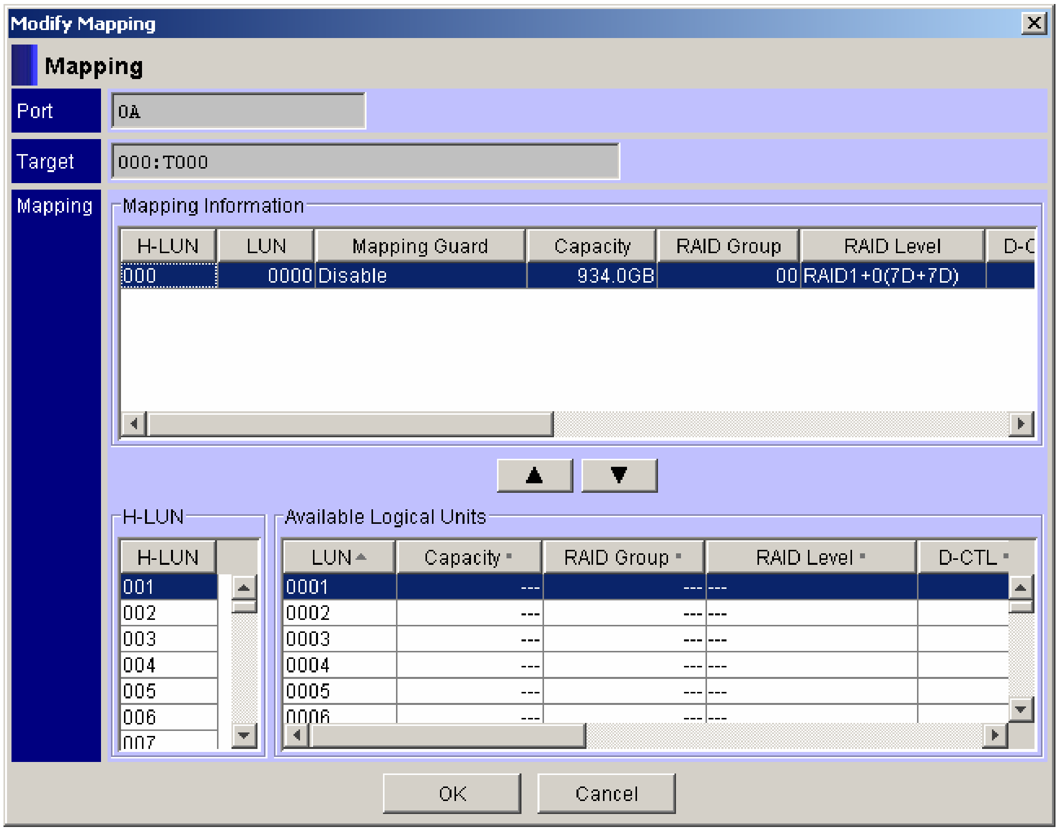
Are you sure you want to format the logical unit(s)?



The format was started.

5. Create iSCSI Targets

The LUN must be mapped to an iSCSI target before an iSCSI initiator can access it. This LUN will be mapped to two iSCSI targets, and then multi-path information will be applied at a later step.



Port: 0A

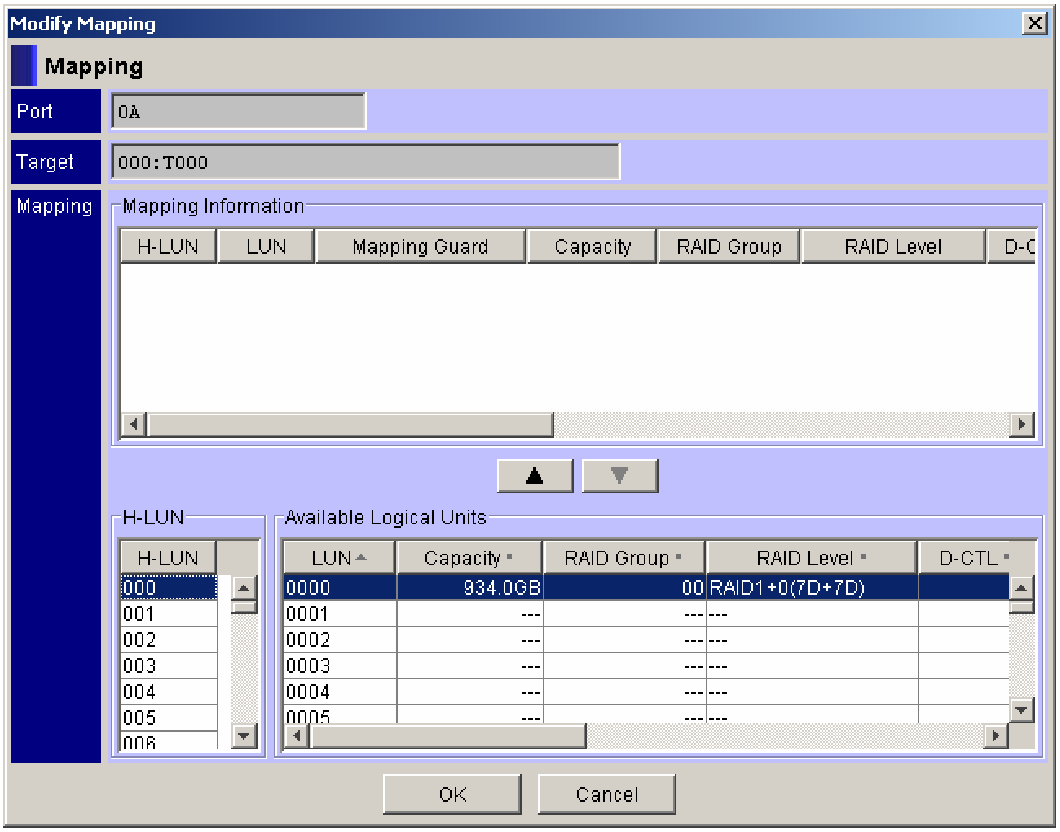
Target: 000:T000

H-LUN	LUN	Mapping Guard	Capacity	RAID Group	RAID Level	D-C
000	0000	Disable	934.0GB	00	RAID1+0(7D+7D)	

H-LUN
001
002
003
004
005
006
007

LUN	Capacity	RAID Group	RAID Level	D-CTL
0001	---	---	---	
0002	---	---	---	
0003	---	---	---	
0004	---	---	---	
0005	---	---	---	
0006	---	---	---	

The LUN is selected and it appears in the lower list. This LUN is mapped to target 000:T000 which belongs to port 0A. The port number will be used later as the internal target identifier.



Port: 0A

Target: 000:T000

Mapping

Mapping Information

H-LUN	LUN	Mapping Guard	Capacity	RAID Group	RAID Level	D-C

H-LUN

H-LUN
000
001
002
003
004
005
006

Available Logical Units

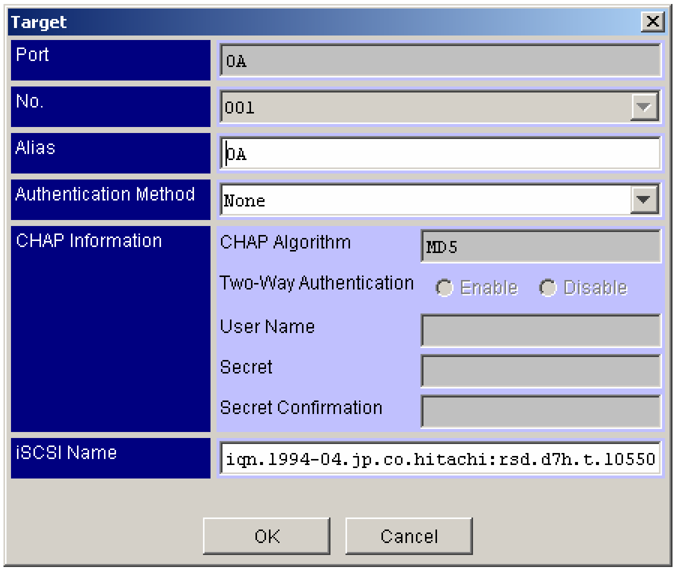
LUN	Capacity	RAID Group	RAID Level	D-CTL
0000	934.0GB	00	RAID1+0(7D+7D)	
0001	---	---	---	
0002	---	---	---	
0003	---	---	---	
0004	---	---	---	
0005	---	---	---	

6. Create Multi-path I/O for iSCSI Targets (optional)

The multi-path functions are handled by the Hitachi Dynamic Link Manager (HDLM) MPIO DSM that is installed on the application host server.

7. Configure Security for iSCSI Targets (optional)

The iSCSI target properties include the CHAP information, which can be set by choosing the authentication method drop-down box.

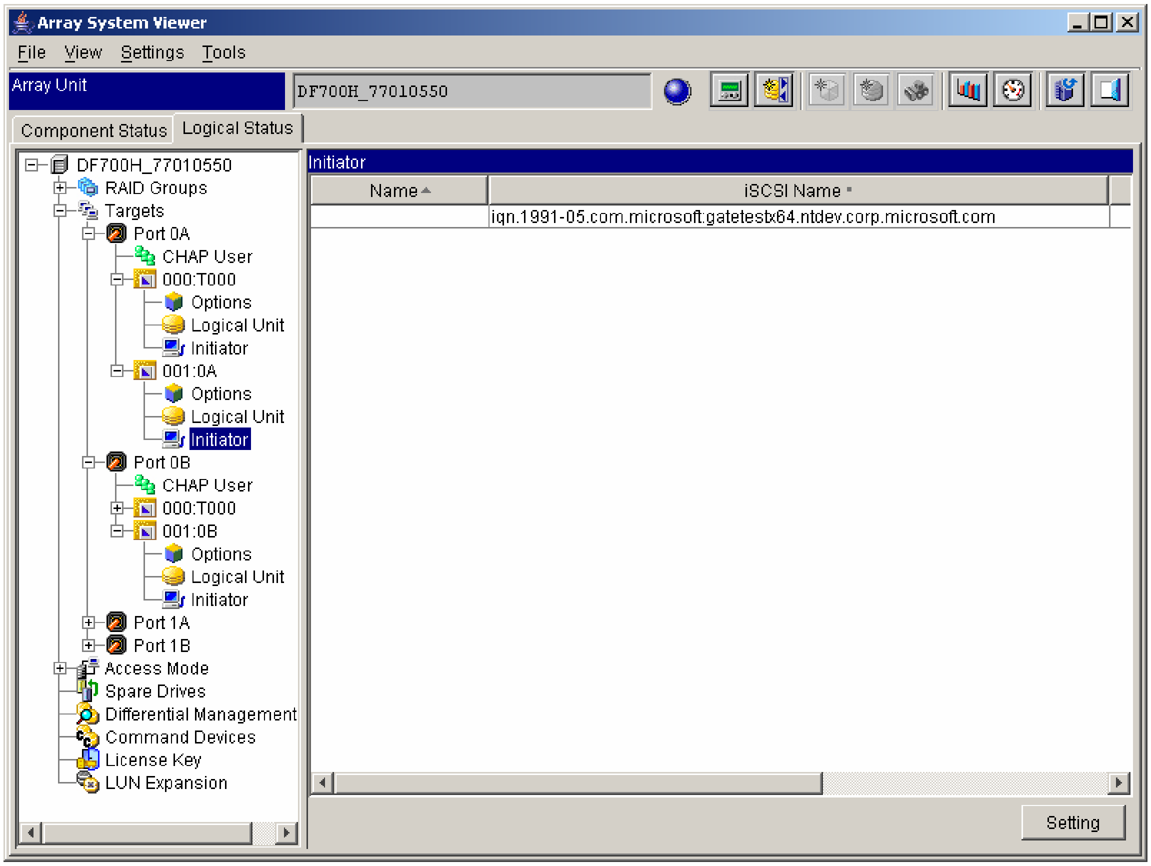


Target

Port	0A
No.	001
Alias	0A
Authentication Method	None
CHAP Information	CHAP Algorithm: MD5 Two-Way Authentication: ○ Enable ○ Disable User Name: Secret: Secret Confirmation:
iSCSI Name	iqn.1994-04.jp.co.hitachi:rsd.d7h.t.10550

8. Make iSCSI Targets Ready for Use for iSCSI Initiators

The iSCSI initiator is assigned to the iSCSI target. Because multi-path has been selected, the same iSCSI initiator is assigned to targets 0A and 0B.

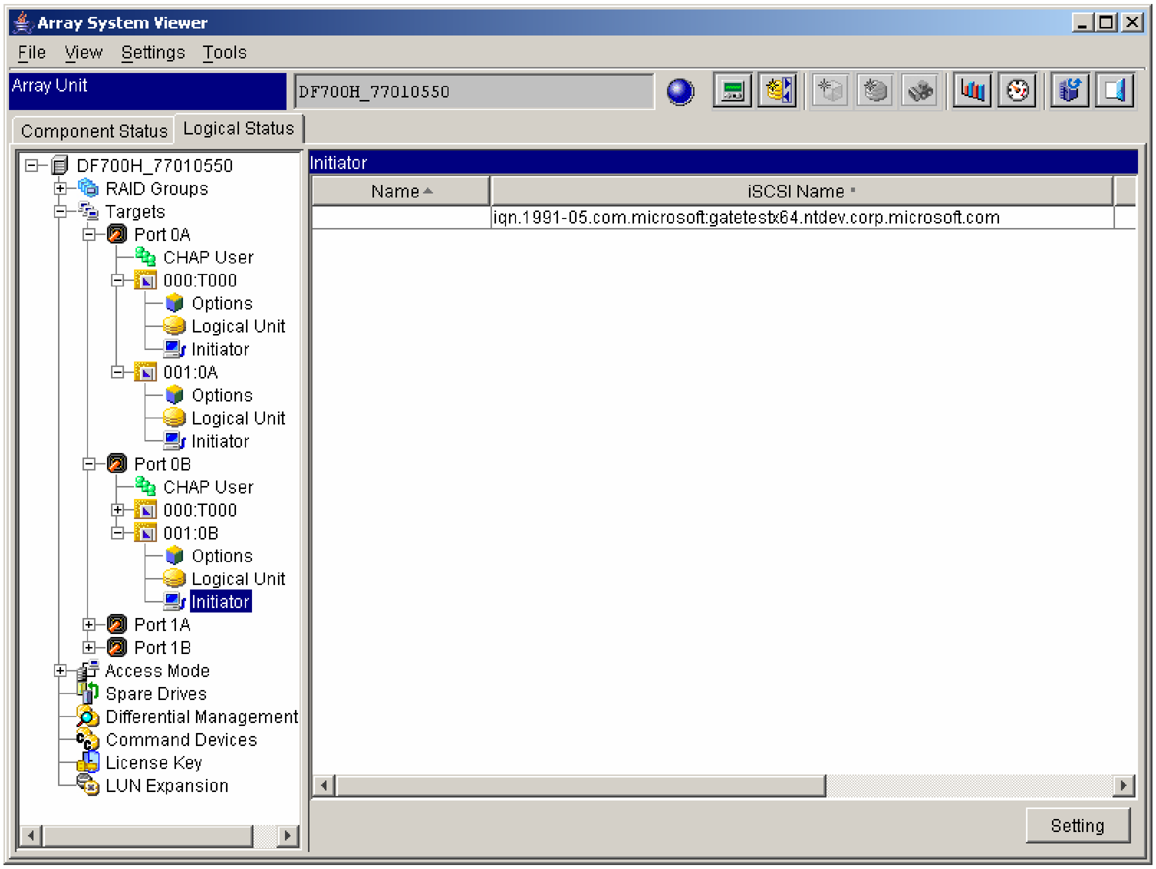


Array System Viewer

Array Unit: DF700H_77010550

Initiator

Name	iSCSI Name
	iqn.1991-05.com.microsoft:gatetestx64.ntdev.corp.microsoft.com



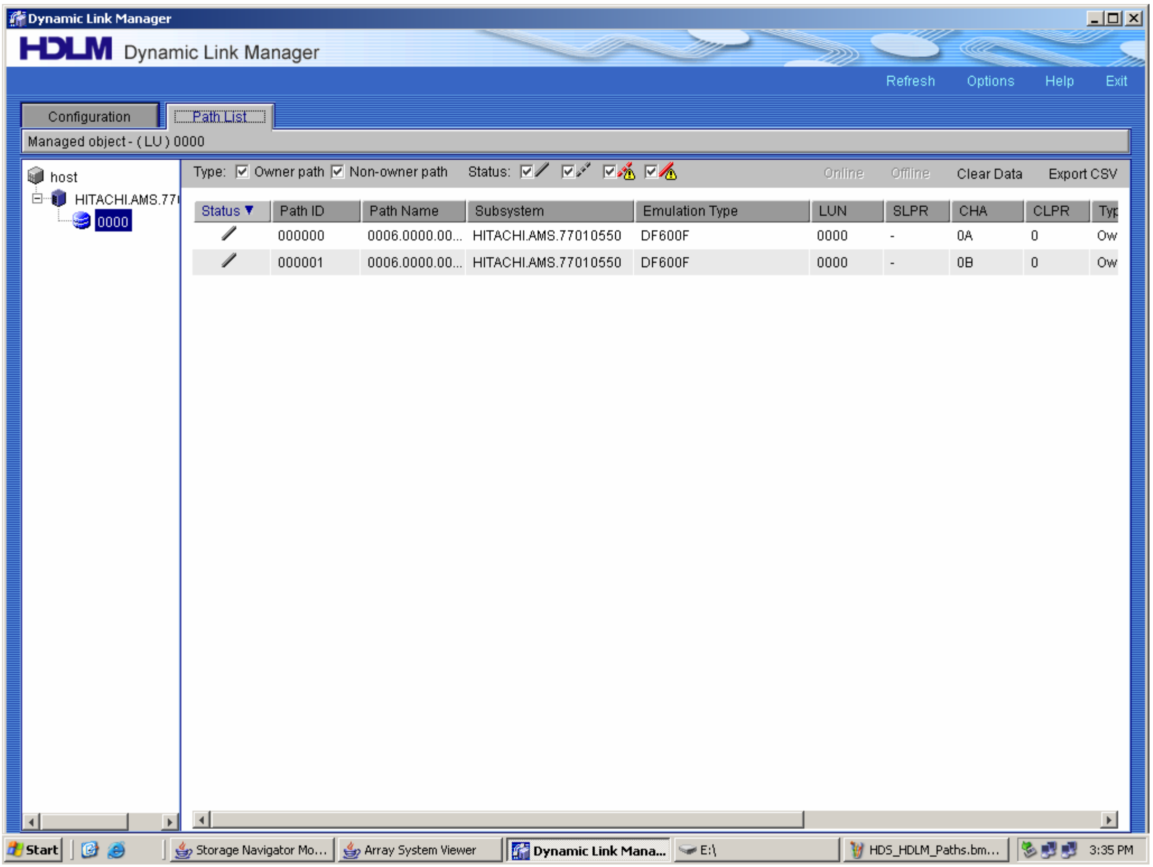
Name	iSCSI Name
	iqn.1991-05.com.microsoft:gatetestx64.ntdev.corp.microsoft.com

The target is now ready for use.

Initiator Configuration Steps

1. Configure Multi-path I/O from Application Host

Hitachi uses the Hitachi Dynamic Link Manager (HDLM) to manage multiple-path I/O. HDLM is implemented as a Microsoft MPIO DSM which is onto the application host server.

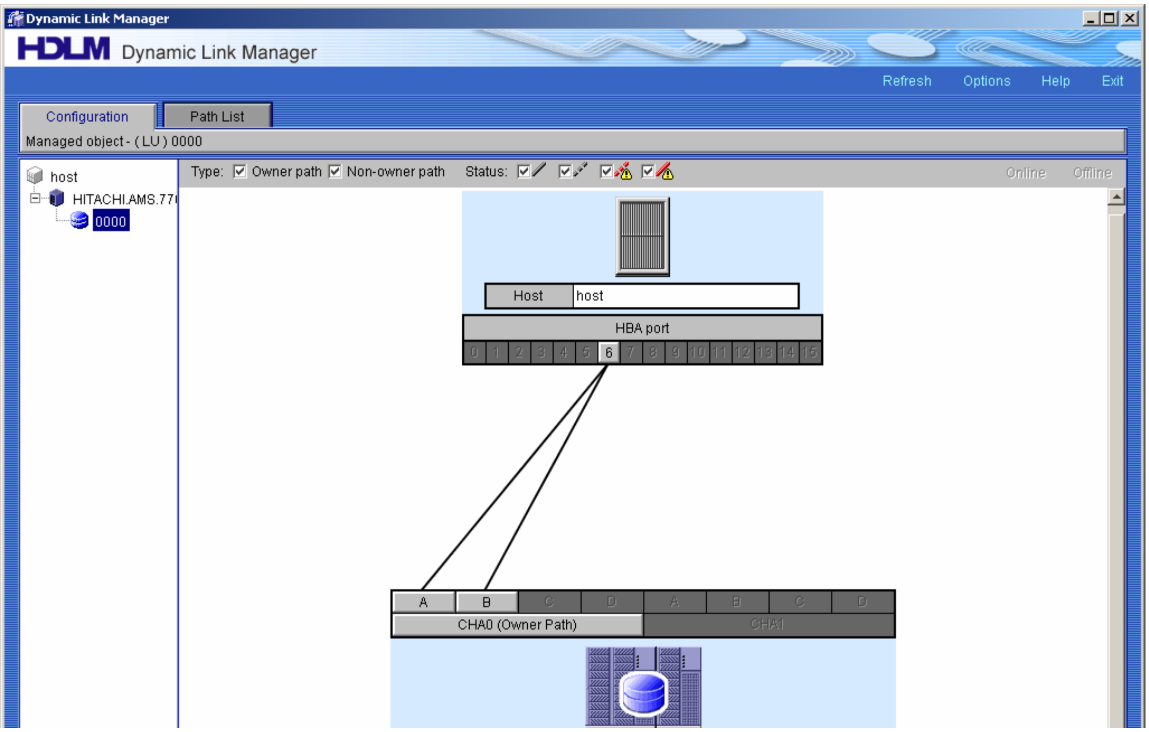


Managed object - (LU) 0000

Type: ☑ Owner path ☑ Non-owner path Status: ☑ ☑ ☑ ☑

Status ▼	Path ID	Path Name	Subsystem	Emulation Type	LUN	SLPR	CHA	CLPR	Typ
/	000000	0006.0000.00...	HITACHI.AMS.77010550	DF600F	0000	-	0A	0	Ow
/	000001	0006.0000.00...	HITACHI.AMS.77010550	DF600F	0000	-	0B	0	Ow

The two paths are assigned to the same iSCSI initiator in the HDLM software so that the iSCSI initiator software can take advantage of the multi-path options.



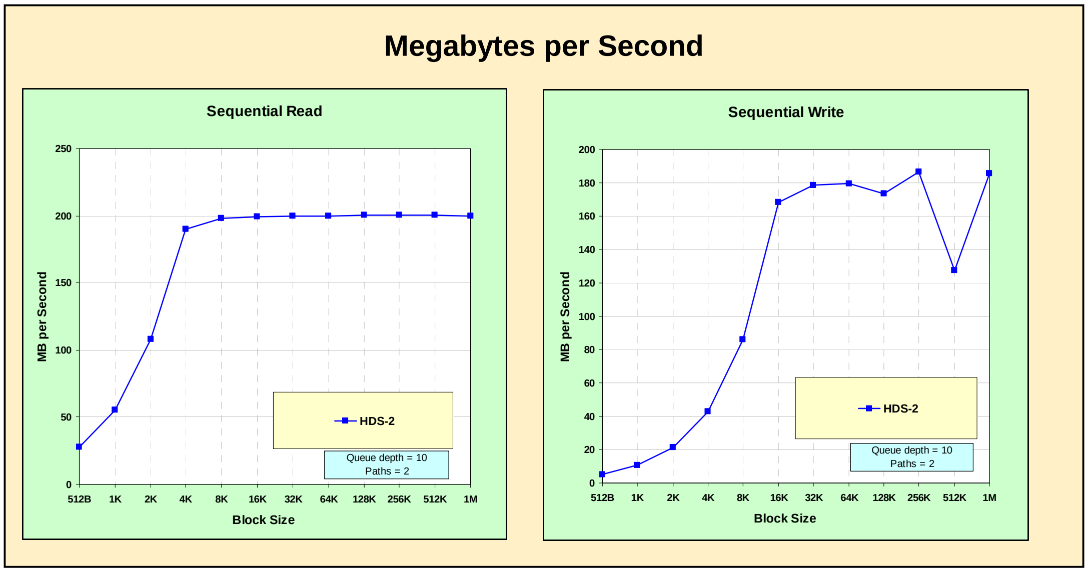
The Microsoft iSCSI initiator software is then configured for multi-path in the standard fashion.

Basic Performance Results

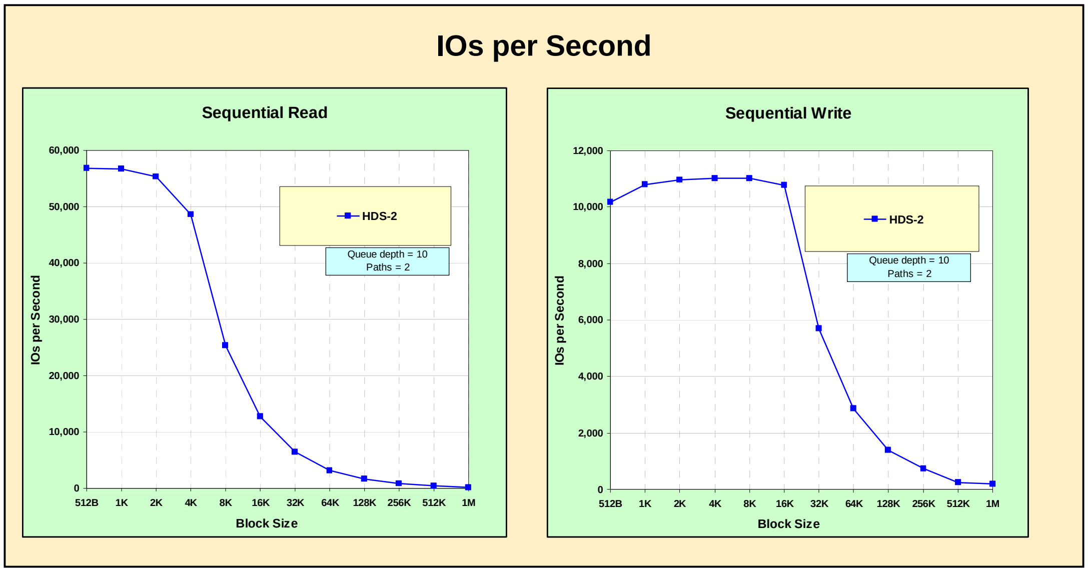
The following performance data is not intended to be viewed as a comprehensive performance benchmark, but to provide a general performance overview for the HDS TagmaStore AMS1000 Solution. Performance will vary depending on drive speeds, number of drives, applications and many other factors.

HDS has a significant body of performance information available that will accurately represent the performance ability of the AMS 1000. Please contact HDS for more detailed performance data.

Selected performance results are shown below, using a standard server-class network adapter, with receive-side scaling on the host. This configuration used two paths from one host, four I/O workers, accessing four target volumes and a queue depth of 10.



Megabytes per Second



IOs per Second

HP StorageWorks 1200 All-in-One Storage System

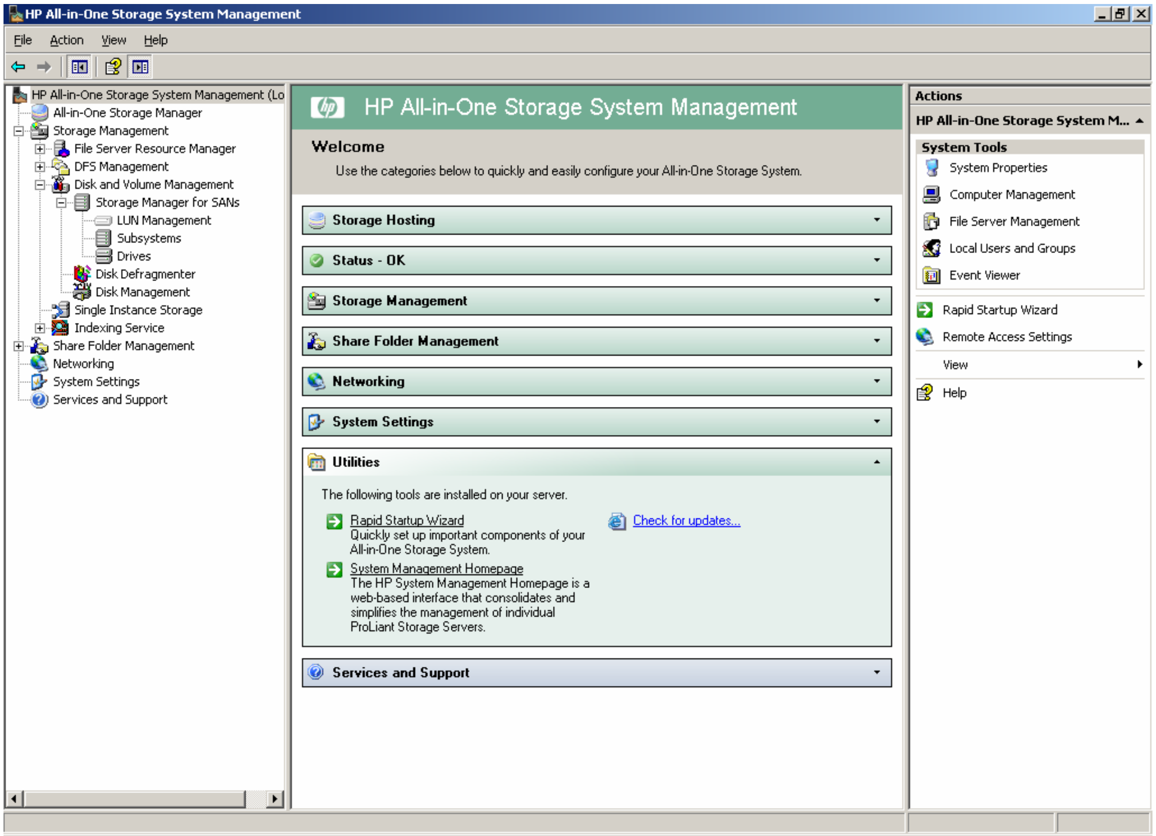
The HP StorageWorks 1200 All-in-One Storage System (AiO1200) is based on Microsoft Windows Storage Server 2003 R2 (WSS) and the Microsoft iSCSI software target. It is a unified NAS device and iSCSI target solution which also includes integrated data protection software and a management console designed for IT generalists who may be new to storage configuration. The AiO1200 is built on the HP ProLiant hardware platform and has a disk subsystem of 12 internal SATA or SAS disk drives available in various storage capacities. The HP All-in-One Storage System is also available in 4 and 6 drive configurations all of which support external storage expansion to direct attach storage enclosures. The version tested for this report included 12 drives and 3.6 terabytes (TB) of raw storage capacity.

The HP All-in-One Storage Manager (ASM) is a unique toolset which is included in the AiO and is designed to reduce the time, expense, and expertise required to deploy and manage storage resources. ASM hides much of the complexity traditionally associated with storage configuration and presents storage in an application-centric context rather than a storage-centric view. The toolset integrates with several Microsoft applications and includes data migration tools for Exchange Server 2003/2007 and SQL Server 2000/2005. The following configuration steps will illustrate how storage can be configured using ASM or how other system-level tools can be used for more granular control.

Target Configuration Steps

1. Configure Network Settings for iSCSI Target Device

The main HP All-in-One management console includes a “Rapid Startup Wizard” which automatically launches at first boot and is used to simplify initial system configuration.



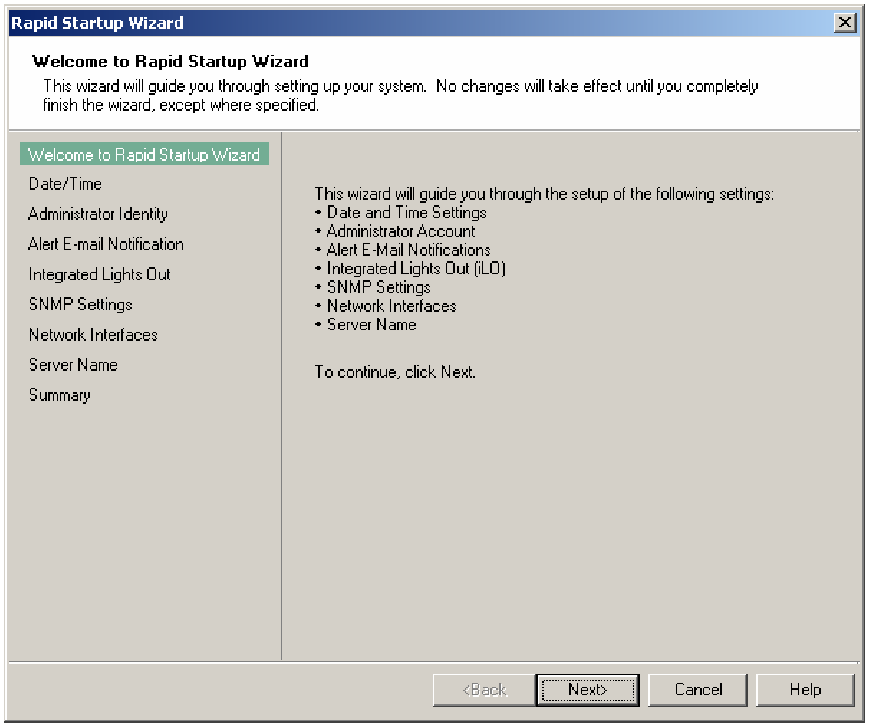
Use the categories below to quickly and easily configure your All-in-One Storage System.

The following tools are installed on your server.

Rapid Startup Wizard
Quickly set up important components of your All-in-One Storage System.

System Management Homepage
The HP System Management Homepage is a web-based interface that consolidates and simplifies the management of individual ProLiant Storage Servers.

The Rapid Startup Wizard includes a place to set the network configuration. This system was configured to use DHCP on its three Ethernet network interfaces.



Welcome to Rapid Startup Wizard

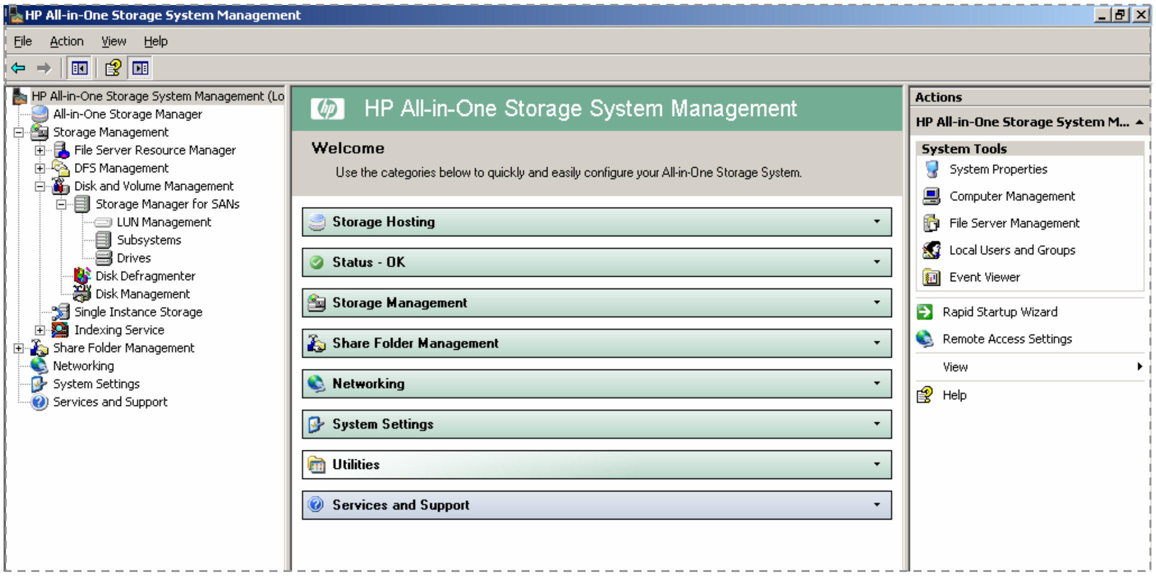
This wizard will guide you through setting up your system. No changes will take effect until you completely finish the wizard, except where specified.

This wizard will guide you through the setup of the following settings:
- Date and Time Settings
- Administrator Account
- Alert E-Mail Notifications
- Integrated Lights Out (iLO)
- SNMP Settings
- Network Interfaces
- Server Name

To continue, click Next.

2. Launch Management Console

All the storage management functions for the HP StorageWorks 1200 All-in-One Storage System are performed from the management console, shown below.



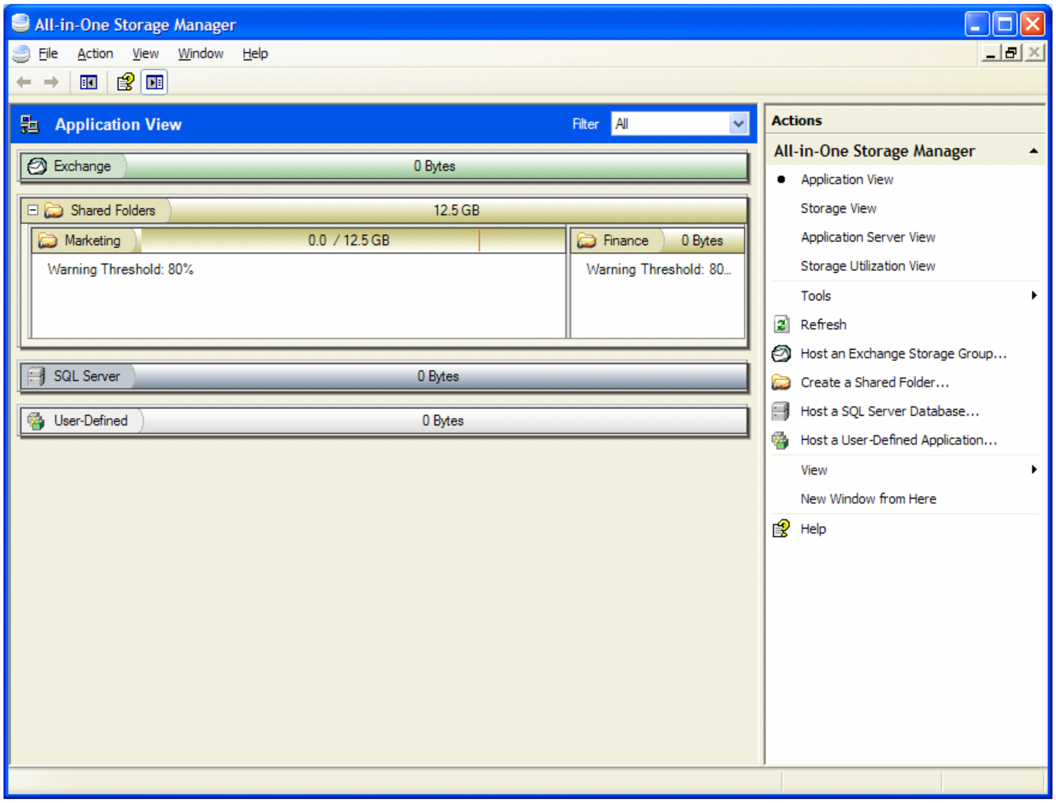
Welcome

Use the categories below to quickly and easily configure your All-in-One Storage System.

In the center section of the management console, several categories of management functions are available.

3. Guided configuration: Link to the All-in-One Storage Manager (ASM)

ASM is an 'application-centric' management interface into the file shares and iSCSI target storage on the AiO and shows capacity usage in terms of managed data areas. ASM exists as the first node in the management console tree. The main ASM management screen is shown below.



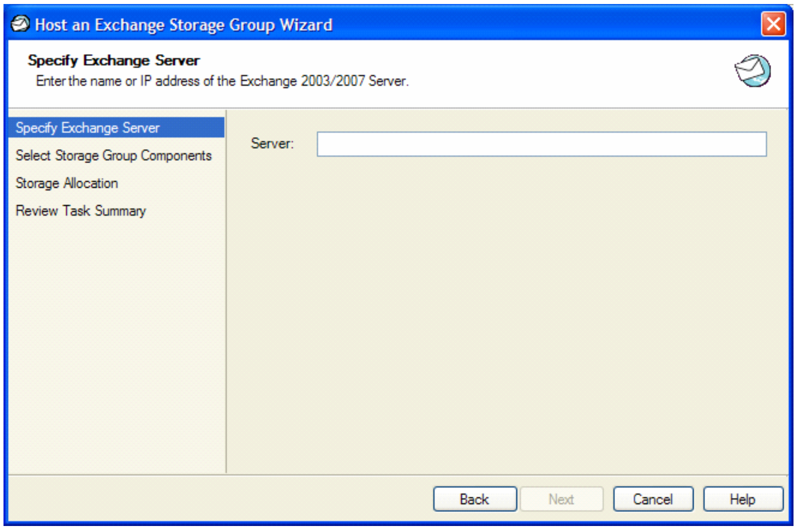
The interface includes several wizards which automate configuration, provisioning, and data migration. These include

- Host an Exchange Storage Group
- Create a Shared Folder
- Host a SQL Server Database
- Host a User-Defined Application

Prior to launching any of the interface wizards, administrators will need to install an ASM agent onto their host server (Windows Server 2003 32-bit or 64-bit). This agent packages the Microsoft iSCSI initiator, an ASM Service which runs on the host, as well as some Microsoft .NET components to enable communication between the host server and the AiO. The agent installation process also sets up application specific security parameters for SQL Server and Exchange.

As an example of the guided configuration capabilities of the AiO we will walk you through the ‘Host an Exchange Storage Group” tool.

Clicking the link on the right side of the interface launches the wizard. The first input screen asks the administrator to specify the Name or IP address of the Microsoft Exchange server where they have installed the ASM Agent.

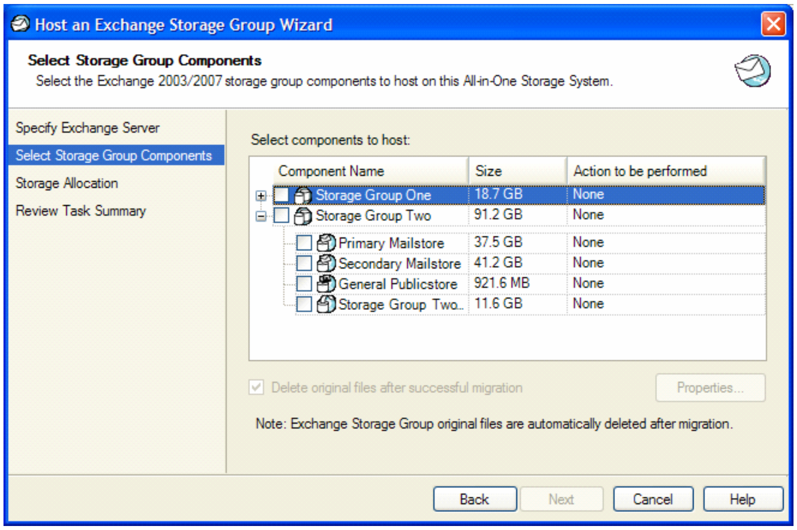


Specify Exchange Server

Enter the name or IP address of the Exchange 2003/2007 Server.

Server:

Clicking NEXT enables ASM to communicate with the service on the host server and brings up the 'Select Storage Group Components' screen. The service uses the Microsoft Exchange API to gather data about the installation and return it to the AiO administrator. Specifically, the administrator is prompted to choose the Storage Group(s) which need to be moved to the iSCSI target storage.



Select Storage Group Components

Select the Exchange 2003/2007 storage group components to host on this All-in-One Storage System.

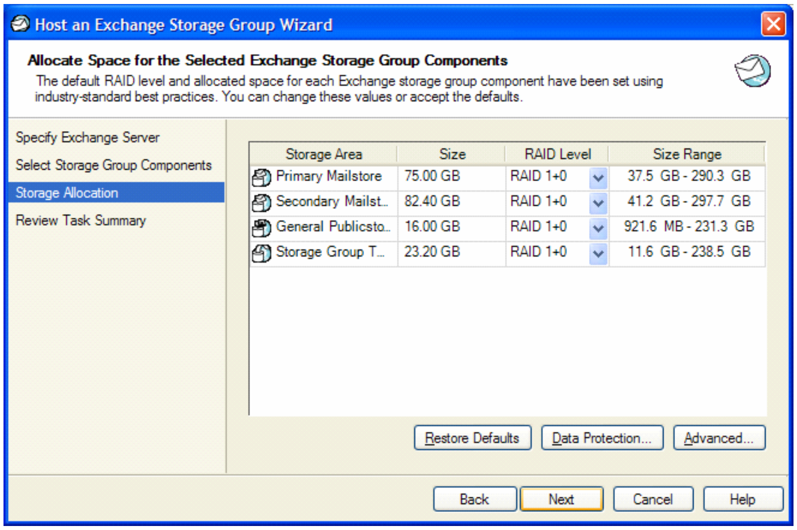
Select components to host:

Component Name	Size	Action to be performed
⊞ □ Storage Group One	18.7 GB	None
⊟ □ Storage Group Two	91.2 GB	None
□ Primary Mailstore	37.5 GB	None
□ Secondary Mailstore	41.2 GB	None
□ General Publicstore	921.6 MB	None
□ Storage Group Two..	11.6 GB	None

☑ Delete original files after successful migration

Note: Exchange Storage Group original files are automatically deleted after migration.

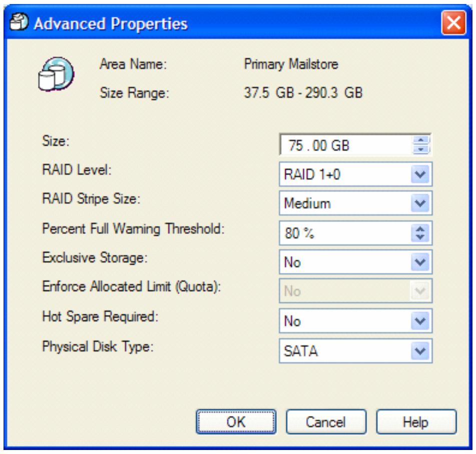
Clicking NEXT brings up the Storage Allocation screen. Here, ASM has recommended a set of storage settings based on Microsoft 'best practices' for Exchange; these include RAID type, stripe settings, exclusive disk use, warning threshold, etc. Administrators can accept these settings or click the Advanced button to manually override. They can also choose between HDD technologies (SATA and/or SAS) if both disk types reside on the AiO or any direct attached storage enclosures.



Allocate Space for the Selected Exchange Storage Group Components

The default RAID level and allocated space for each Exchange storage group component have been set using industry-standard best practices. You can change these values or accept the defaults.

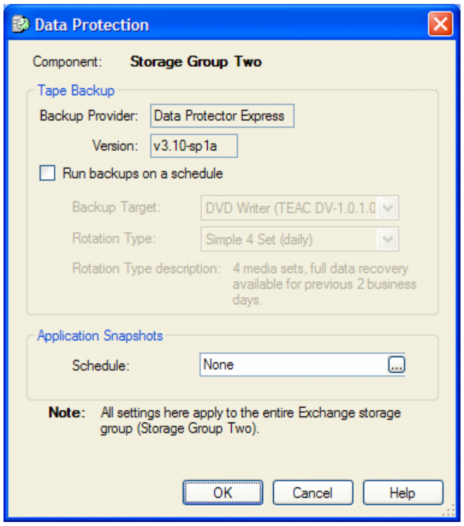
Storage Area	Size	RAID Level	Size Range
Primary Mailstore	75.00 GB	RAID 1+0	37.5 GB - 290.3 GB
Secondary Mailst...	82.40 GB	RAID 1+0	41.2 GB - 297.7 GB
General Publicsto...	16.00 GB	RAID 1+0	921.6 MB - 231.3 GB
Storage Group T...	23.20 GB	RAID 1+0	11.6 GB - 238.5 GB



Area Name: Primary Mailstore

Size Range: 37.5 GB - 290.3 GB

Size:	75 .00 GB
RAID Level:	RAID 1+0
RAID Stripe Size:	Medium
Percent Full Warning Threshold:	80 %
Exclusive Storage:	No
Enforce Allocated Limit (Quota):	No
Hot Spare Required:	No
Physical Disk Type:	SATA



Component: **Storage Group Two**

Tape Backup

Backup Provider: Data Protector Express

Version: v3.10-sp1a

☐ Run backups on a schedule

Backup Target: DVD Writer (TEAC DV-1.0.1.0

Rotation Type: Simple 4 Set (daily)

Rotation Type description: 4 media sets, full data recovery available for previous 2 business days.

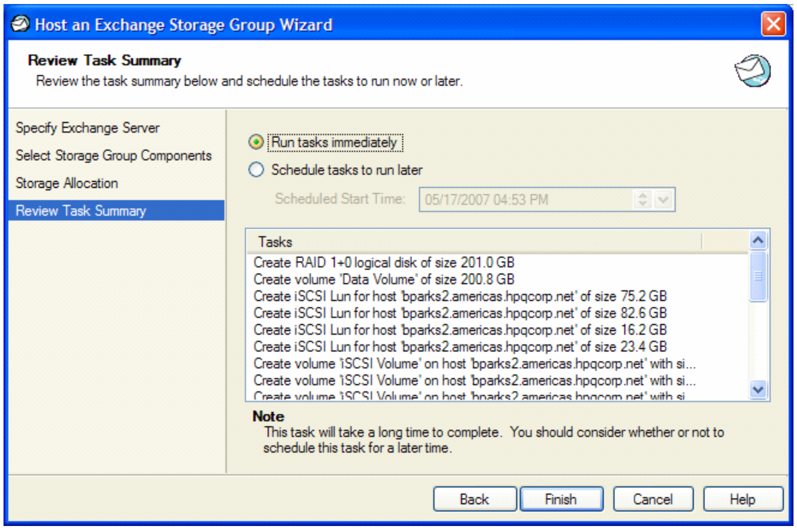
Application Snapshots

Schedule: None

Note: All settings here apply to the entire Exchange storage group (Storage Group Two).

Clicking on the Data Protection button brings up a screen that allows administrators to configure VSS snapshots for this iSCSI Target storage and to configure a traditional backup job using the HP Data Protector Express software which is included on the AiO.

Clicking NEXT will bring up a task summary of the steps that ASM will automatically perform. Tasks can be run immediately or scheduled for later; in the case of data migration the process will tell the Exchange server to temporary halt the service so that data can be migrated to the newly created iSCSI LUNs and will then restart the service.



Review Task Summary

Review the task summary below and schedule the tasks to run now or later.

● Run tasks immediately

○ Schedule tasks to run later

Scheduled Start Time: 05/17/2007 04:53 PM

Tasks

Create RAID 1+0 logical disk of size 201.0 GB
Create volume 'Data Volume' of size 200.8 GB
Create iSCSI Lun for host 'bparks2.americas.hpqcorp.net' of size 75.2 GB
Create iSCSI Lun for host 'bparks2.americas.hpqcorp.net' of size 82.6 GB
Create iSCSI Lun for host 'bparks2.americas.hpqcorp.net' of size 16.2 GB
Create iSCSI Lun for host 'bparks2.americas.hpqcorp.net' of size 23.4 GB
Create volume 'iSCSI Volume' on host 'bparks2.americas.hpqcorp.net' with si...
Create volume 'iSCSI Volume' on host 'bparks2.americas.hpqcorp.net' with si...
Create volume 'iSCSI Volume' on host 'bparks2.americas.hpqcorp.net' with si...

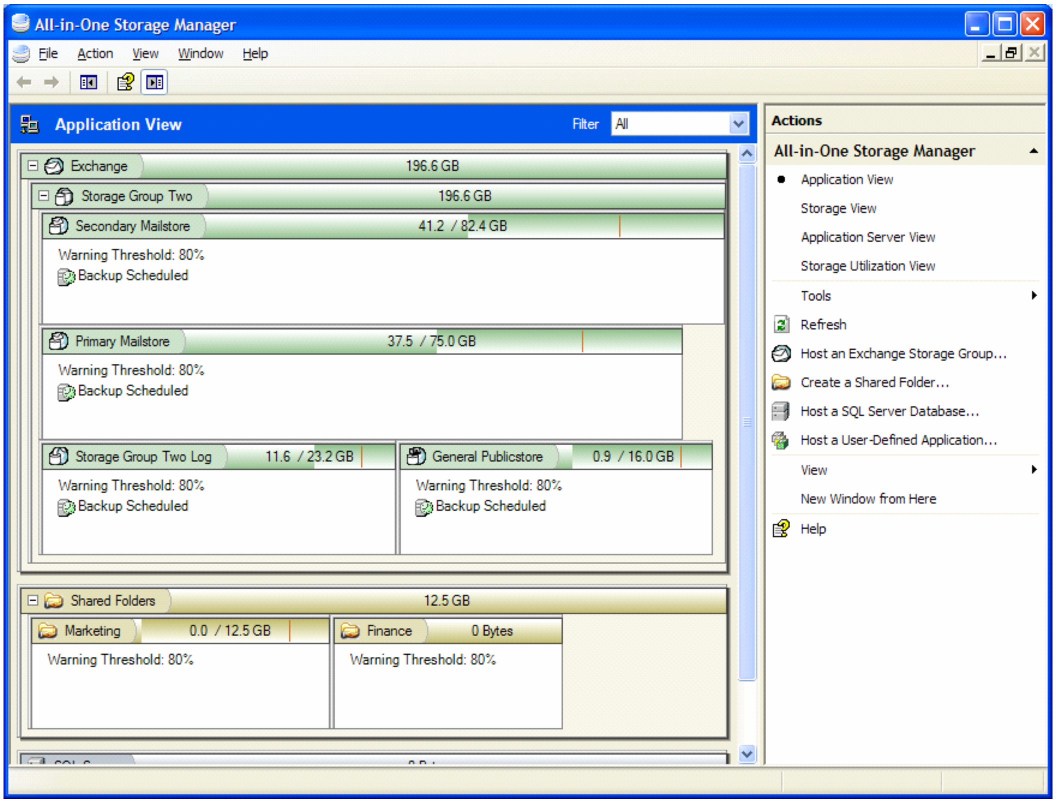
Note

This task will take a long time to complete. You should consider whether or not to schedule this task for a later time.

Once the job runs the system will automatically

- Create the logical drive on the physical disks
- Create the data volume
- Create iSCSI LUN and connect the host to the target
- Create and format the iSCSI volume
- Set directory quotas and alerts on the iSCSI target storage
- Migrate storage group components
- Create the backup job

Once the job is executed, storage tasks such as expansion and protection of the Storage Group can be managed from the main ASM interface as shown below.

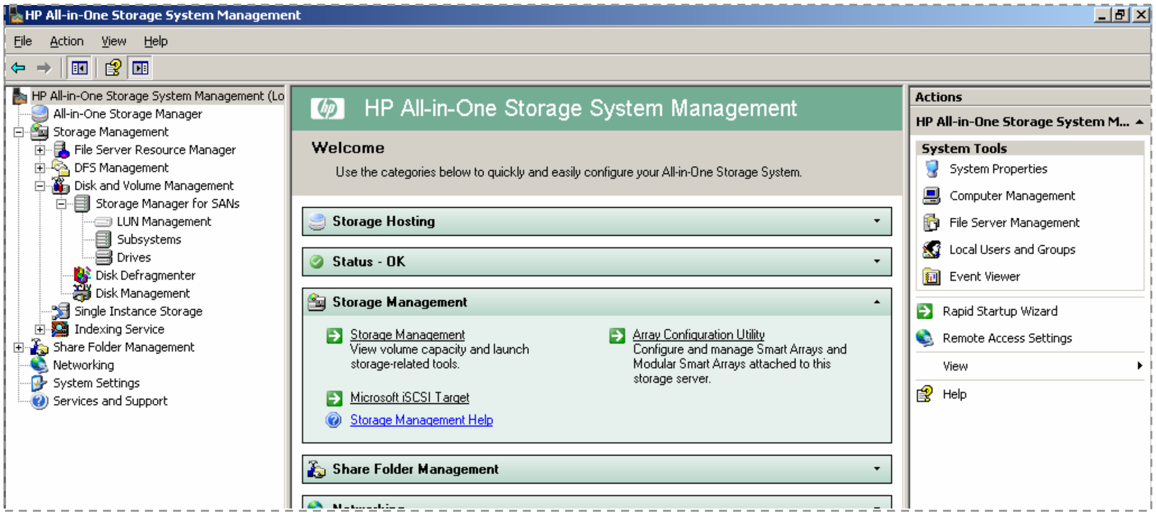


NOTE: Remaining steps 4 through 8 illustrate how to manually configure iSCSI target storage outside of the All-in-One Storage Manager. If using ASM, steps 4 through 9 are performed automatically by the various ASM application tools.

Manual configuration if not using ASM (Steps 4 through 9):

4. Create LUNs on Disk Array

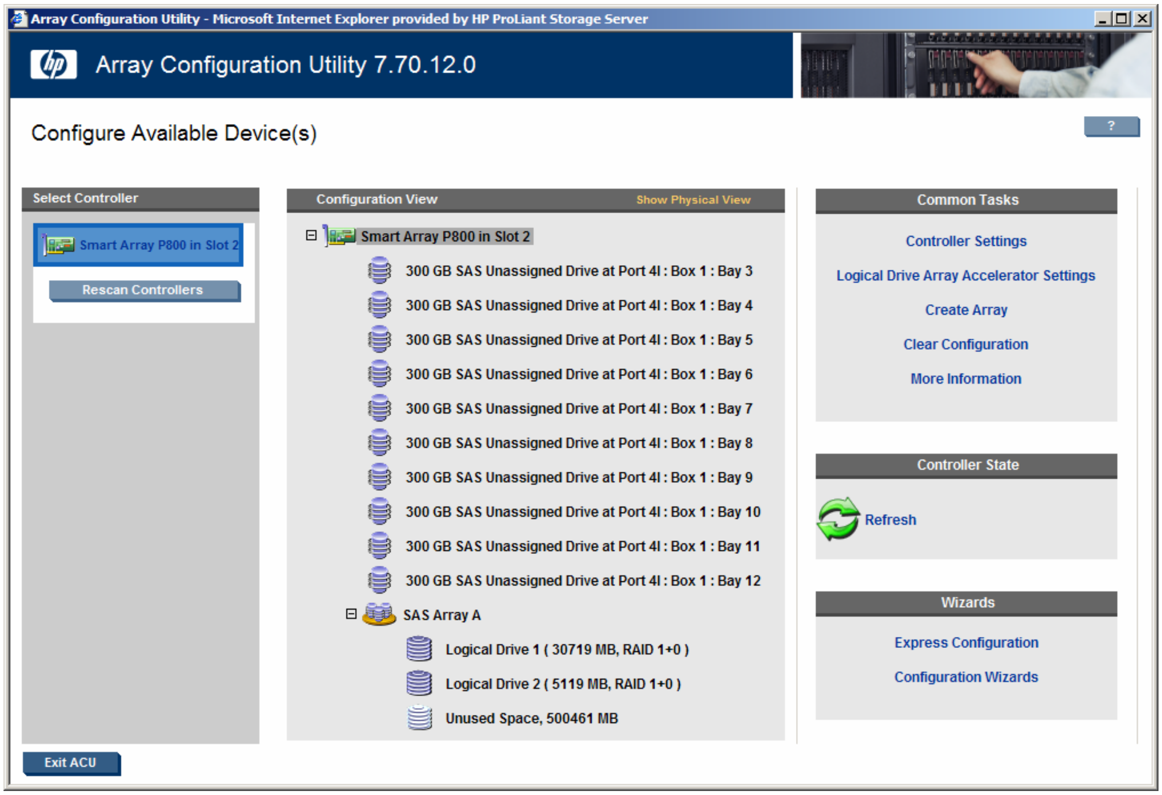
To create the LUNs on the Disk Array, the administrator selects the “Array Configuration Utility” scenario from the “Storage Management” section of the management console. This launches the array configuration utility.



Use the categories below to quickly and easily configure your All-in-One Storage System.

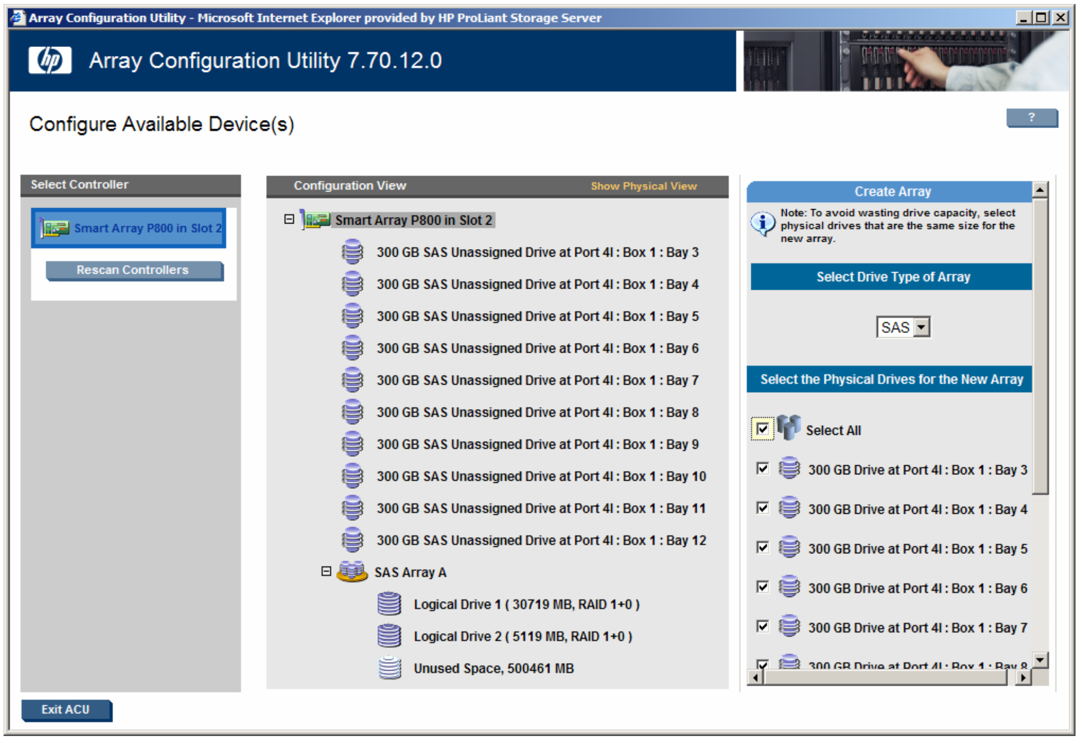
Storage Management: View volume capacity and launch storage-related tools.

Array Configuration Utility: Configure and manage Smart Arrays and Modular Smart Arrays attached to this storage server.



Smart Array P800 in Slot 2
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 3
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 4
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 5
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 6
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 7
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 8
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 9
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 10
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 11
- 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 12
- SAS Array A
  - Logical Drive 1 (30719 MB, RAID 1+0)
  - Logical Drive 2 (5119 MB, RAID 1+0)
  - Unused Space, 500461 MB

Highlighting the “Create Array” menu item allows the creation of a data volume across the unassigned drives in the system. All ten of the unassigned drives will be used for the iSCSI data volumes.



Array Configuration Utility - Microsoft Internet Explorer provided by HP ProLiant Storage Server

Array Configuration Utility 7.70.12.0

Configure Available Device(s)

Select Controller

Smart Array P800 in Slot 2

Rescan Controllers

Configuration View — Show Physical View

- Smart Array P800 in Slot 2
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 3
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 4
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 5
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 6
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 7
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 8
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 9
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 10
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 11
  - 300 GB SAS Unassigned Drive at Port 4I : Box 1 : Bay 12
  - SAS Array A
    - Logical Drive 1 (30719 MB, RAID 1+0)
    - Logical Drive 2 (5119 MB, RAID 1+0)
    - Unused Space, 500461 MB

Create Array

Note: To avoid wasting drive capacity, select physical drives that are the same size for the new array.

Select Drive Type of Array

SAS

Select the Physical Drives for the New Array

☑ Select All

☑ 300 GB Drive at Port 4I : Box 1 : Bay 3

☑ 300 GB Drive at Port 4I : Box 1 : Bay 4

☑ 300 GB Drive at Port 4I : Box 1 : Bay 5

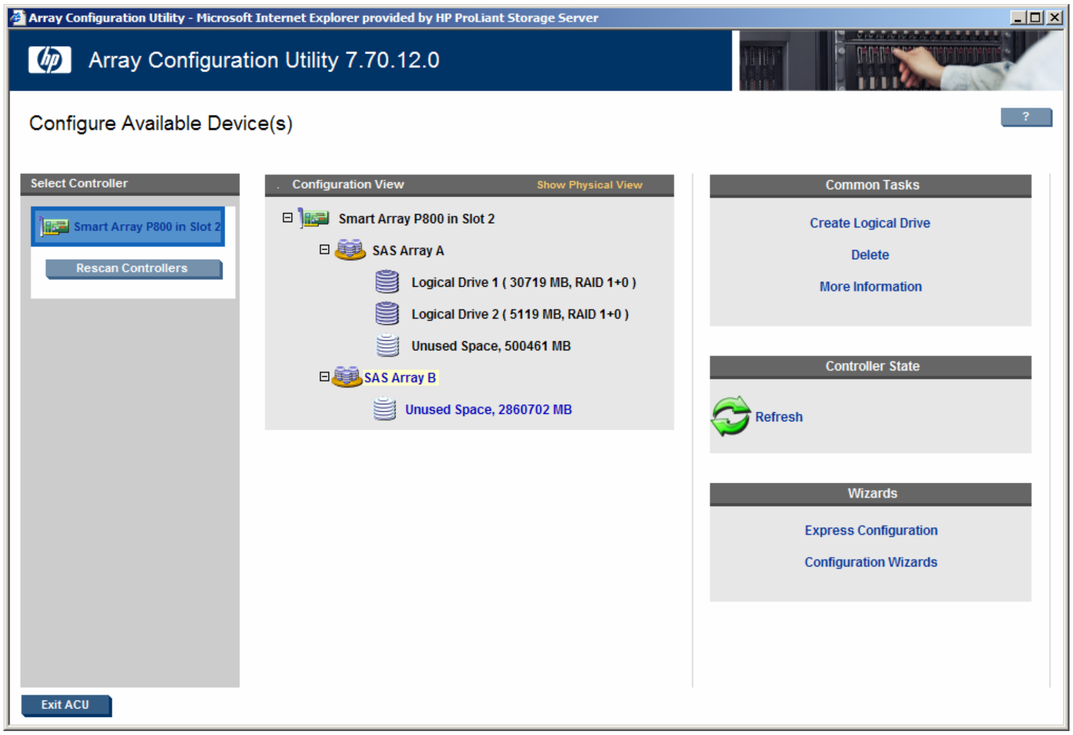
☑ 300 GB Drive at Port 4I : Box 1 : Bay 6

☑ 300 GB Drive at Port 4I : Box 1 : Bay 7

☑ 300 GB Drive at Port 4I : Box 1 : Bay 8

Exit ACU

Clicking “Create Logical Drive” displays the options for Logical Drive creation, including RAID type and size. We create a logical drive of the type RAID 1+0 and use all the available space.



Array Configuration Utility - Microsoft Internet Explorer provided by HP ProLiant Storage Server

Array Configuration Utility 7.70.12.0

Configure Available Device(s)

Select Controller

Smart Array P800 in Slot 2

Rescan Controllers

Configuration View — Show Physical View

- Smart Array P800 in Slot 2
  - SAS Array A
    - Logical Drive 1 (30719 MB, RAID 1+0)
    - Logical Drive 2 (5119 MB, RAID 1+0)
    - Unused Space, 500461 MB
  - SAS Array B
    - Unused Space, 2860702 MB

Common Tasks

Create Logical Drive

Delete

More Information

Controller State

Refresh

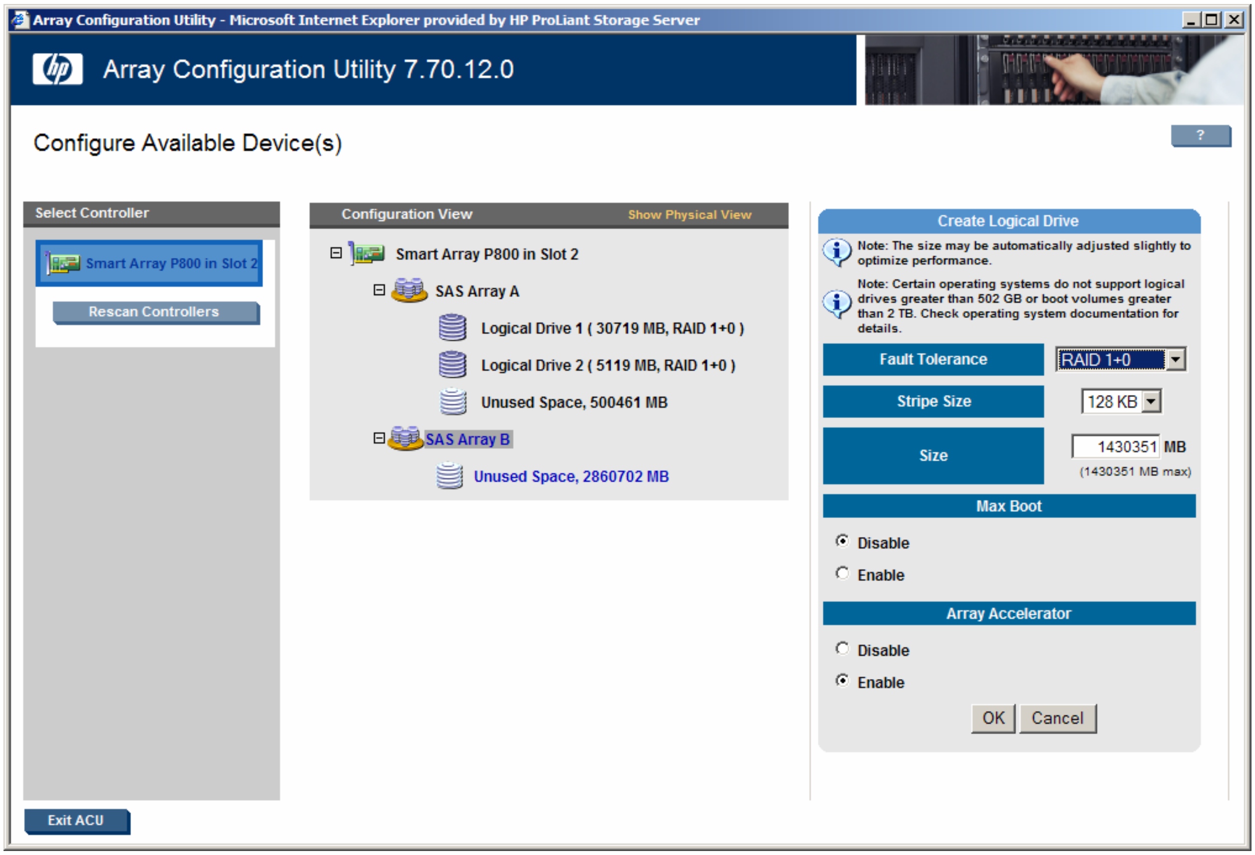
Wizards

Express Configuration

Configuration Wizards

Exit ACU

Note – It is important at this point to note that the storage solution LUN size should not be confused with the size of the iSCSI target. The iSCSI target will be configured in a later step and is associated with the storage needed for a particular application on the host server. It is recommended that the LUN size on the storage hardware be as large as reasonably possible to allow the storage subsystem to optimize the use of the physical disks underlying the LUN that is created. In this case, as shown below, we are choosing to create one LUN at the maximum size available for this hardware. The iSCSI targets created later will fit into this one LUN, based on the needs of the host application.



Array Configuration Utility - Microsoft Internet Explorer provided by HP ProLiant Storage Server

Array Configuration Utility 7.70.12.0

Configure Available Device(s)

Select Controller
- Smart Array P800 in Slot 2
- Rescan Controllers

Configuration View — Show Physical View

```
⊟ Smart Array P800 in Slot 2
    ⊟ SAS Array A
          Logical Drive 1 ( 30719 MB, RAID 1+0 )
          Logical Drive 2 ( 5119 MB, RAID 1+0 )
          Unused Space, 500461 MB
    ⊟ SAS Array B
          Unused Space, 2860702 MB
```

Create Logical Drive

Note: The size may be automatically adjusted slightly to optimize performance.

Note: Certain operating systems do not support logical drives greater than 502 GB or boot volumes greater than 2 TB. Check operating system documentation for details.

Fault Tolerance	RAID 1+0
Stripe Size	128 KB
Size	1430351 MB (1430351 MB max)

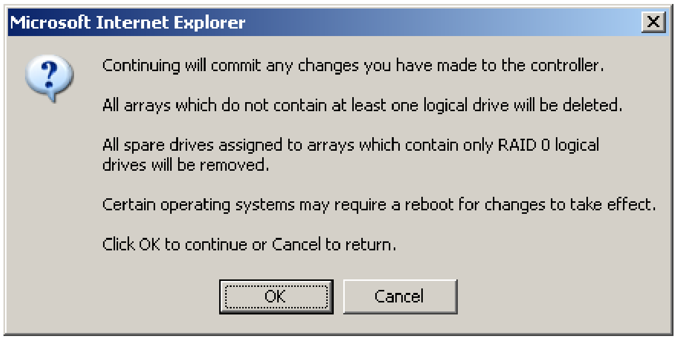
Max Boot
- ● Disable
- ○ Enable

Array Accelerator
- ○ Disable
- ● Enable

OK | Cancel

Exit ACU

This configuration is saved.



Microsoft Internet Explorer

Continuing will commit any changes you have made to the controller.

All arrays which do not contain at least one logical drive will be deleted.

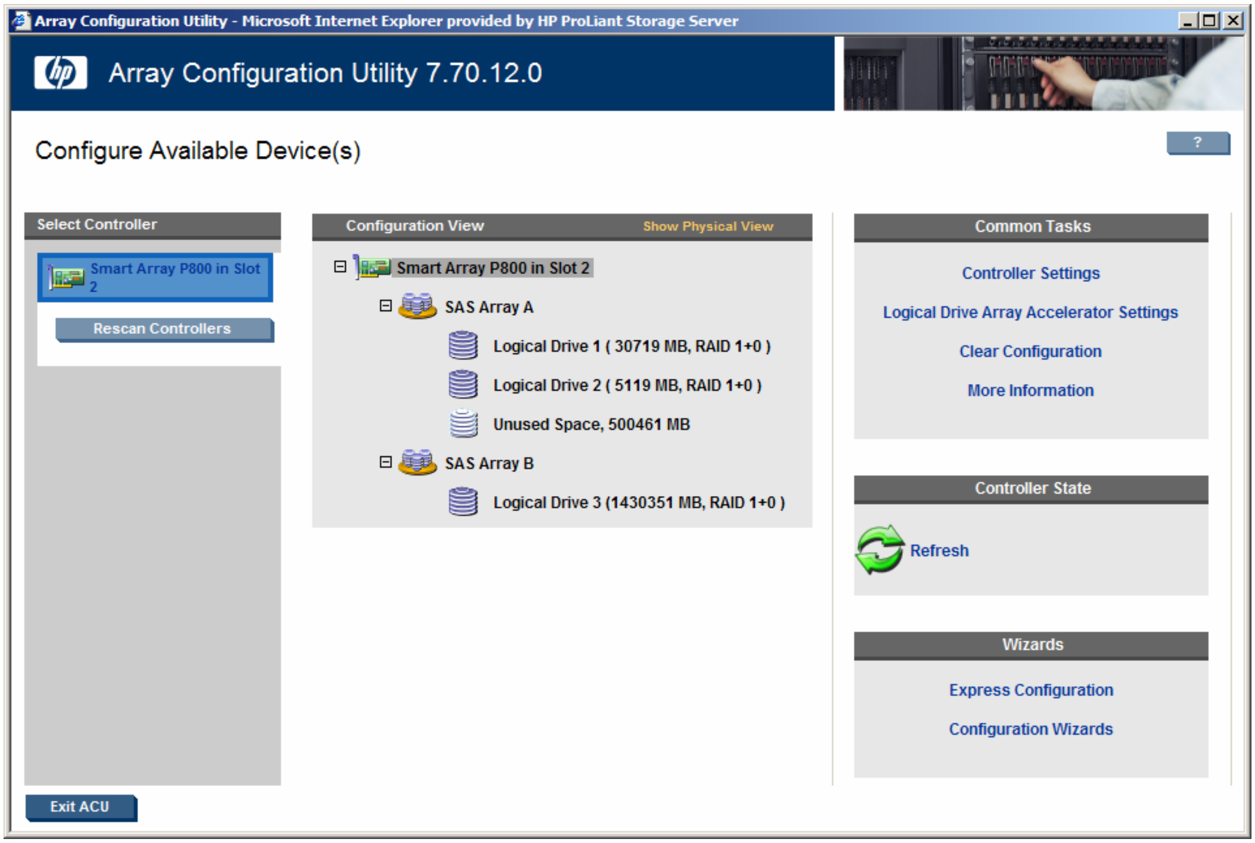
All spare drives assigned to arrays which contain only RAID 0 logical drives will be removed.

Certain operating systems may require a reboot for changes to take effect.

Click OK to continue or Cancel to return.

OK | Cancel

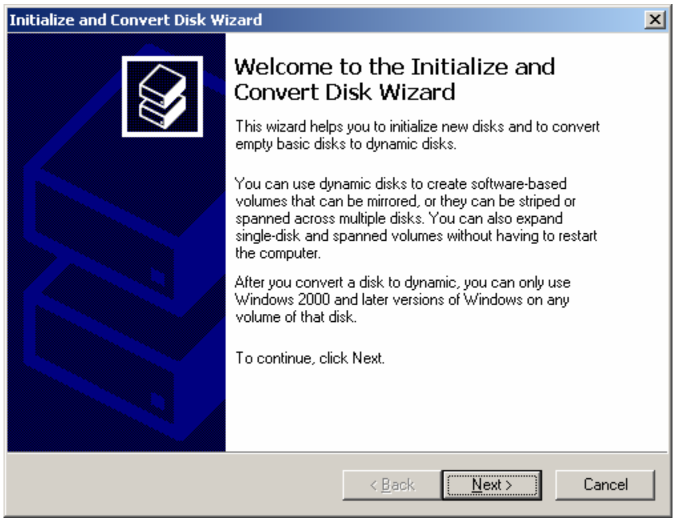
The final configuration is displayed.


Array Configuration Utility - Microsoft Internet Explorer provided by HP ProLiant Storage Server
Array Configuration Utility 7.70.12.0
Configure Available Device(s)
?
Select Controller
Smart Array P800 in Slot 2
Rescan Controllers
Configuration View
Show Physical View
Common Tasks
Controller Settings
Logical Drive Array Accelerator Settings
Clear Configuration
More Information
Controller State
Refresh
Wizards
Express Configuration
Configuration Wizards
Exit ACU

Smart Array P800 in Slot 2
- SAS Array A
  - Logical Drive 1 (30719 MB, RAID 1+0)
  - Logical Drive 2 (5119 MB, RAID 1+0)
  - Unused Space, 500461 MB
- SAS Array B
  - Logical Drive 3 (1430351 MB, RAID 1+0)

5. Make LUNs Ready for Use

Because this storage solution is running on a Microsoft Windows-based platform, the remaining steps would be familiar to a Windows administrator. These include assigning a drive letter for the internal server, providing a volume name, etc. These are prompted by using the standard Disk Management function from the management console.



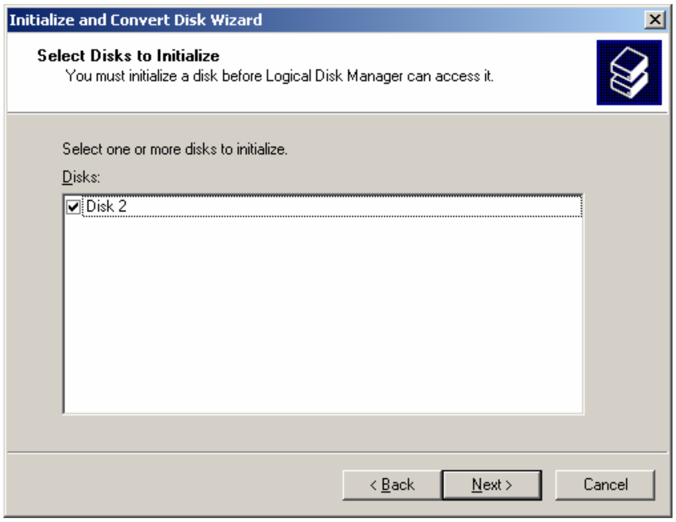
Welcome to the Initialize and Convert Disk Wizard

This wizard helps you to initialize new disks and to convert empty basic disks to dynamic disks.

You can use dynamic disks to create software-based volumes that can be mirrored, or they can be striped or spanned across multiple disks. You can also expand single-disk and spanned volumes without having to restart the computer.

After you convert a disk to dynamic, you can only use Windows 2000 and later versions of Windows on any volume of that disk.

To continue, click Next.



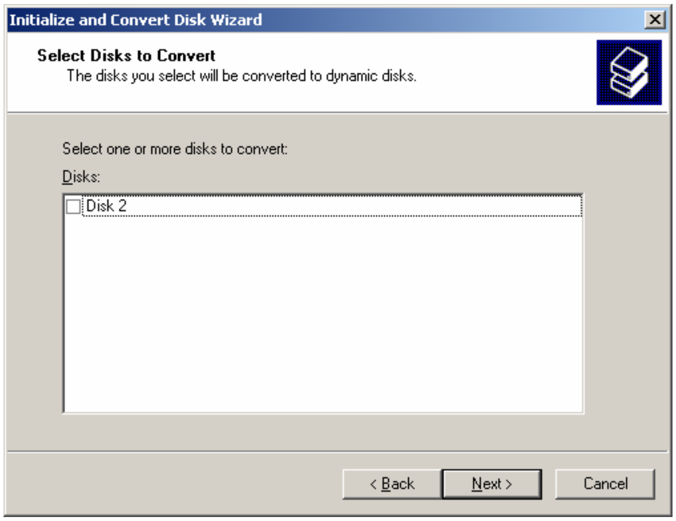
Initialize and Convert Disk Wizard

Select Disks to Initialize
You must initialize a disk before Logical Disk Manager can access it.

Select one or more disks to initialize.

Disks:

☑ Disk 2



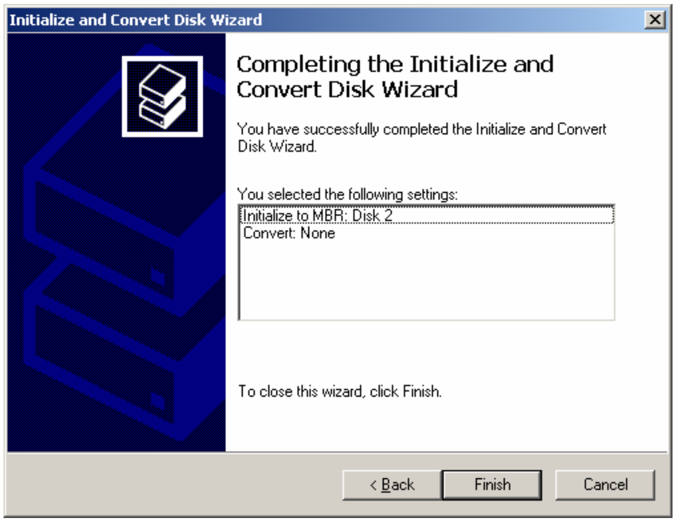
Initialize and Convert Disk Wizard

Select Disks to Convert
The disks you select will be converted to dynamic disks.

Select one or more disks to convert:

Disks:

□ Disk 2



Initialize and Convert Disk Wizard

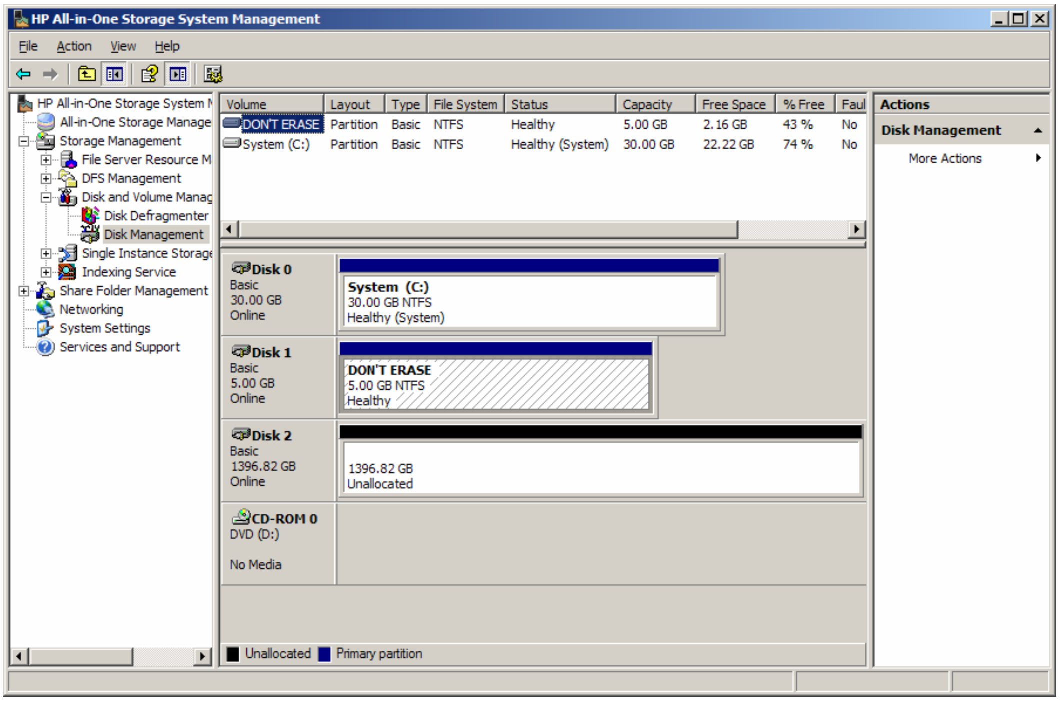
Completing the Initialize and Convert Disk Wizard

You have successfully completed the Initialize and Convert Disk Wizard.

You selected the following settings:

Initialize to MBR: Disk 2
Convert: None

To close this wizard, click Finish.

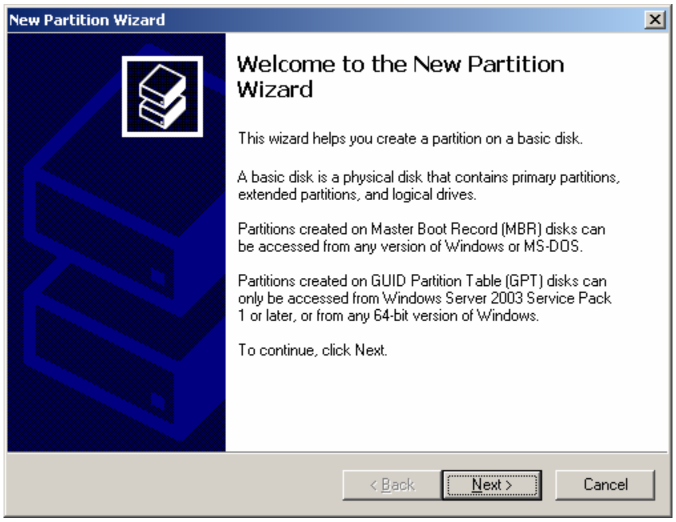


Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free	Faul
DON'T ERASE	Partition	Basic	NTFS	Healthy	5.00 GB	2.16 GB	43 %	No
System (C:)	Partition	Basic	NTFS	Healthy (System)	30.00 GB	22.22 GB	74 %	No

Disk 0 Basic 30.00 GB Online	**System (C:)** 30.00 GB NTFS Healthy (System)
Disk 1 Basic 5.00 GB Online	**DON'T ERASE** 5.00 GB NTFS Healthy
Disk 2 Basic 1396.82 GB Online	1396.82 GB Unallocated
CD-ROM 0 DVD (D:) No Media	

■ Unallocated ■ Primary partition

The LUN has now been created. The next step is to create a partition on the LUN and format it in the normal manner that Windows administrators would expect.



Welcome to the New Partition Wizard

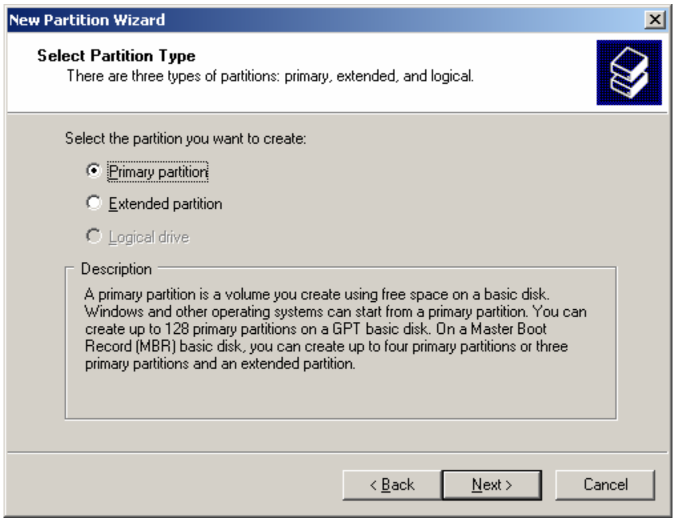
This wizard helps you create a partition on a basic disk.

A basic disk is a physical disk that contains primary partitions, extended partitions, and logical drives.

Partitions created on Master Boot Record (MBR) disks can be accessed from any version of Windows or MS-DOS.

Partitions created on GUID Partition Table (GPT) disks can only be accessed from Windows Server 2003 Service Pack 1 or later, or from any 64-bit version of Windows.

To continue, click Next.



New Partition Wizard

Select Partition Type

There are three types of partitions: primary, extended, and logical.

Select the partition you want to create:

● Primary partition

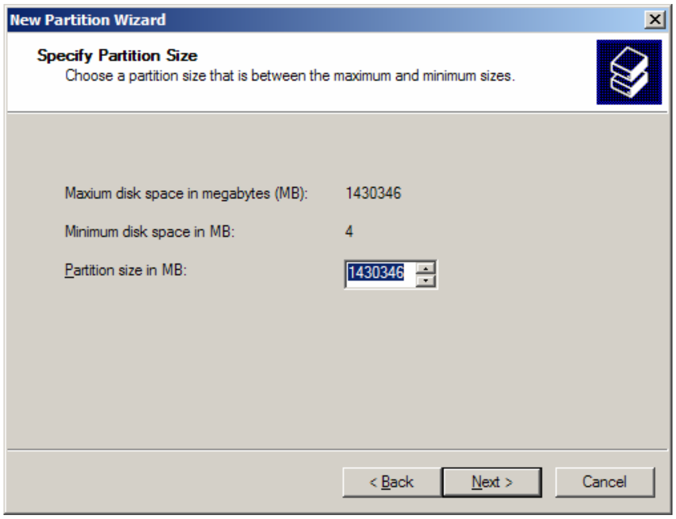
○ Extended partition

○ Logical drive

Description

A primary partition is a volume you create using free space on a basic disk. Windows and other operating systems can start from a primary partition. You can create up to 128 primary partitions on a GPT basic disk. On a Master Boot Record (MBR) basic disk, you can create up to four primary partitions or three primary partitions and an extended partition.

We choose the maximum available size for the new partition. We want Windows to manage the entire partition as one entity.



New Partition Wizard

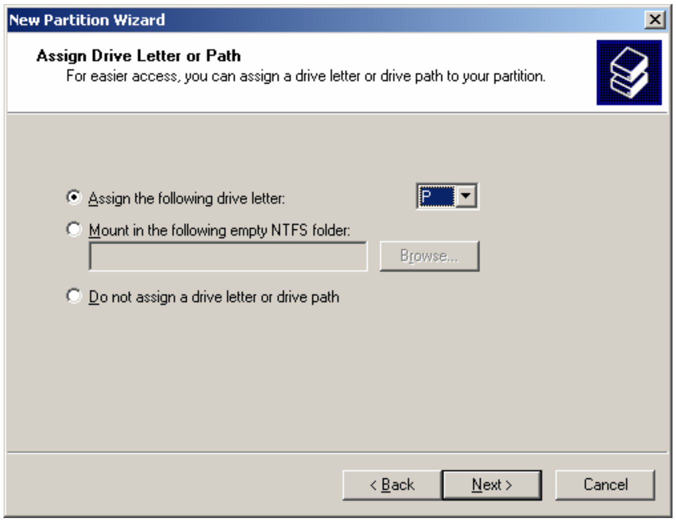
Specify Partition Size

Choose a partition size that is between the maximum and minimum sizes.

Maxium disk space in megabytes (MB): 1430346

Minimum disk space in MB: 4

Partition size in MB: 1430346



New Partition Wizard

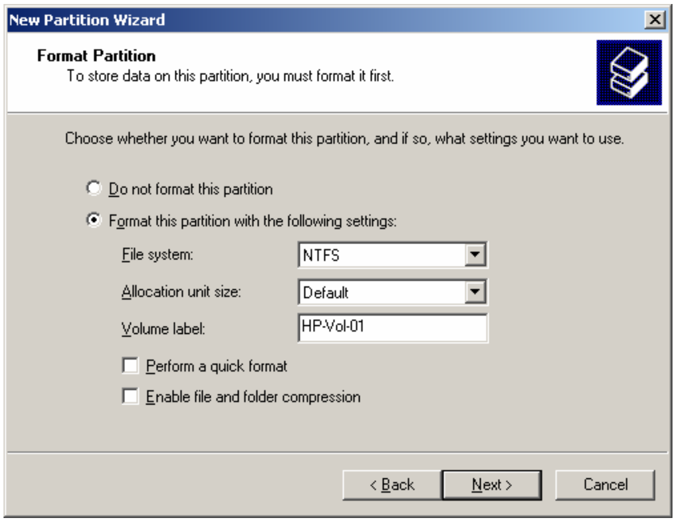
Assign Drive Letter or Path

For easier access, you can assign a drive letter or drive path to your partition.

● Assign the following drive letter: P

○ Mount in the following empty NTFS folder:

○ Do not assign a drive letter or drive path



Format Partition

To store data on this partition, you must format it first.

Choose whether you want to format this partition, and if so, what settings you want to use.

○ Do not format this partition

● Format this partition with the following settings:

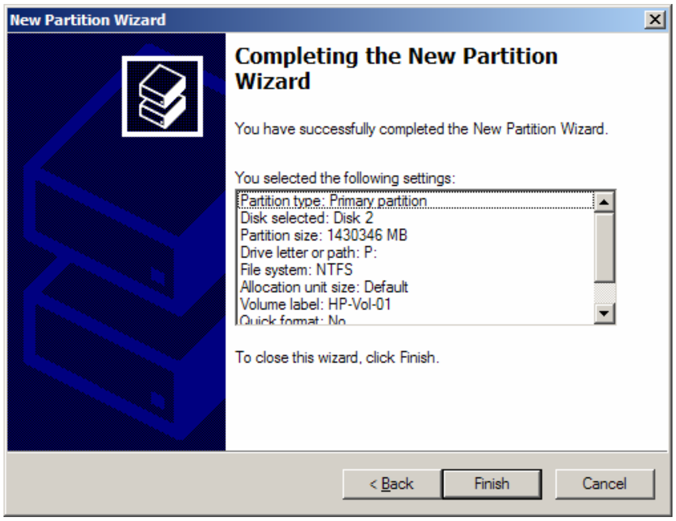
File system: NTFS

Allocation unit size: Default

Volume label: HP-Vol-01

□ Perform a quick format

□ Enable file and folder compression



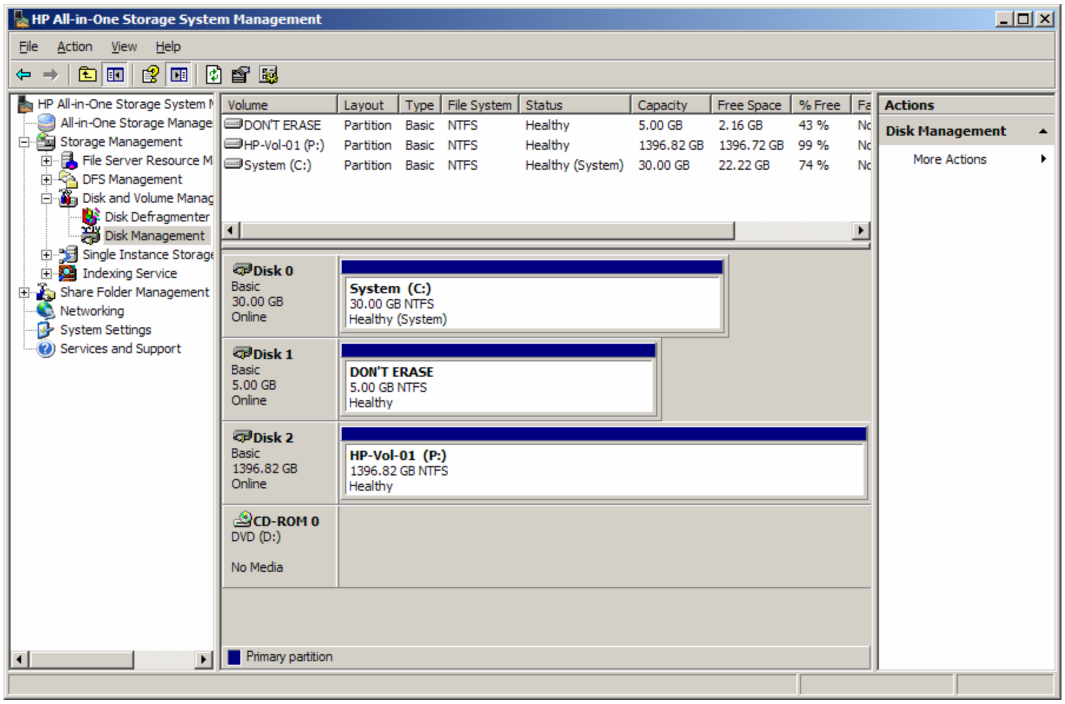
Completing the New Partition Wizard

You have successfully completed the New Partition Wizard.

You selected the following settings:

Partition type: Primary partition
Disk selected: Disk 2
Partition size: 1430346 MB
Drive letter or path: P:
File system: NTFS
Allocation unit size: Default
Volume label: HP-Vol-01
Quick format: No

To close this wizard, click Finish.



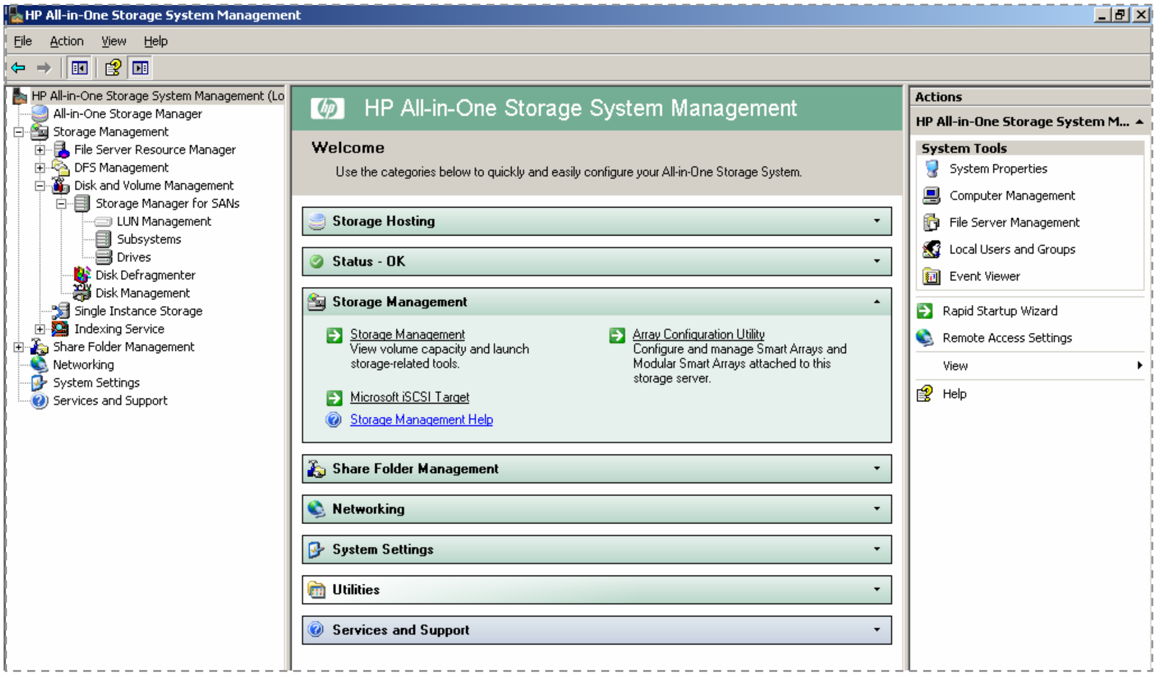
Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free	Fa
DON'T ERASE	Partition	Basic	NTFS	Healthy	5.00 GB	2.16 GB	43 %	Nc
HP-Vol-01 (P:)	Partition	Basic	NTFS	Healthy	1396.82 GB	1396.72 GB	99 %	Nc
System (C:)	Partition	Basic	NTFS	Healthy (System)	30.00 GB	22.22 GB	74 %	Nc

Disk 0 Basic 30.00 GB Online	System (C:) 30.00 GB NTFS Healthy (System)
Disk 1 Basic 5.00 GB Online	DON'T ERASE 5.00 GB NTFS Healthy
Disk 2 Basic 1396.82 GB Online	HP-Vol-01 (P:) 1396.82 GB NTFS Healthy
CD-ROM 0 DVD (D:) No Media	

The LUN is now ready for use. The next step will create iSCSI targets and associate them with this newly-created LUN.

6. Create iSCSI Targets

Clicking on the Microsoft iSCSI target function in the Storage Management section of the management console begins the iSCSI target creation process.



Welcome

Use the categories below to quickly and easily configure your All-in-One Storage System.

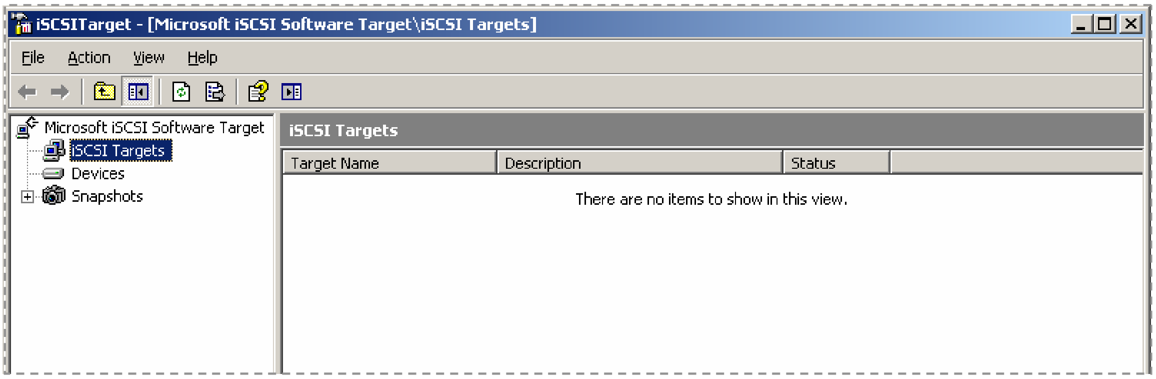
Storage Management
View volume capacity and launch storage-related tools.

Array Configuration Utility
Configure and manage Smart Arrays and Modular Smart Arrays attached to this storage server.

Microsoft iSCSI Target

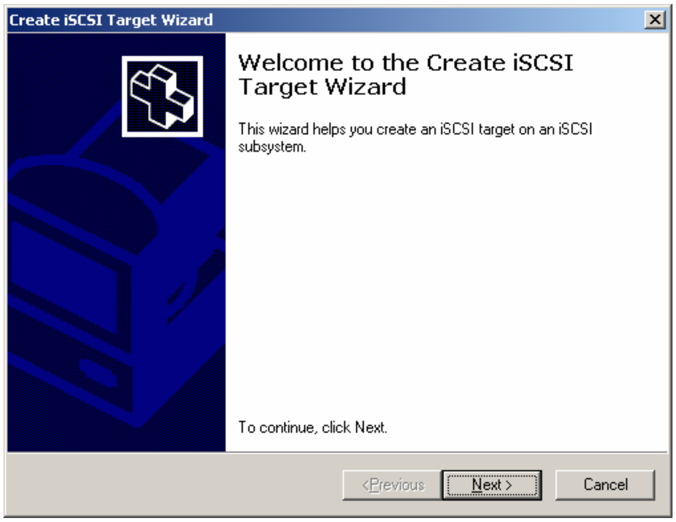
Storage Management Help

The iSCSI target window opens, and the iSCSI target creation wizard is started by using the right mouse click button.


iSCSITarget - [Microsoft iSCSI Software Target\iSCSI Targets]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
Devices
Snapshots
iSCSI Targets
Target Name
Description
Status

There are no items to show in this view.

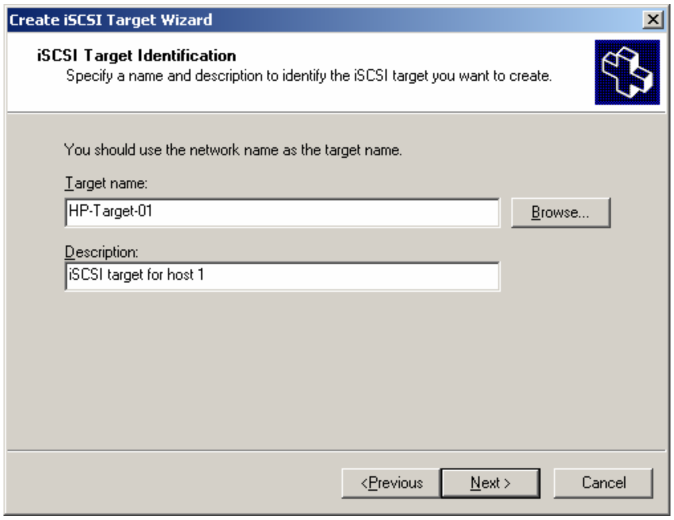
We will create a total of four targets, two associated with host number one and two associated with host number two. The individual steps to create the first target are shown below.



Welcome to the Create iSCSI Target Wizard

This wizard helps you create an iSCSI target on an iSCSI subsystem.

To continue, click Next.



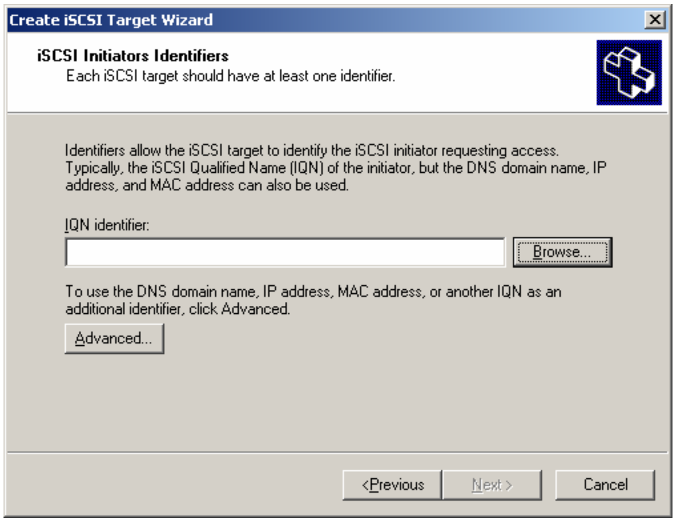
iSCSI Target Identification

Specify a name and description to identify the iSCSI target you want to create.

You should use the network name as the target name.

Target name: HP-Target-01

Description: iSCSI target for host 1



Create iSCSI Target Wizard

iSCSI Initiators Identifiers

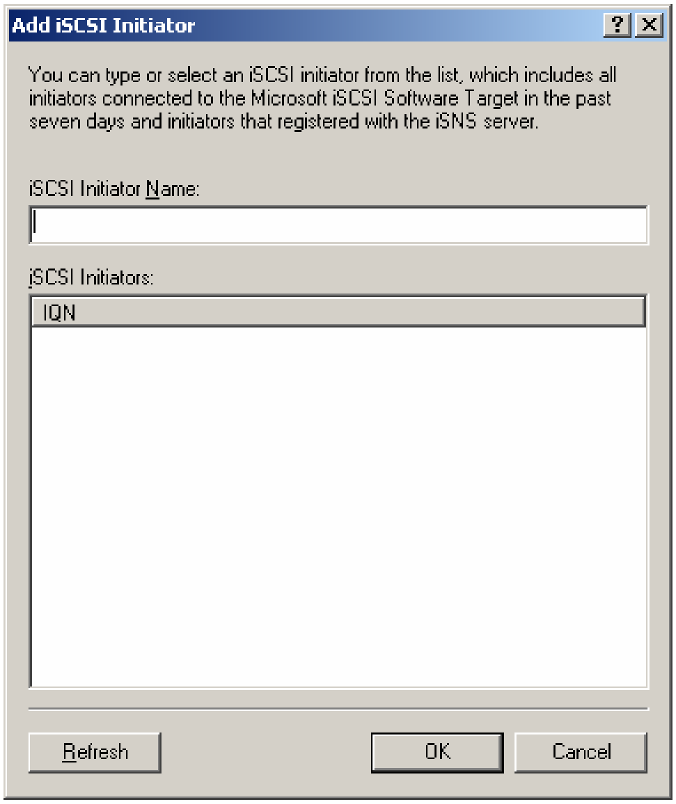
Each iSCSI target should have at least one identifier.

Identifiers allow the iSCSI target to identify the iSCSI initiator requesting access. Typically, the iSCSI Qualified Name (IQN) of the initiator, but the DNS domain name, IP address, and MAC address can also be used.

IQN identifier:

To use the DNS domain name, IP address, MAC address, or another IQN as an additional identifier, click Advanced.

Because there have been no previous iSCSI initiators assigned to this target, the initiators must be specifically identified.



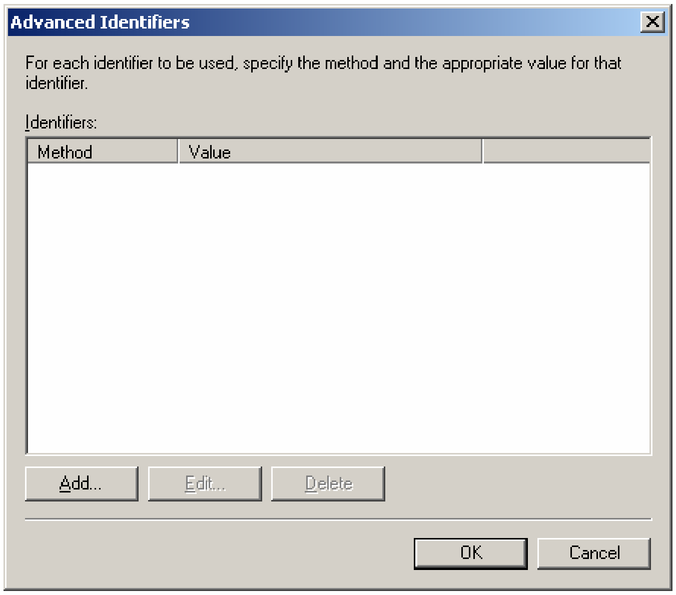
Add iSCSI Initiator

You can type or select an iSCSI initiator from the list, which includes all initiators connected to the Microsoft iSCSI Software Target in the past seven days and initiators that registered with the iSNS server.

iSCSI Initiator Name:

iSCSI Initiators:

IQN



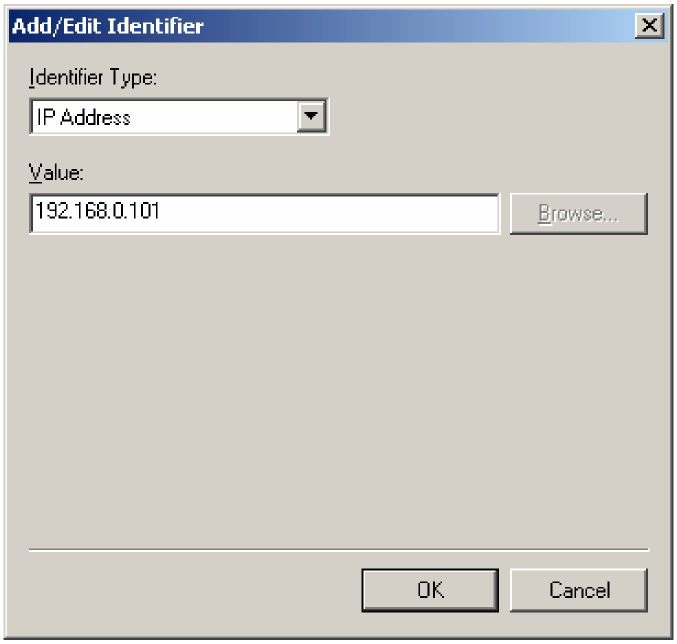
Advanced Identifiers

For each identifier to be used, specify the method and the appropriate value for that identifier.

Identifiers:

Method	Value

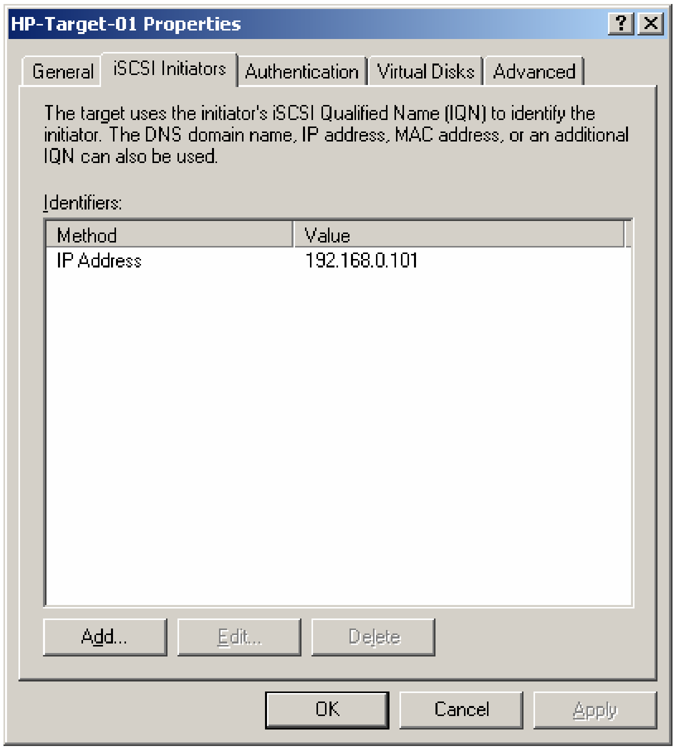
The initiators will be identified by their IP address.



Add/Edit Identifier

Identifier Type: IP Address

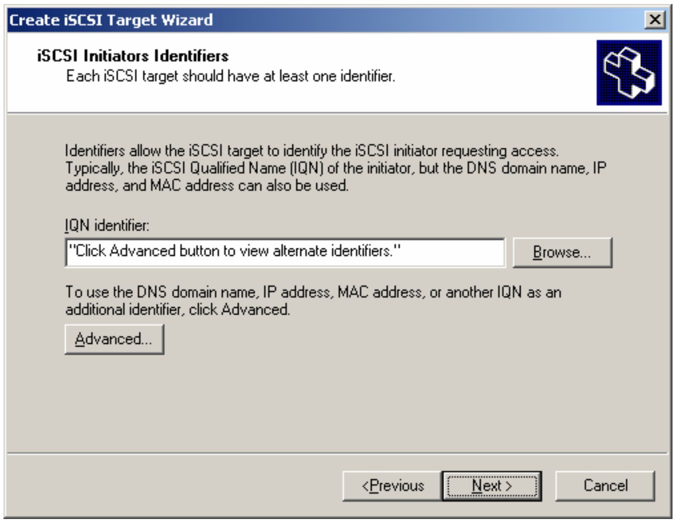
Value: 192.168.0.101



The target uses the initiator's iSCSI Qualified Name (IQN) to identify the initiator. The DNS domain name, IP address, MAC address, or an additional IQN can also be used.

Identifiers:

Method	Value
IP Address	192.168.0.101



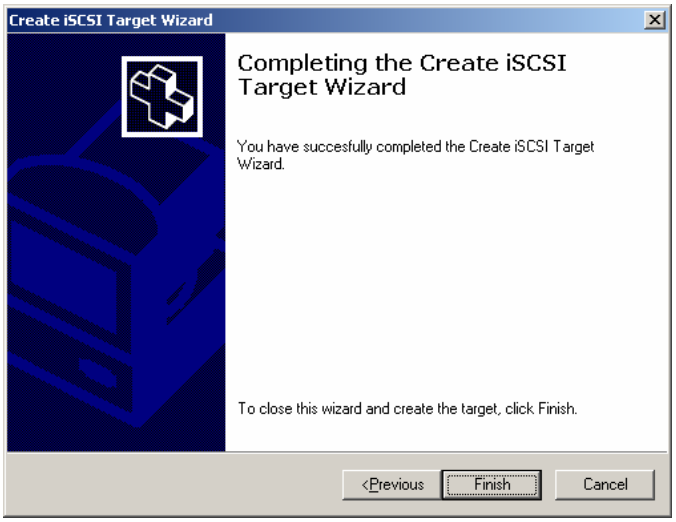
iSCSI Initiators Identifiers

Each iSCSI target should have at least one identifier.

Identifiers allow the iSCSI target to identify the iSCSI initiator requesting access. Typically, the iSCSI Qualified Name (IQN) of the initiator, but the DNS domain name, IP address, and MAC address can also be used.

IQN identifier: "Click Advanced button to view alternate identifiers."

To use the DNS domain name, IP address, MAC address, or another IQN as an additional identifier, click Advanced.

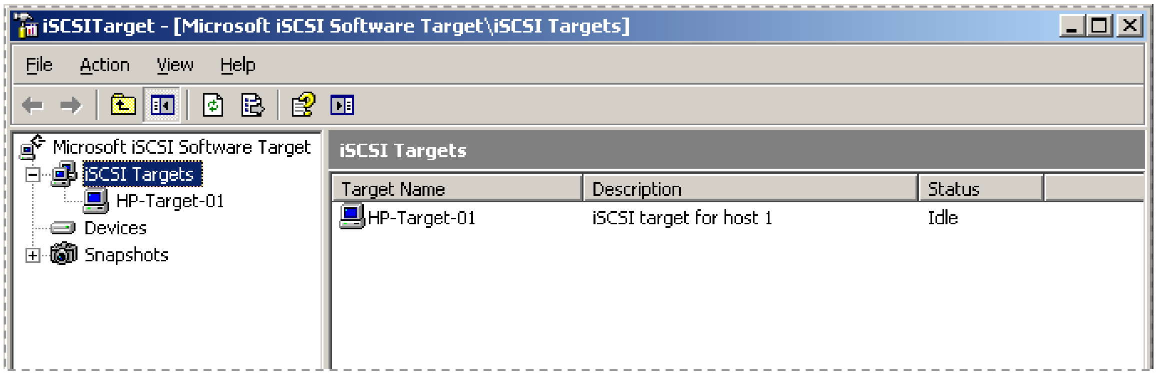


Completing the Create iSCSI Target Wizard

You have succesfully completed the Create iSCSI Target Wizard.

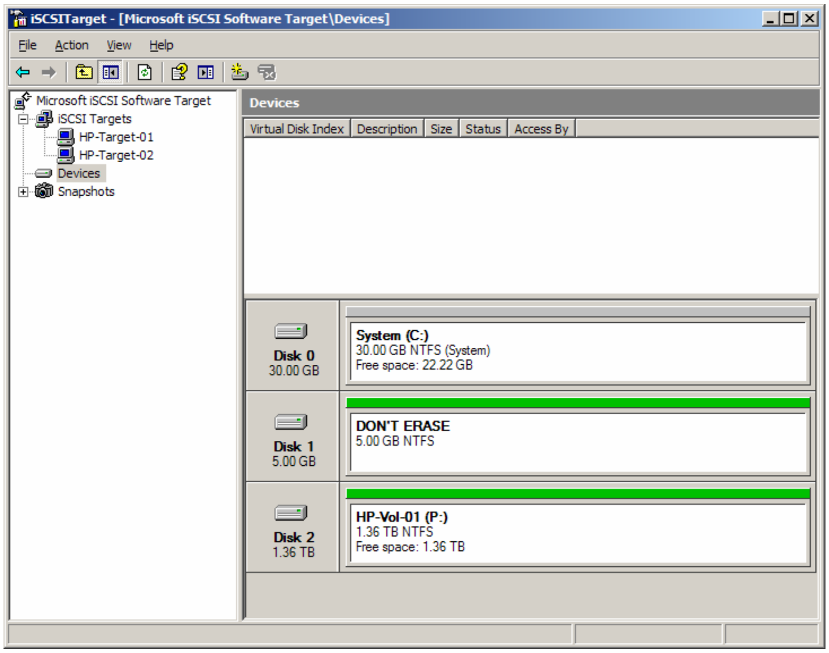
To close this wizard and create the target, click Finish.

The target now appears in the target list of the iSCSI target management window.


iSCSITarget - [Microsoft iSCSI Software Target\iSCSI Targets]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
Devices
Snapshots
iSCSI Targets

Target Name	Description	Status
HP-Target-01	iSCSI target for host 1	Idle

The management console also shows the underlying devices available for the iSCSI targets. The storage that will be used by the iSCSI initiators (application hosts) will be defined in a later step when the virtual disks are created.


iSCSITarget - [Microsoft iSCSI Software Target\Devices]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
HP-Target-02
Devices
Snapshots
Devices

Virtual Disk Index	Description	Size	Status	Access By

Disk 0
30.00 GB

System (C:)
30.00 GB NTFS (System)
Free space: 22.22 GB

Disk 1
5.00 GB

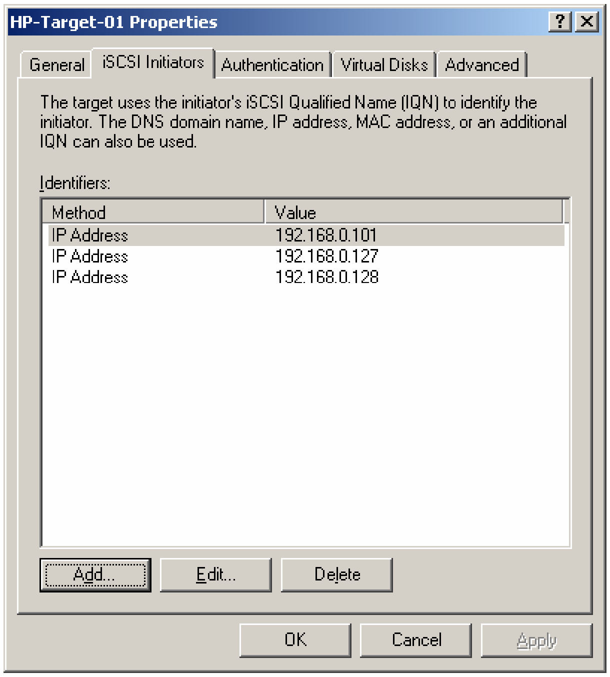
DON'T ERASE
5.00 GB NTFS

Disk 2
1.36 TB

HP-Vol-01 (P:)
1.36 TB NTFS
Free space: 1.36 TB

7. Create Multi-path I/O for iSCSI Targets (optional)

For a Microsoft-based target solution, multiple paths to the target device are created by providing multiple iSCSI initiator identifiers for the same target. In the example above, we add a second and third IP address that is to be associated with the same iSCSI initiator, so that there are three IP addresses that can access the target. These three addresses are associated with three Ethernet ports on the same host server.



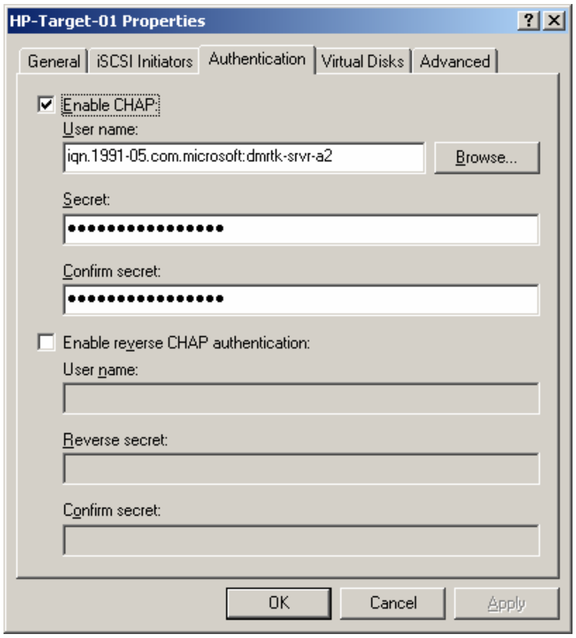
The target uses the initiator's iSCSI Qualified Name (IQN) to identify the initiator. The DNS domain name, IP address, MAC address, or an additional IQN can also be used.

Identifiers:

Method	Value
IP Address	192.168.0.101
IP Address	192.168.0.127
IP Address	192.168.0.128

8. Configure Security for iSCSI Targets (optional)

If security is desired for the iSCSI communication between the initiator and the target, the CHAP secret can be entered in the Authentication tab.



☑ Enable CHAP:

User name: iqn.1991-05.com.microsoft:dmrtk-srvr-a2

Secret: ●●●●●●●●●●●●●●●●●

Confirm secret: ●●●●●●●●●●●●●●●●●

□ Enable reverse CHAP authentication:

User name:

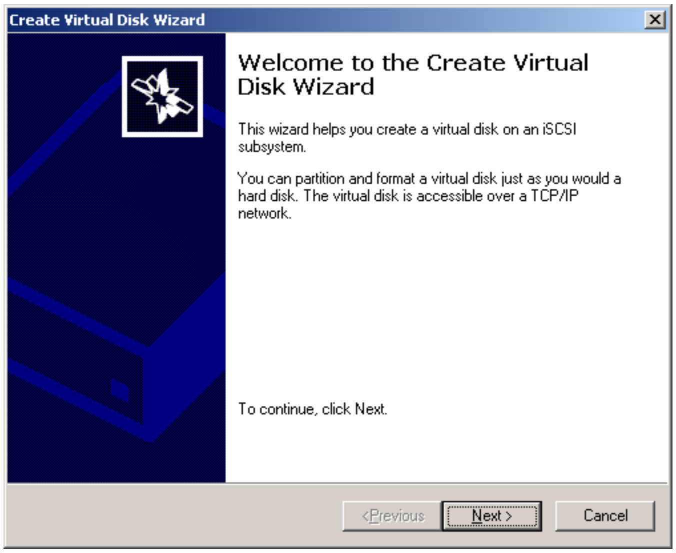
Reverse secret:

Confirm secret:

9. Make iSCSI Targets Ready for Use for iSCSI Initiators

Virtual disks need to be created on the iSCSI targets for Microsoft-based iSCSI target solutions. These virtual disks represent the storage volumes that the iSCSI initiators will use. The maximum capacity represented by all the virtual disks on a given iSCSI target on a Microsoft-based iSCSI target solution is two terabytes (2 TB) per target. In this example, we create a 100 GB and 200 GB virtual disk for each of the two iSCSI targets. These virtual disks will be viewed as volumes by the iSCSI initiators over the TCP/IP network.

By right-clicking on the target name, the "Create Virtual Disk" wizard is launched.



Create Virtual Disk Wizard

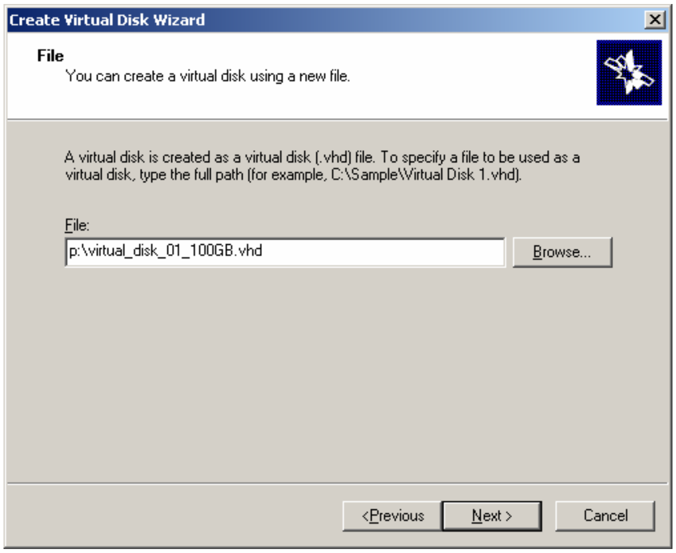
Welcome to the Create Virtual Disk Wizard

This wizard helps you create a virtual disk on an iSCSI subsystem.

You can partition and format a virtual disk just as you would a hard disk. The virtual disk is accessible over a TCP/IP network.

To continue, click Next.

The virtual disk is created on the internal disk volume that is available to the iSCSI target. In this case, it is the "P" volume.



Create Virtual Disk Wizard

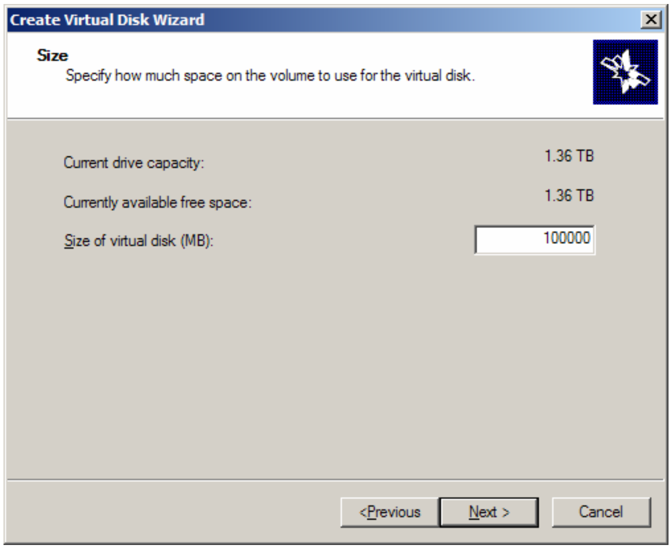
File

You can create a virtual disk using a new file.

A virtual disk is created as a virtual disk (.vhd) file. To specify a file to be used as a virtual disk, type the full path (for example, C:\Sample\Virtual Disk 1.vhd).

File: p:\virtual_disk_01_100GB.vhd

The size of the virtual disk depends on the needs of the application on the host server. For this virtual disk, we choose a size of 100 GB from the available 1.34 TB on this volume.



Create Virtual Disk Wizard

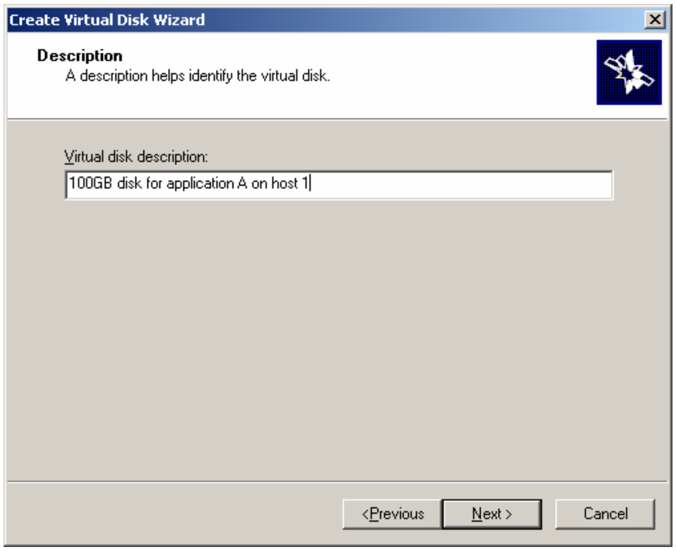
Size
Specify how much space on the volume to use for the virtual disk.

Current drive capacity: 1.36 TB

Currently available free space: 1.36 TB

Size of virtual disk (MB): 100000

A description, although optional, is useful for better management.

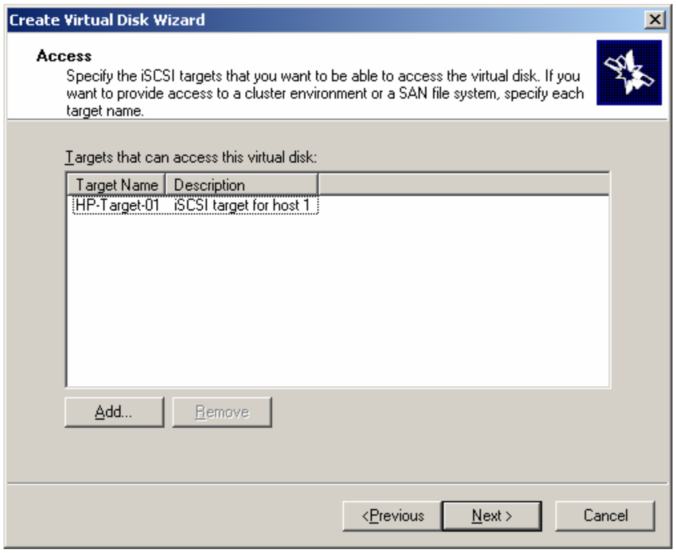


Create Virtual Disk Wizard

Description
A description helps identify the virtual disk.

Virtual disk description: 100GB disk for application A on host 1

This virtual disk must be associated with an iSCSI target in order for the application host to use this storage as an iSCSI storage volume.



Create Virtual Disk Wizard

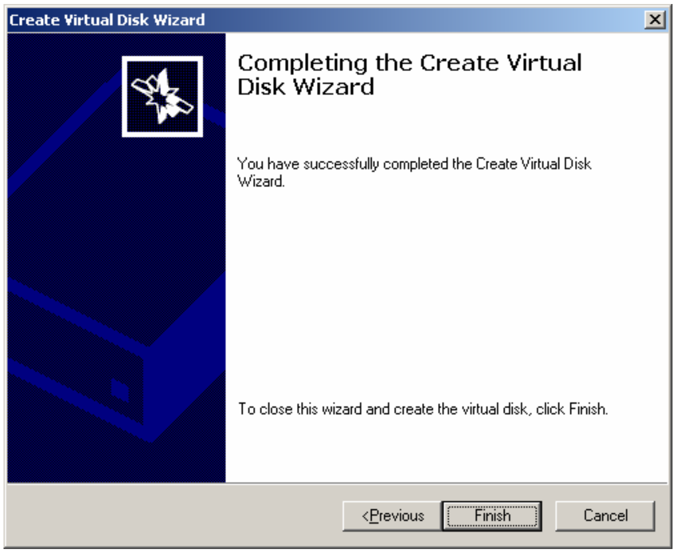
Access

Specify the iSCSI targets that you want to be able to access the virtual disk. If you want to provide access to a cluster environment or a SAN file system, specify each target name.

Targets that can access this virtual disk:

Target Name	Description
HP-Target-01	iSCSI target for host 1

This completes the virtual disk configuration.



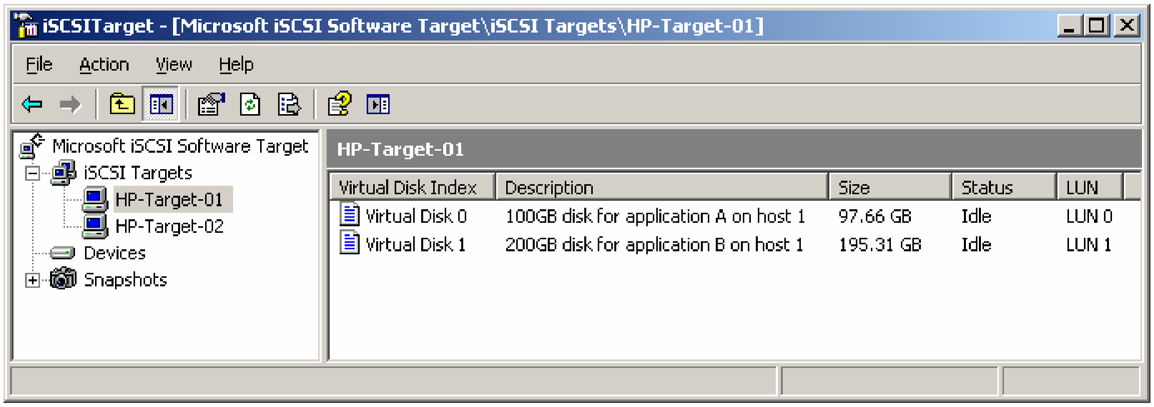
Create Virtual Disk Wizard

Completing the Create Virtual Disk Wizard

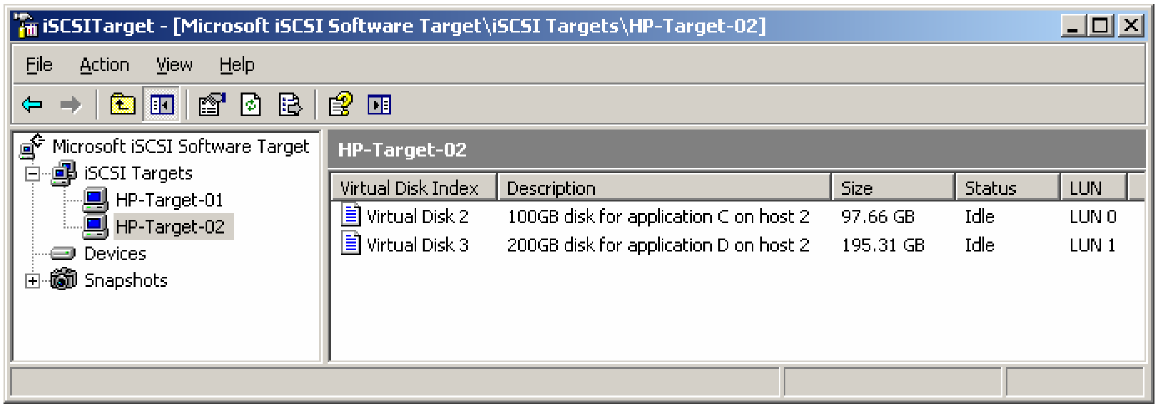
You have successfully completed the Create Virtual Disk Wizard.

To close this wizard and create the virtual disk, click Finish.

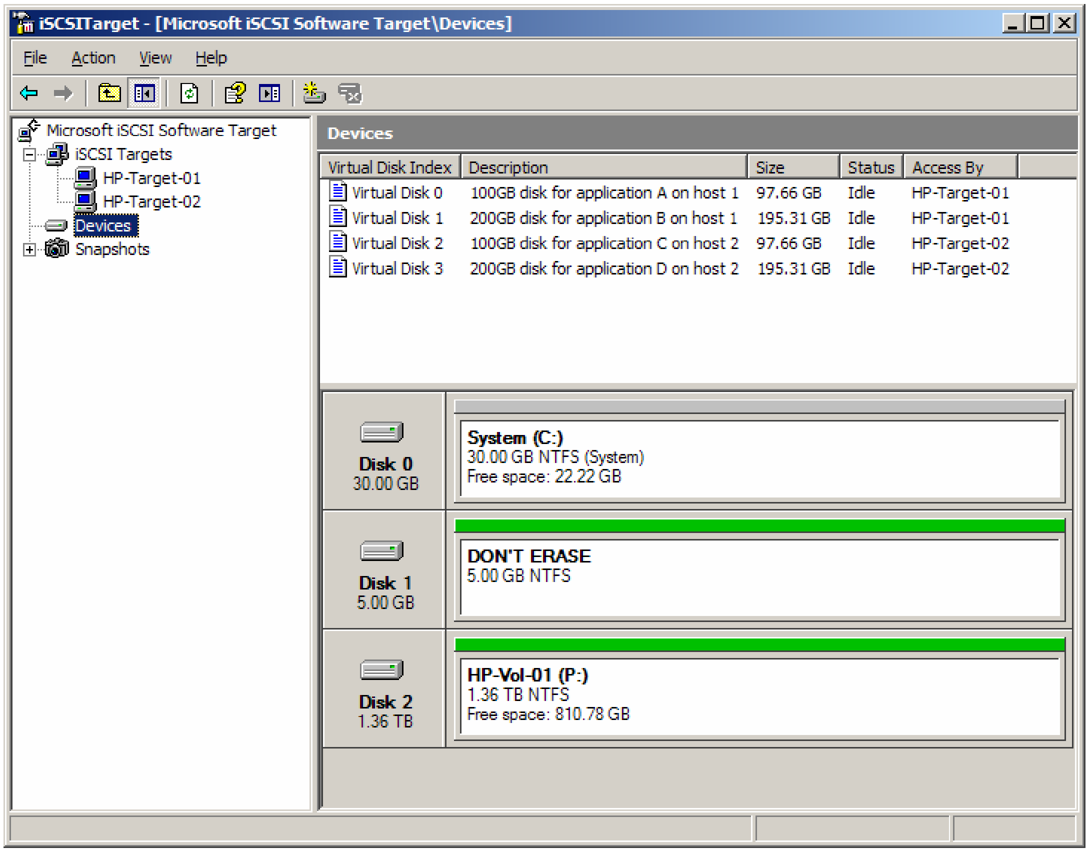
We repeat this process to create three more virtual disks. After configuring the virtual disks, the management console shows the virtual disks associated with each iSCSI target.


iSCSITarget - [Microsoft iSCSI Software Target\iSCSI Targets\HP-Target-01]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
HP-Target-02
Devices
Snapshots
HP-Target-01

Virtual Disk Index	Description	Size	Status	LUN
Virtual Disk 0	100GB disk for application A on host 1	97.66 GB	Idle	LUN 0
Virtual Disk 1	200GB disk for application B on host 1	195.31 GB	Idle	LUN 1


iSCSITarget - [Microsoft iSCSI Software Target\iSCSI Targets\HP-Target-02]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
HP-Target-02
Devices
Snapshots
HP-Target-02

Virtual Disk Index	Description	Size	Status	LUN
Virtual Disk 2	100GB disk for application C on host 2	97.66 GB	Idle	LUN 0
Virtual Disk 3	200GB disk for application D on host 2	195.31 GB	Idle	LUN 1


iSCSITarget - [Microsoft iSCSI Software Target\Devices]
File
Action
View
Help
Microsoft iSCSI Software Target
iSCSI Targets
HP-Target-01
HP-Target-02
Devices
Snapshots
Devices

Virtual Disk Index	Description	Size	Status	Access By
Virtual Disk 0	100GB disk for application A on host 1	97.66 GB	Idle	HP-Target-01
Virtual Disk 1	200GB disk for application B on host 1	195.31 GB	Idle	HP-Target-01
Virtual Disk 2	100GB disk for application C on host 2	97.66 GB	Idle	HP-Target-02
Virtual Disk 3	200GB disk for application D on host 2	195.31 GB	Idle	HP-Target-02

Disk	Volume
Disk 0 30.00 GB	System (C:) 30.00 GB NTFS (System) Free space: 22.22 GB
Disk 1 5.00 GB	DON'T ERASE 5.00 GB NTFS
Disk 2 1.36 TB	HP-Vol-01 (P:) 1.36 TB NTFS Free space: 810.78 GB

The target side configuration is now complete.

Initiator Configuration Steps

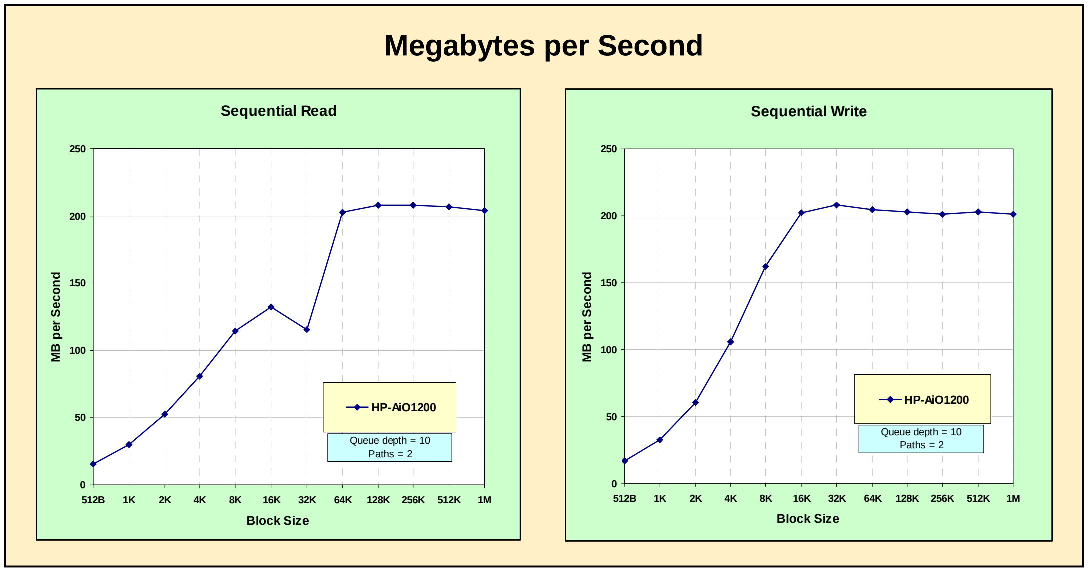
Configure Multi-path I/O from Application Host

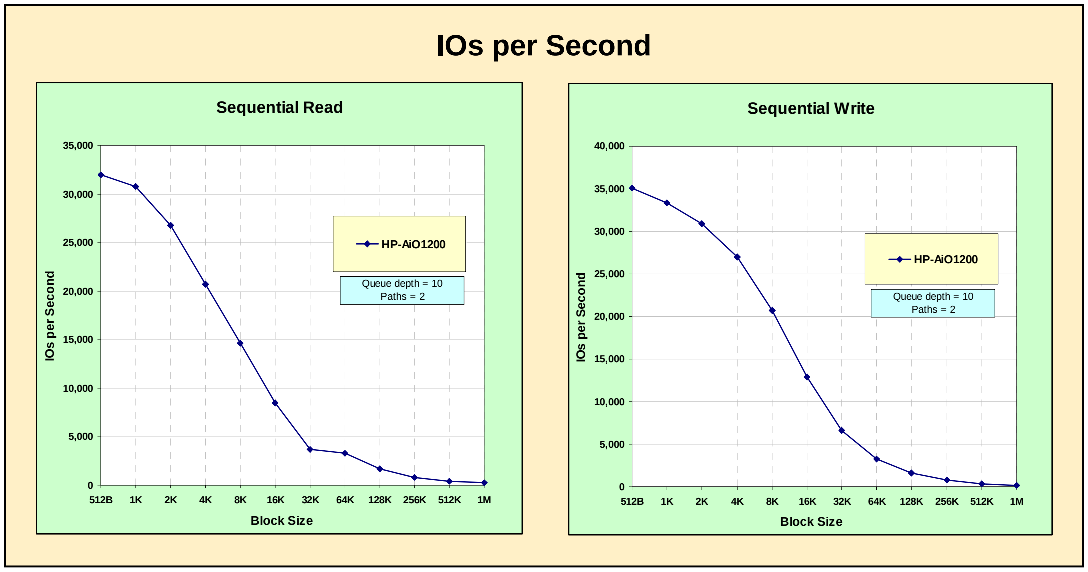
To configure multi-path iSCSI I/O for the initiator that uses the HP All-in-One 1200 iSCSI targets, follow the directions for Microsoft Multi-path I/O from the Deployment section of this document above.

Basic Performance Results

The following performance data is not intended to be viewed as a comprehensive performance benchmark, but to provide a general performance overview for the HP StorageWorks All-in-One1200 Storage System.

Selected performance results are shown below, using a standard server-class network adapter, with receive-side scaling on the host. This configuration used two paths from one host, two I/O workers, simultaneously accessing two target volumes and a queue depth of 10. Each target volume used a dedicated path, with no load-balancing across the paths.





LeftHand Networks® SAN/iQ®

The LeftHand Networks SAN/iQ storage system is an iSCSI target solution that includes three (3) HP ProLiant DL320s systems and the LeftHand Networks SAN/iQ software. It includes 10K or 15K RPM SAS disk drives totaling up to 3.6 TB of raw capacity per module, configured as RAID 10. In this case, the three ProLiant DL320s servers are clustered together to create a "virtual storage array" consisting of 5.4 TB of total usable storage. In addition to RAID10 at the disk level, LeftHand offers "network RAID" to provide an additional layer of protection for individual LUNs which guards against network or any other hardware failure.

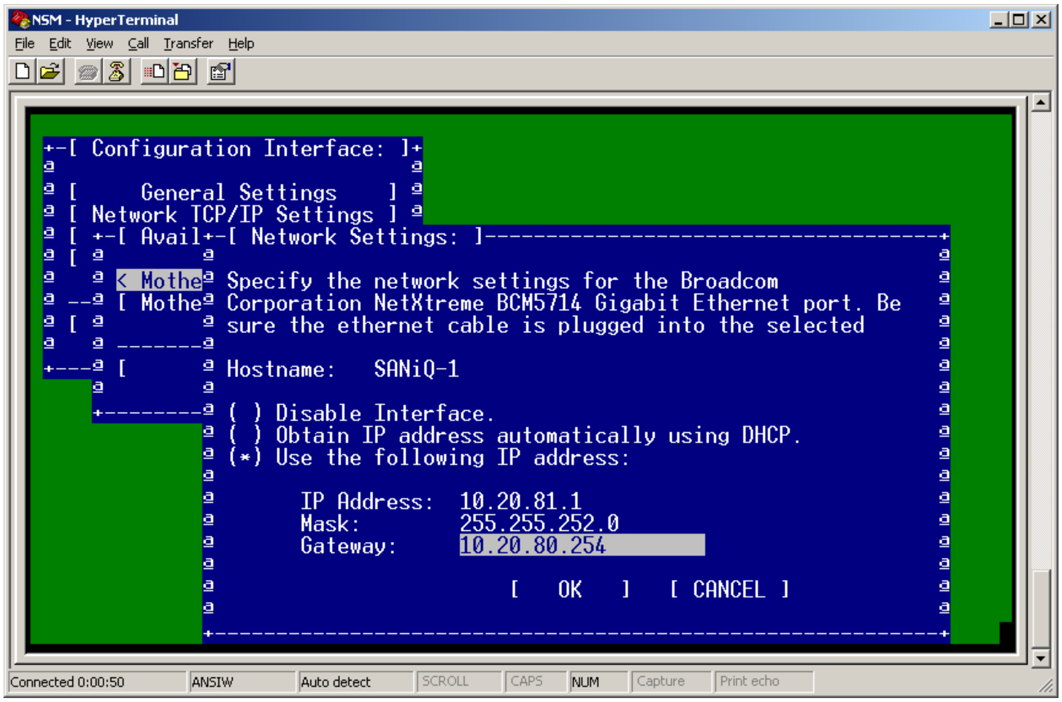
SAN/iQ includes many additional management features as part of the basic SAN offering. These features include snapshots, volume branching, thin provisioning, offsite DR snapshots, iSCSI load balancing, block-level load balancing, and automated capacity management. Customers can expand the storage cluster at any time by adding additional units to the cluster. This not only increases capacity, but SAN/iQ automatically re-load balances all the existing LUNs across the new configuration, increasing the performance of the SAN as well.

Another capability is LeftHand's "multi-site SAN" in which customers physically locate half their cluster in one location and the other half at a different location, such as another building or floor. In this case, the SAN is now "fault-tolerant" in that a location disaster will not interrupt service. This capability is included in the base offering, and does not require any additional administration to set up and manage.

Target Configuration Steps

1. Configure Network Settings for iSCSI Target Device

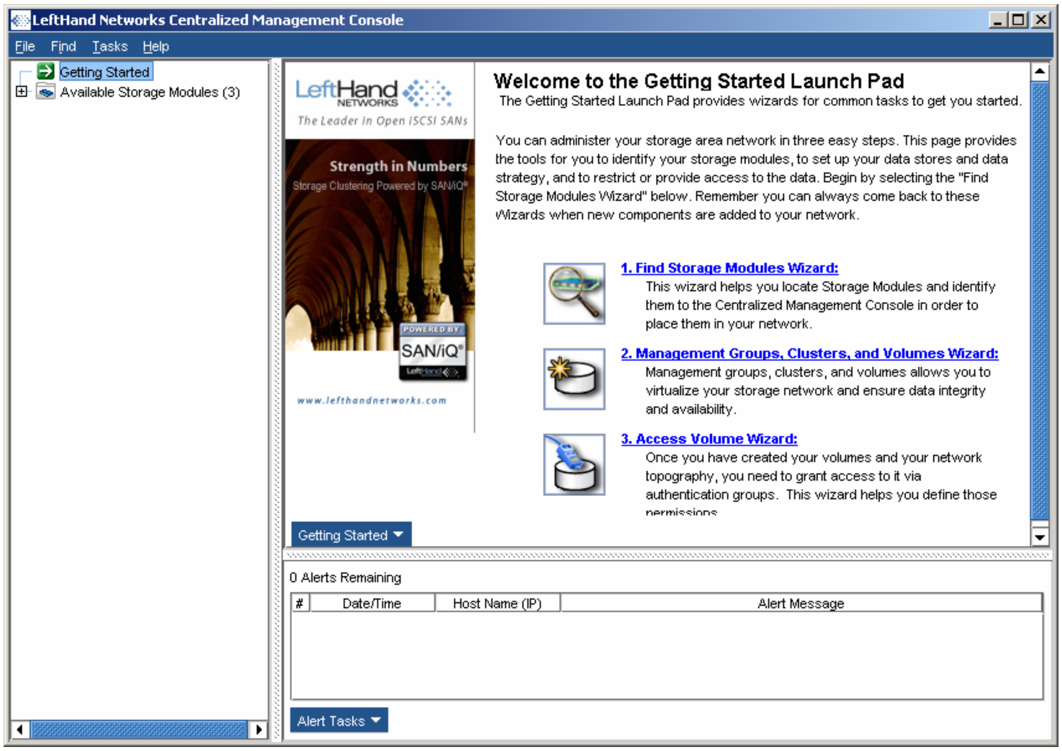
To install the LeftHand Networks SAN/iQ from factory settings, a computer must be connected via the supplied serial cable to the LeftHand NSM. The first Ethernet port must be given an IP address. Later, a virtual IP address will be assigned using the management console that will be the address that the clients use to access the target volumes and to manage the storage cluster.



```
+-[ Configuration Interface: ]+
ª                             ª
ª [     General Settings    ] ª
ª [ Network TCP/IP Settings ] ª
ª [ +-[ Avail+-[ Network Settings: ]------------------------------------+
ª [ ª        ª                                                          ª
ª   ª < Motheª Specify the network settings for the Broadcom            ª
ª --ª [ Motheª Corporation NetXtreme BCM5714 Gigabit Ethernet port. Be  ª
ª [ ª        ª sure the ethernet cable is plugged into the selected     ª
ª   ª -------ª                                                          ª
+---ª [      ª Hostname:   SANiQ-1                                      ª
    ª        ª                                                          ª
    +--------ª ( ) Disable Interface.                                   ª
             ª ( ) Obtain IP address automatically using DHCP.          ª
             ª (*) Use the following IP address:                        ª
             ª                                                          ª
             ª      IP Address:  10.20.81.1                             ª
             ª      Mask:        255.255.252.0                          ª
             ª      Gateway:     10.20.80.254                           ª
             ª                                                          ª
             ª                    [   OK   ]   [ CANCEL ]               ª
             ª                                                          ª
             +----------------------------------------------------------+
```

2. Launch Management Console

Launching the Management Console begins the discovery process and displays the NSMs. The three basic steps to configure the system including creation and assignment of all the targets are listed on the main screen, each driven by a wizard.


LeftHand Networks Centralized Management Console
File Find Tasks Help
Getting Started
Available Storage Modules (3)
LeftHand NETWORKS
The Leader In Open iSCSI SANs
Strength in Numbers
Storage Clustering Powered by SAN/iQ®
POWERED BY SAN/iQ®
www.lefthandnetworks.com
Getting Started
Alert Tasks

Welcome to the Getting Started Launch Pad

The Getting Started Launch Pad provides wizards for common tasks to get you started.

You can administer your storage area network in three easy steps. This page provides the tools for you to identify your storage modules, to set up your data stores and data strategy, and to restrict or provide access to the data. Begin by selecting the "Find Storage Modules Wizard" below. Remember you can always come back to these Wizards when new components are added to your network.

1. Find Storage Modules Wizard:
This wizard helps you locate Storage Modules and identify them to the Centralized Management Console in order to place them in your network.

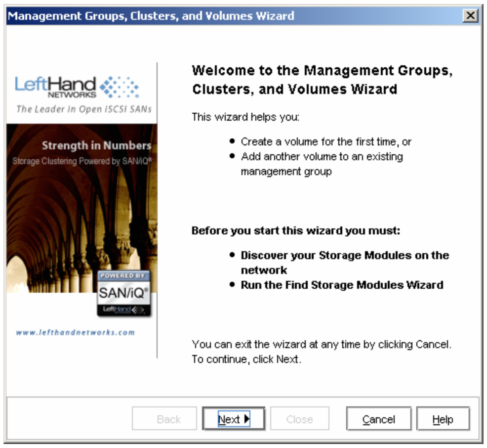
2. Management Groups, Clusters, and Volumes Wizard:
Management groups, clusters, and volumes allows you to virtualize your storage network and ensure data integrity and availability.

3. Access Volume Wizard:
Once you have created your volumes and your network topography, you need to grant access to it via authentication groups. This wizard helps you define those permissions

0 Alerts Remaining

#	Date/Time	Host Name (IP)	Alert Message

The LeftHand Networks SAN/iQ solution uses the concept of management groups to organize its storage clusters. The “Management Group, Clusters and Volumes” wizard steps the administrator through the initial management configuration and creation of the first volume.



Management Groups, Clusters, and Volumes Wizard

Welcome to the Management Groups, Clusters, and Volumes Wizard

This wizard helps you:

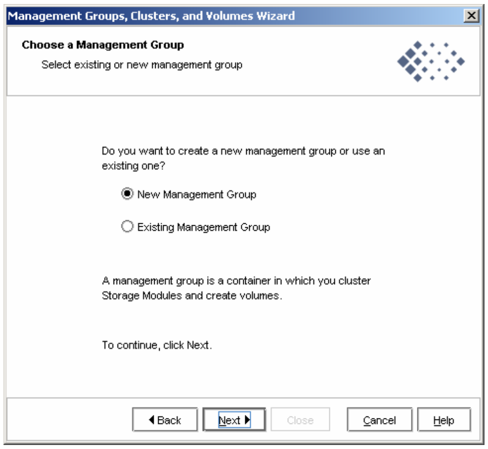
- Create a volume for the first time, or
- Add another volume to an existing management group

Before you start this wizard you must:

- **Discover your Storage Modules on the network**
- **Run the Find Storage Modules Wizard**

You can exit the wizard at any time by clicking Cancel.
To continue, click Next.

The wizard asks few questions to complete the initial management configuration, including the name of the management group, virtual IP address to be used for the cluster and the first volume information.



Management Groups, Clusters, and Volumes Wizard

Choose a Management Group

Select existing or new management group

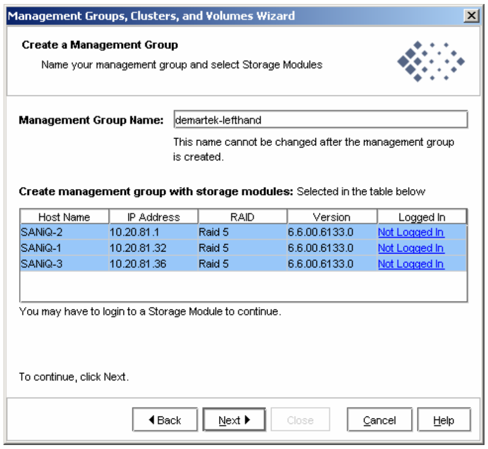
Do you want to create a new management group or use an existing one?

● New Management Group

○ Existing Management Group

A management group is a container in which you cluster Storage Modules and create volumes.

To continue, click Next.



Management Groups, Clusters, and Volumes Wizard

Create a Management Group

Name your management group and select Storage Modules

Management Group Name: demartek-lefthand

This name cannot be changed after the management group is created.

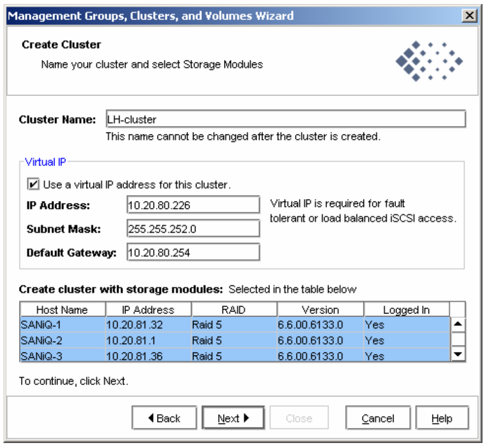
Create management group with storage modules: Selected in the table below

Host Name	IP Address	RAID	Version	Logged In
SANiQ-2	10.20.81.1	Raid 5	6.6.00.6133.0	Not Logged In
SANiQ-1	10.20.81.32	Raid 5	6.6.00.6133.0	Not Logged In
SANiQ-3	10.20.81.36	Raid 5	6.6.00.6133.0	Not Logged In

You may have to login to a Storage Module to continue.

To continue, click Next.

The storage cluster is given a virtual IP address, that will be used for all access to the volumes assigned to the cluster. The LeftHand Networks solution presents the virtual IP address to the clients and manages all fail-over and load balancing functions behind this virtual address.



Create Cluster

Name your cluster and select Storage Modules

Cluster Name: LH-cluster

This name cannot be changed after the cluster is created.

Virtual IP

☑ Use a virtual IP address for this cluster.

IP Address: 10.20.80.226

Subnet Mask: 255.255.252.0

Default Gateway: 10.20.80.254

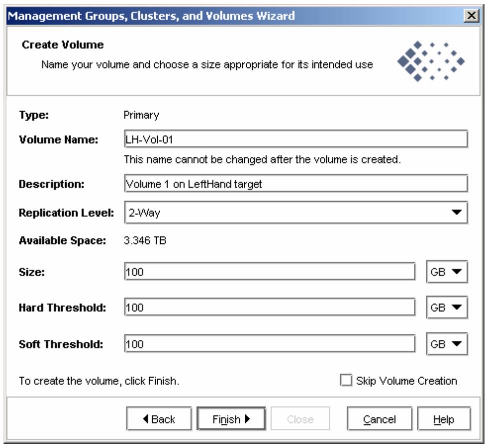
Virtual IP is required for fault tolerant or load balanced iSCSI access.

Create cluster with storage modules: Selected in the table below

Host Name	IP Address	RAID	Version	Logged In
SANiQ-1	10.20.81.32	Raid 5	6.6.00.6133.0	Yes
SANiQ-2	10.20.81.1	Raid 5	6.6.00.6133.0	Yes
SANiQ-3	10.20.81.36	Raid 5	6.6.00.6133.0	Yes

To continue, click Next.

After the wizard has the virtual IP address, it prompts for the information to create the first volume, including volume name, replication features and capacity. In this case, 2-way replication is selected, which tells SAN/iQ to provide an additional layer of data protection for this volume.



Create Volume

Name your volume and choose a size appropriate for its intended use

Type: Primary

Volume Name: LH-Vol-01

This name cannot be changed after the volume is created.

Description: Volume 1 on LeftHand target

Replication Level: 2-Way

Available Space: 3.346 TB

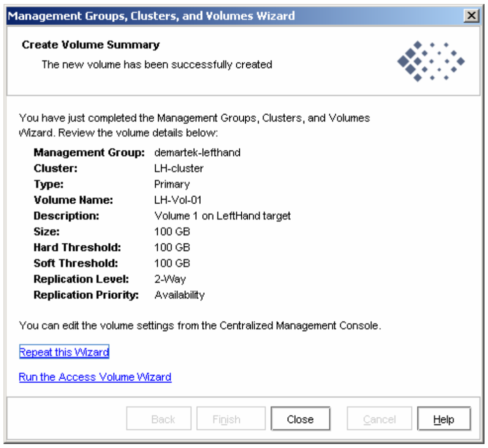
Size: 100 GB

Hard Threshold: 100 GB

Soft Threshold: 100 GB

To create the volume, click Finish.

☐ Skip Volume Creation



Create Volume Summary

The new volume has been successfully created

You have just completed the Management Groups, Clusters, and Volumes Wizard. Review the volume details below:

Management Group: demartek-lefthand
Cluster: LH-cluster
Type: Primary
Volume Name: LH-Vol-01
Description: Volume 1 on LeftHand target
Size: 100 GB
Hard Threshold: 100 GB
Soft Threshold: 100 GB
Replication Level: 2-Way
Replication Priority: Availability

You can edit the volume settings from the Centralized Management Console.

Repeat this Wizard

Run the Access Volume Wizard

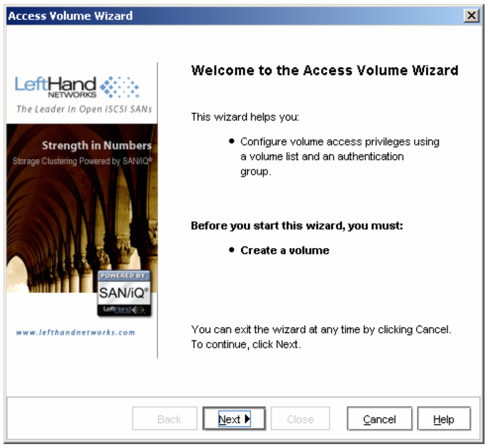
This wizard can be repeated to created additional volumes. Note that the "Access Volume Wizard" can be run to complete all the remaining target management steps.

3. Create LUNs on Disk Array

The LUNs are created using the "Management Group, Clusters and Volumes" wizard as described above in step 2.

4. Make LUNs Ready for Use

To make the volumes ready to use, they must be assigned to a host and appropriate security applied. The "Access Volume Wizard" is run to complete this process. This step can be run directly at the conclusion of the previous wizard from step 2 above.



Welcome to the Access Volume Wizard

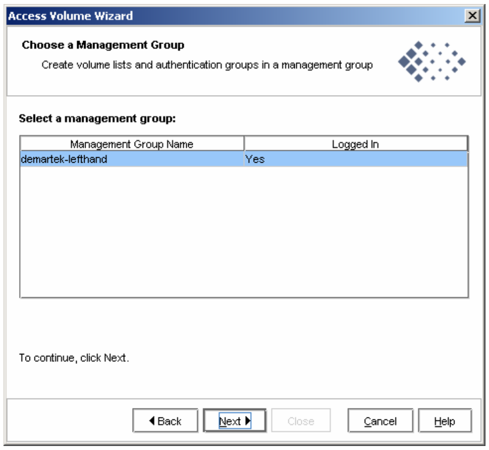
This wizard helps you:

- Configure volume access privileges using a volume list and an authentication group.

Before you start this wizard, you must:

- Create a volume

You can exit the wizard at any time by clicking Cancel.
To continue, click Next.



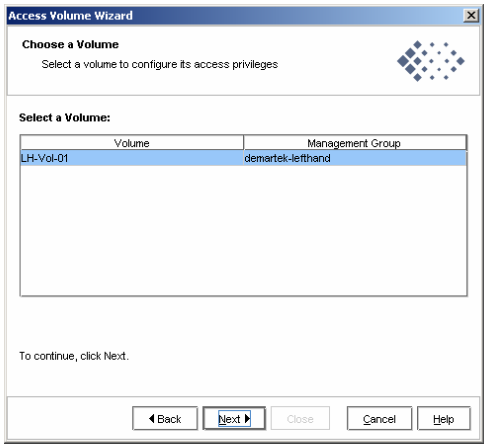
Choose a Management Group

Create volume lists and authentication groups in a management group

Select a management group:

Management Group Name	Logged In
demartek-lefthand	Yes

To continue, click Next.



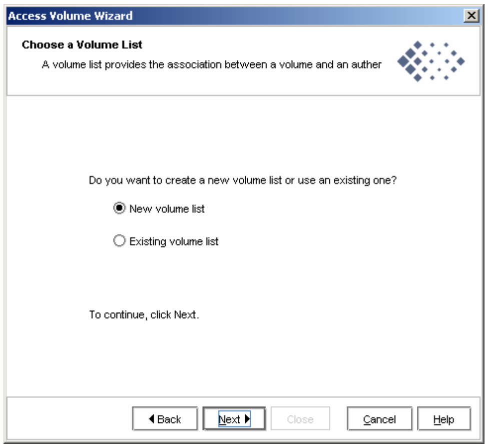
Choose a Volume

Select a volume to configure its access privileges

Select a Volume:

Volume	Management Group
LH-Vol-01	demartek-lefthand

To continue, click Next.



Choose a Volume List

A volume list provides the association between a volume and an auther

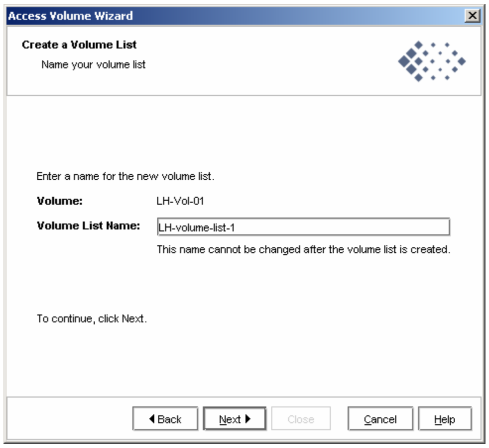
Do you want to create a new volume list or use an existing one?

● New volume list

○ Existing volume list

To continue, click Next.

A volume list provides the association between the volume and a host. After the first volume has been associated with a host, other volumes can be added to the volume list, and these volumes are automatically associated with the same host.



Create a Volume List

Name your volume list

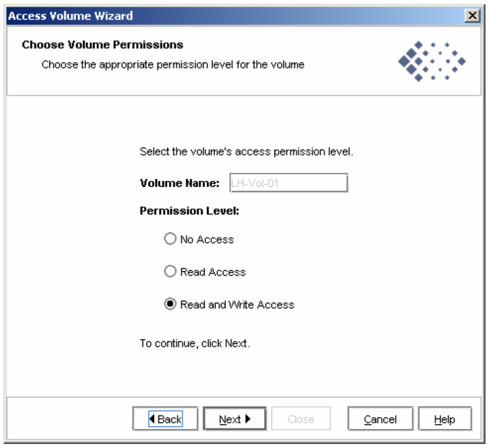
Enter a name for the new volume list.

Volume: LH-Vol-01

Volume List Name: LH-volume-list-1

This name cannot be changed after the volume list is created.

To continue, click Next.



Choose Volume Permissions

Choose the appropriate permission level for the volume

Select the volume's access permission level.

Volume Name: LH-Vol-01

Permission Level:

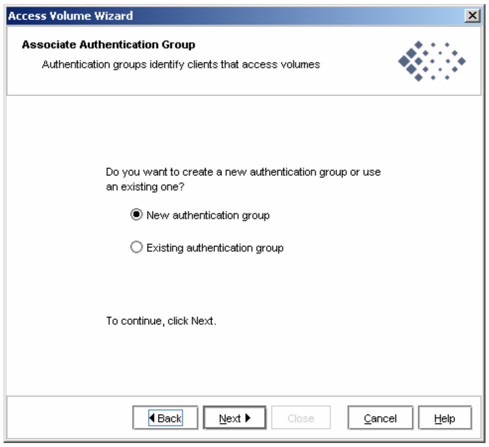
○ No Access

○ Read Access

● Read and Write Access

To continue, click Next.

The authentication group provides the information about the hosts that will access the volumes in this volume list. In this case, the name of the host is used as the name of the authentication group.



Associate Authentication Group

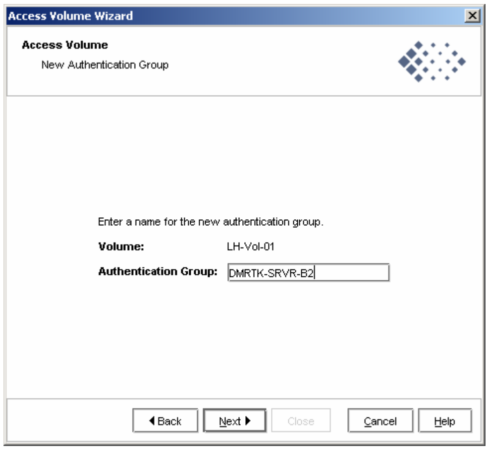
Authentication groups identify clients that access volumes

Do you want to create a new authentication group or use an existing one?

● New authentication group

○ Existing authentication group

To continue, click Next.



Access Volume

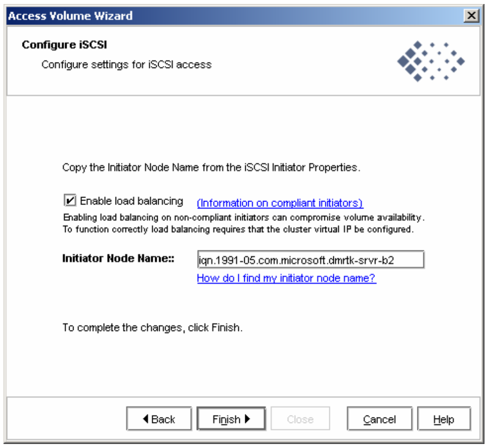
New Authentication Group

Enter a name for the new authentication group.

Volume: LH-Vol-01

Authentication Group: DMRTK-SRVR-B2

The iSCSI initiator name of the host is provided, along with any desired load balancing.



Configure iSCSI

Configure settings for iSCSI access

Copy the Initiator Node Name from the iSCSI Initiator Properties.

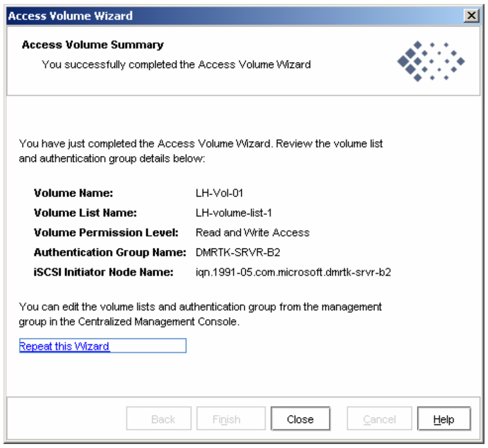
☑ Enable load balancing (Information on compliant initiators)

Enabling load balancing on non-compliant initiators can compromise volume availability. To function correctly load balancing requires that the cluster virtual IP be configured.

Initiator Node Name:: iqn.1991-05.com.microsoft.dmrtk-srvr-b2

How do I find my initiator node name?

To complete the changes, click Finish.



Access Volume Summary

You successfully completed the Access Volume Wizard

You have just completed the Access Volume Wizard. Review the volume list and authentication group details below:

Volume Name:	LH-Vol-01
Volume List Name:	LH-volume-list-1
Volume Permission Level:	Read and Write Access
Authentication Group Name:	DMRTK-SRVR-B2
iSCSI Initiator Node Name:	iqn.1991-05.com.microsoft.dmrtk-srvr-b2

You can edit the volume lists and authentication group from the management group in the Centralized Management Console.

Repeat this Wizard

This wizard can be repeated for additional volume lists or host information.

5. Create iSCSI Targets

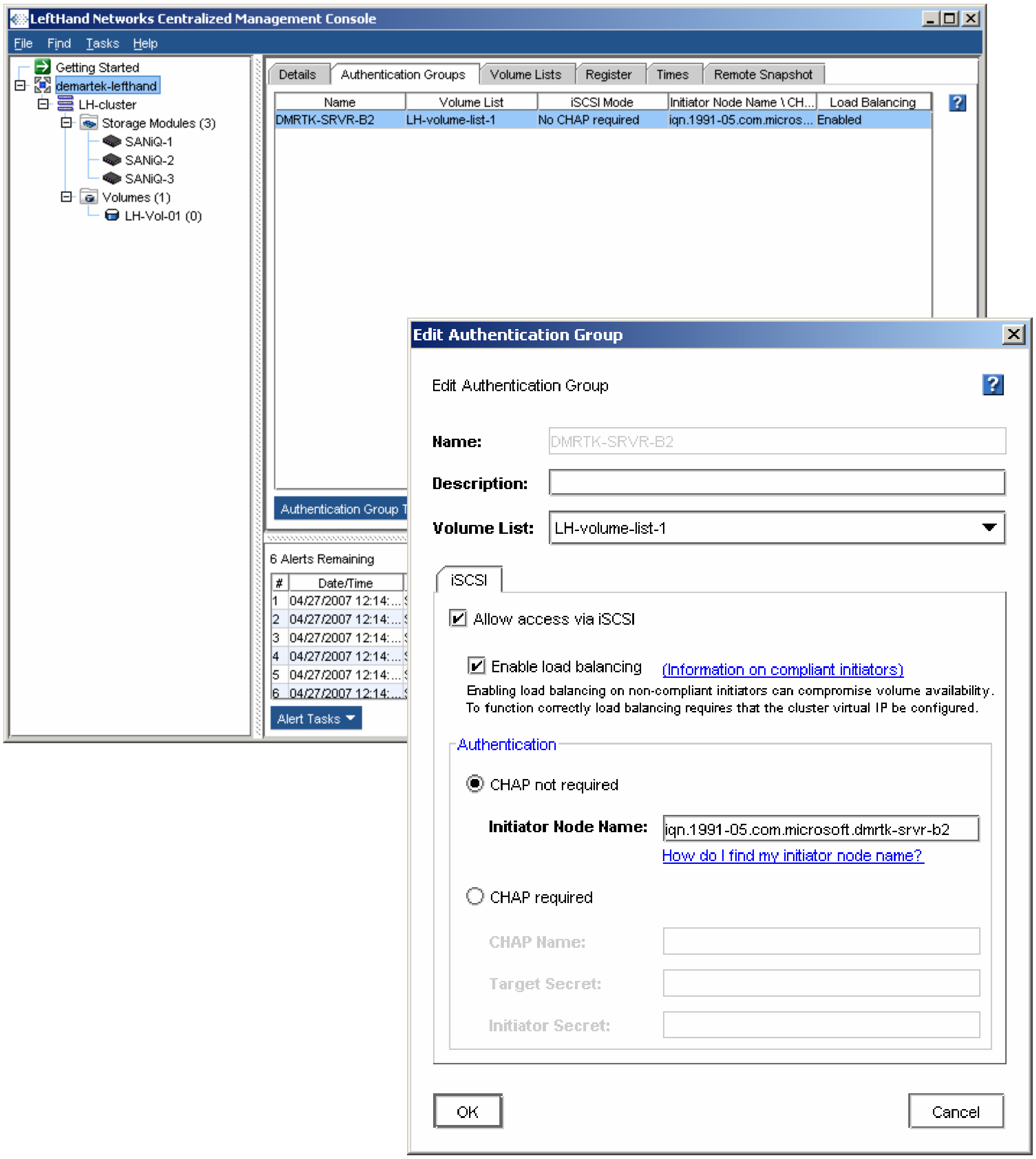
The targets are created in step 2 above.

6. Create Multi-path I/O for iSCSI Targets (optional)

Multi-path I/O is automatically performed by the storage cluster on the target side. Initiator side MPIO is configured below in the Initiator Configuration Steps.

7. Configure Security for iSCSI Targets (optional)

Additional security, such as CHAP, can be configured by editing the authentication group for the volume.



Name	Volume List	iSCSI Mode	Initiator Node Name \ CH...	Load Balancing
DMRTK-SRVR-B2	LH-volume-list-1	No CHAP required	iqn.1991-05.com.micros...	Enabled

6 Alerts Remaining

#	Date/Time
1	04/27/2007 12:14:...
2	04/27/2007 12:14:...
3	04/27/2007 12:14:...
4	04/27/2007 12:14:...
5	04/27/2007 12:14:...
6	04/27/2007 12:14:...

Edit Authentication Group

Edit Authentication Group

Name: DMRTK-SRVR-B2

Description:

Volume List: LH-volume-list-1

iSCSI

☑ Allow access via iSCSI

☑ Enable load balancing (Information on compliant initiators)

Enabling load balancing on non-compliant initiators can compromise volume availability. To function correctly load balancing requires that the cluster virtual IP be configured.

Authentication

● CHAP not required

Initiator Node Name: iqn.1991-05.com.microsoft.dmrtk-srvr-b2

How do I find my initiator node name?

○ CHAP required

CHAP Name:

Target Secret:

Initiator Secret:

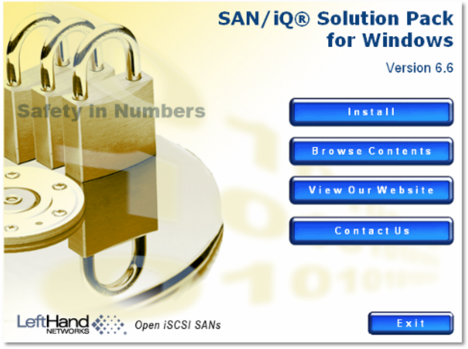
8. Make iSCSI Targets Ready for Use for iSCSI Initiators

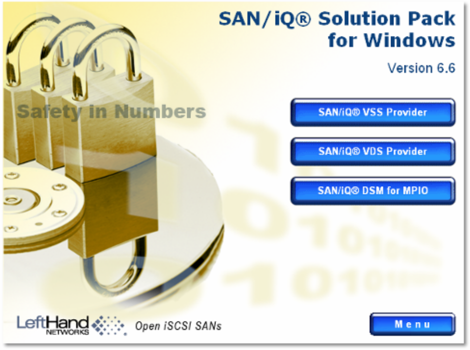
No additional steps are needed to make the targets ready for use.

Initiator Configuration Steps

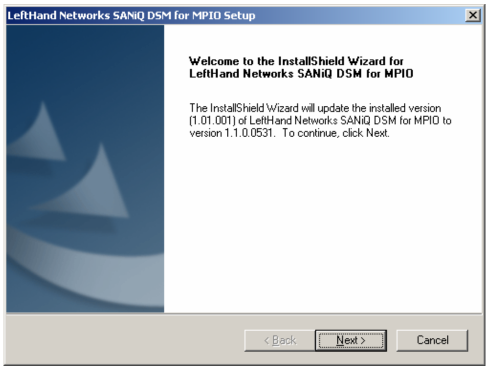
1. Configure Multi-path I/O from Application Host

MPIO for the initiator can be enabled by running the SAN/iQ Solution Pack from the application host.



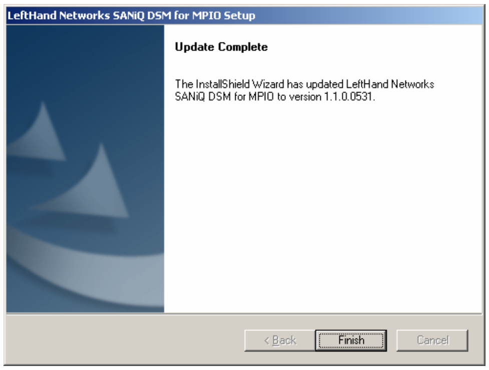


The SAN/iQ DSM for MPIO is selected, which begins the installation for the MPIO DSM.


LeftHand Networks SANiQ DSM for MPIO Setup

Welcome to the InstallShield Wizard for LeftHand Networks SANiQ DSM for MPIO

The InstallShield Wizard will update the installed version (1.01.001) of LeftHand Networks SANiQ DSM for MPIO to version 1.1.0.0531. To continue, click Next.


LeftHand Networks SANiQ DSM for MPIO Setup

Update Complete

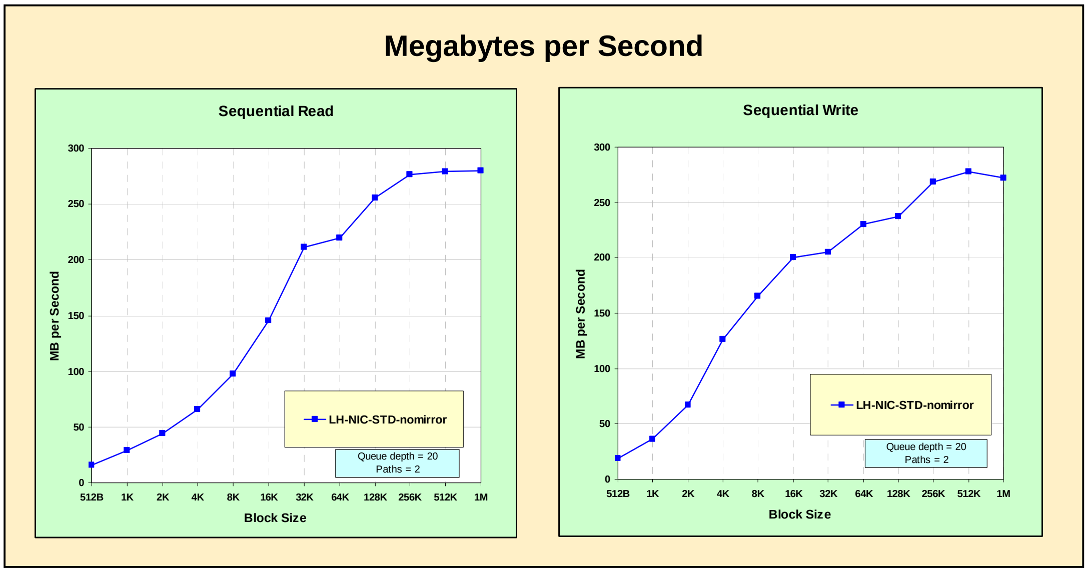
The InstallShield Wizard has updated LeftHand Networks SANiQ DSM for MPIO to version 1.1.0.0531.

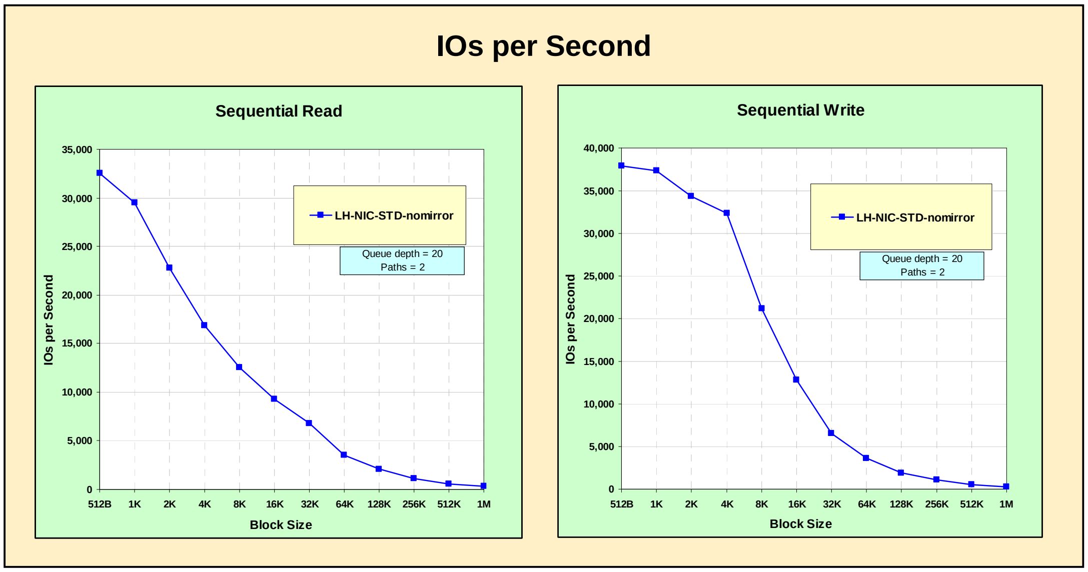
When the iSCSI initiator is launched to logon to the LeftHand Networks targets, the default addresses are selected, and MPIO is enabled for all the paths and targets. The “Advanced” tab in the initiator logon process is not needed.

Basic Performance Results

The following performance data is not intended to be viewed as a comprehensive performance benchmark, but to provide a general performance overview for the LeftHand Networks SAN/iQ solution.

Selected performance results are shown below, using a standard server-class network adapter, without receive-side scaling on the host. This configuration used two paths from two hosts, two I/O workers (one from each host), simultaneously accessing two target volumes and a queue depth of 20. Each host accessed its target volume with a pair of NICs configured as one “teaming” NIC. The target was configured as “non-mirrored.”





Storage Management Notes

Efficient Storage Management

Storage Manager for SANs

Storage Manager for SANs (SMfS) is a Microsoft Management Console snap-in that administrators can use to create and manage the logical units (LUNs) that are used to allocate space on storage arrays in both Fibre Channel and iSCSI environments. Administered through a conventional snap-in, Storage Manager for SANs can be used on storage area network (SAN) based storage arrays that support Virtual Disk Server (VDS) using a hardware VDS provider. Because of hardware, protocol, transport layer and security differences, configuration and LUN management differ for the two types (iSCSI and Fibre Channel) of supported environments. This feature will work with any type of Host Bus Adapter (HBA) or switches on the SAN. A list of VDS providers that have passed the Hardware Compatibility Tests (HCT) is available on http://www.microsoft.com/storage.

LUN management for Fibre Channel subsystems

On a Fibre Channel storage subsystem, LUNs are assigned directly to a server, which accesses the LUN through one or more Host Bus Adapter (HBA) ports. The administrator needs only to identify the server that will access the LUN, and enable one or more HBA ports on the server to be used for LUN I/O traffic. When the server is assigned to a LUN, the server can immediately access the LUN to create, augment, delete, and mask (or unmask) the LUN.

Support for multiple I/O paths. If a server supports Microsoft Multi-path I/O (MPIO), Storage Manager for SANs can provide path failover by enabling multiple ports on the server for LUN I/O traffic. To prevent data loss in a Fibre Channel environment, make sure that the server supports MPIO before enabling multiple ports. (On an iSCSI subsystem, this is not needed: the Microsoft iSCSI initiator (version 2.0) that is installed on the server supports MPIO.)

LUN management for iSCSI subsystems

Unlike on a Fibre Channel storage subsystem, LUNs on an iSCSI subsystem are not directly assigned to a server. For iSCSI, a LUN is assigned to a *target* – a logical entity that contains one or more LUNs. A server accesses the LUN by logging on to the target using the server's iSCSI initiator. To log on to a target, the initiator connects to *portals* on the target; a subsystem has one or more portals, which are associated with targets. If a server's initiator is logged on to a target, and a new LUN is assigned to the target, the server can immediately access the LUN.

Securing data on an iSCSI SAN. To help secure data transfers between the server and the subsystem, configure security for the login sessions between initiators and targets. Using Storage Manager for SANs, you can configure one-way or mutual Challenge Handshake Authentication Protocol (CHAP) authentication between the initiator and targets, and you can also configure Internet Protocol security (IPSec) data encryption.

Summary

Internet SCSI (iSCSI) can be a useful and relatively inexpensive way to provide storage for new applications or to provide a networked pool of storage for existing applications. Microsoft and its storage partners provide a variety of storage solutions that can be implemented relatively easily. This report allows administrators and IT managers to explore iSCSI technology and see actual deployment examples.

There is no question that iSCSI storage solutions and technology have a place in many IT environments. The performance of iSCSI storage solutions is adequate for many applications and iSCSI technology provides the benefits of storage area network technology for a lower cost than Fibre Channel storage solutions.

Related Links

For more information on storage for Windows Server Storage and iSCSI in particular, see the following:

- Microsoft Storage at http://www.microsoft.com/storage/
- Microsoft iSCSI Storage at http://www.microsoft.com/WindowsServer2003/technologies/storage/iscsi/default.mspx
- Microsoft Windows Storage Server at http://www.microsoft.com/windowsserversystem/wss2003/default.mspx
- Microsoft Windows Unified Data Storage Server 2003 at http://www.microsoft.com/windowsserversystem/storage/wudss.mspx
- Microsoft Storage Technical Articles and White Papers at http://www.microsoft.com/windowsserversystem/storage/indextecharticle.mspx
- Microsoft Scalable Networking Pack at http://www.microsoft.com/technet/network/snp/default.mspx
- Microsoft Exchange Solution Reviewed Program – Storage at http://technet.microsoft.com/en-us/exchange/bb412164.aspx
- Microsoft Cluster Server at http://www.microsoft.com/windowsserver2003/technologies/clustering/default.mspx

For more information on the Microsoft storage partner products mentioned in this report, see the following:

- Dell PowerVault NX1950 Networked Storage Solution at http://www.dell.com/content/products/productdetails.aspx/pvaul_nx1950?c=us&cs=555&l=en&s=biz
- EqualLogic PS3800XV at http://www.equallogic.com/products/view.aspx?id=1989
- HDS TagmaStore AMS1000 at http://www.hds.com/products_services/adaptable_modular_storage/
- HP StorageWorks 1200 All-in-One Storage System at http://www.hp.com/go/AiOStorage
- LeftHand Networks SAN/iQ at http://www.lefthandnetworks.com/products/nsm.php

For more information on RFC documents, see the following:

- RFC1334: CHAP and PAP at http://rfc.net/rfc1334.html
- RFC3720: iSCSI specification at http://rfc.net/rfc3720.html
- RFC4301: IPSec at http://rfc.net/rfc4301.html

For more information on IOMeter, the open-source I/O load generator and performance analysis tool:

- http://sourceforge.net/projects/iometer/