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VMware® ESX Server 3.0.1 Configuration and Operation Using a PS Series Group

Abstract

This Technical Report describes how to use VMware ESX Server 3.0.1 with PS Series storage arrays from EqualLogic to create a dynamic and scalable virtualized environment.

TR1025
V1.1

Table of Contents

Technical Report and Software Revision Information

The following table describes the release history of this Technical Report.

Revision	Date	Change
1.0	06/2006	Initial release
1.1	10/2006	Updated for ESX Server 3.0.1 and Virtual Center 2.0.1

The following table shows the software versions used for the preparation of this Technical Report:

Vendor	Model	Software Revision
EqualLogic, Inc.	PS	V3.0.5
EqualLogic	Auto-Snapshot Manager for Windows	Version 2.0
Microsoft®	Windows Server™ 2003 Enterprise Edition	SP1 Hotfix: KB891957
Microsoft	iSCSI Initiator Service	V2.01
VMware	ESX Server	3.0.1
VMware	VirtualCenter	2.0.1
QLogic™	QLA4050/4052 iSCSI HBA	BIOS: 1.7 Firmware: 2.0.0.7 Rom Loader: 1.0.0.0
VMware	ESX Server Service Console (Linux Redhat) Driver	3.10
QLogic	SANsurfer Manager	4.01.00
QLogic	SCSIport Miniport Driver	2.1.0.3
QLogic	STORport Miniport Driver*	2.1.0.8

Introduction

This technical report describes how VMware virtualization software, including VMware ESX Server 3 and VirtualCenter 2, can work together with EqualLogic PS Series iSCSI SANs to provide a dynamic and scalable virtual environment. The report also provides flexible guidelines for designing and implementing a virtual environment appropriate to your IT ecosystem.

Note: This technical report frequently refers you to VMware and EqualLogic product documentation as the most current sources of implementation details, procedures, and best practices. To facilitate working with these documents, the following table lists the documents that are referenced within this technical report.

Vendor	Document Title
EqualLogic, Inc.	Booting Windows Server 2003 from an iSCSI SAN Technical Report
EqualLogic, Inc.	Deploying Microsoft Windows Server 2003 in an iSCSI SAN Technical Report
EqualLogic, Inc.	Network Connection and Performance Guidelines Technical Report
EqualLogic, Inc.	Deploying Microsoft Multipath I/O in an iSCSI SAN Technical Report
EqualLogic, Inc.	PS Series Group Administration Manual
EqualLogic, Inc.	PS Series Host Integration Tools for Microsoft Windows Manual
EqualLogic, Inc.	PS Series Quick Start Manual
QLogic	QLA4010/4010c Users Guide
VMware	Installation & Upgrade Guide for VMware Virtual Infrastructure
VMware	SAN Configuration Guide for ESX Server 3 and VirtualCenter 2
VMware	Virtual Infrastructure Server Configuration Guide
VMware	Virtual Machine Backup Guide
VMware	VMware Server Administration Guide
VMware	Backup Compatibility Guide

EqualLogic, Inc. documents are available at the EqualLogic support website:

https://www.equallogic.com/login.aspx

VMware documents are available at: http://www.vmware.com/support/pubs/vi_pubs.html

VMware for Virtualized Environments

Virtualization is a technology that makes sense for today's computing environment. It refers to separating physical computing resources from the processes that use those resources. Virtualization techniques can be applied to processing power, memory, disk storage, network access, and all other elements of a computer system, making it possible to virtualize complete systems.

VMware wraps an application and its operating system into a transportable virtual machine (VM). VMs run on a VMware Virtualization Layer. This layer serves as a go-between, handling VM requests for computer and network resources and presenting those resources to the VM in standard ways. For example, regardless of the underlying physical SCSI adapter, VMware presents it to the VM as a Buslogic or LSI logic adapter.

A primary goal of virtualization technology is to increase resource management and flexibility. VMware's virtualization approach makes it possible to run multiple instances of VMs on each server, sharing hardware resources and thereby getting higher utilization of existing hardware. With utilization rates often in single or low double-digit ranges for non-virtualized servers, the potential for hardware reduction and improved efficiency is enormous. VMware case studies often report post-virtualization utilization rates of 60% or better, with resulting reductions in required hardware of 7 to 1 or better.

Each VM runs its own operating system and applications, and is isolated from all other VMs. They cannot communicate with each other except through normal networking channels. This isolation prevents a problem in one virtual machine from bringing down the entire physical server.

About VMware Virtual Machines

Virtual machines are really just sets of files used by a physical server. These files contain the guest operating system, applications, and data for each VM. These files are stored on a drive accessible to the physical server the VM machine is currently running on.

If the drive containing the VM file structure is accessible to another physical server running VMware software, the VM can be moved or restarted on another physical server.

Virtualization with VMware can result in major improvements in the areas of:

- Server consolidation
- Testing optimization
- Responsiveness to new or changed requirements
- High Availability

Server Consolidation

VMware software makes it possible to efficiently run multiple virtual servers on one physical server. This capability reduces the need to buy additional hardware and when first installed, can often allow IT to retire existing hardware. Increased resource utilization and easier system management are the result.

Further, consolidating virtual servers that provide critical applications and services onto a smaller number of scalable enterprise-class servers (in place of a larger number of basic boxes) can deliver increased reliability and easier future growth, along with reduced TCO.

The ability to rapidly provision standard virtual machines can speed testing and increase its repeatability. Developers and test personnel can maintain VMs for every environment of interest, switching between them in moments and reverting to standard baselines whenever necessary.

Responsiveness to New or Changed Requirements

Provisioning new virtual servers is far faster and easier than provisioning physical servers, allowing IT to respond to requests for new servers and services in a fraction of the time required in a non-virtualized environment. Standardized virtual servers can be created once, then deployed again and again in minutes.

High Availability

Virtual servers support features like NIC teaming and virtual machine clustering to provide high-availability virtual environments. ESX Server provides additional high availability features, including native SAN connectivity and path failover.

Hosted vs Bare-Metal Implementations

VMware virtualization products can either run on top of an existing operating system (a hosted implementation) or run directly on the server hardware (a bare-metal implementation). Each approach has benefits and drawbacks which are described in the following paragraphs.

A hosted implementation sits on top of a standard operating system (the host operating system) and provides services that are inherited from the operating system it runs on. This approach provides support for the broadest range of hardware, since the underlying operating system provides compatibility. VMware Server (which replaces VMware GSX Server) is a hosted implementation.

In a bare-metal implementation, VMware software replaces the host operating system of the server and runs directly on the hardware. This provides for the most efficient use of the server hardware, maximizing the scalability, robustness, and performance of the overall system. VMware ESX Server is a bare-metal implementation.

VMware Server

VMware Server is workgroup-level virtualization software that runs as an application on top of the Windows or Linux host operating system already in place on the physical host server. It partitions the physical host server into multiple virtual machines as shown in the following figure. Relying on the capabilities of the host OS for access to resources, VMware Server supports 2-4 guest virtual machines for each processor core in the physical server. Figure 1 shows the VMware Server architecture.
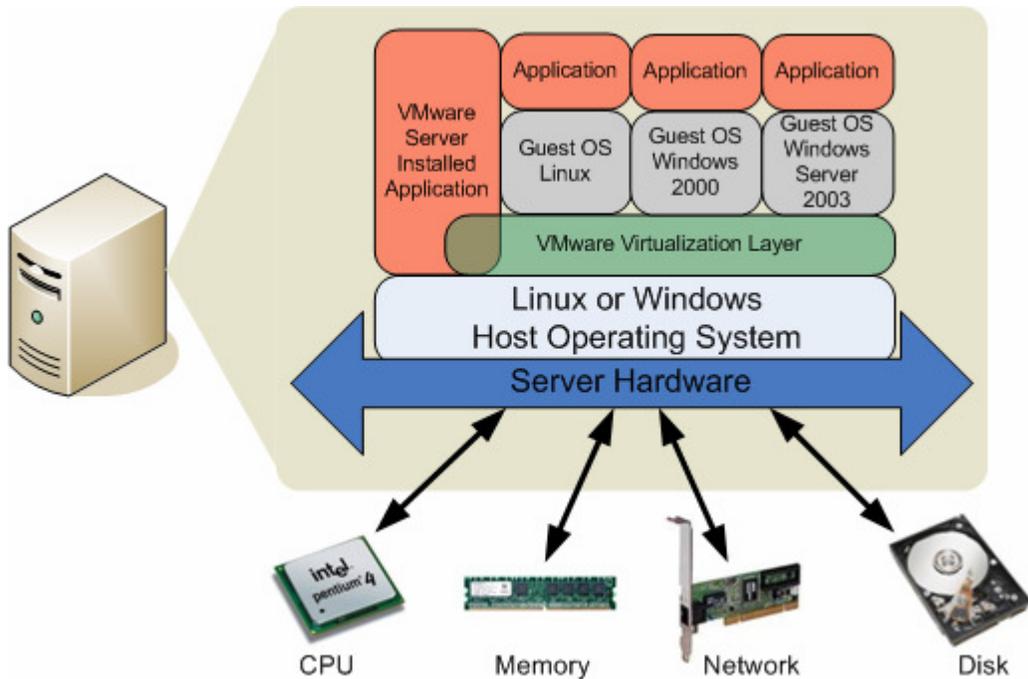
Figure 1: VMware Server architecture.

VMware Server can run on a Windows or Linux host. Virtual machines can be stored on PS Series array volumes local to the server host or located on the SAN and accessed through the Microsoft software initiator.

For the most current VMware Server requirements, refer to the *VMware Server Administration Guide*.

VMware ESX Server

VMware ESX Server is enterprise infrastructure virtualization software for mission-critical environments. While VMware Server sits on top of the server's already-installed OS, VMware ESX Server replaces the host OS on the server, applying the server's full resources to the virtual machines (less a few percent to run the virtualization software). This maximizes the performance of the virtual machines running on the server, and allows VMware ESX Server to support 4-8 virtual machines for each processor core in the physical server. Figure 2 shows the VMware ESX Server architecture.

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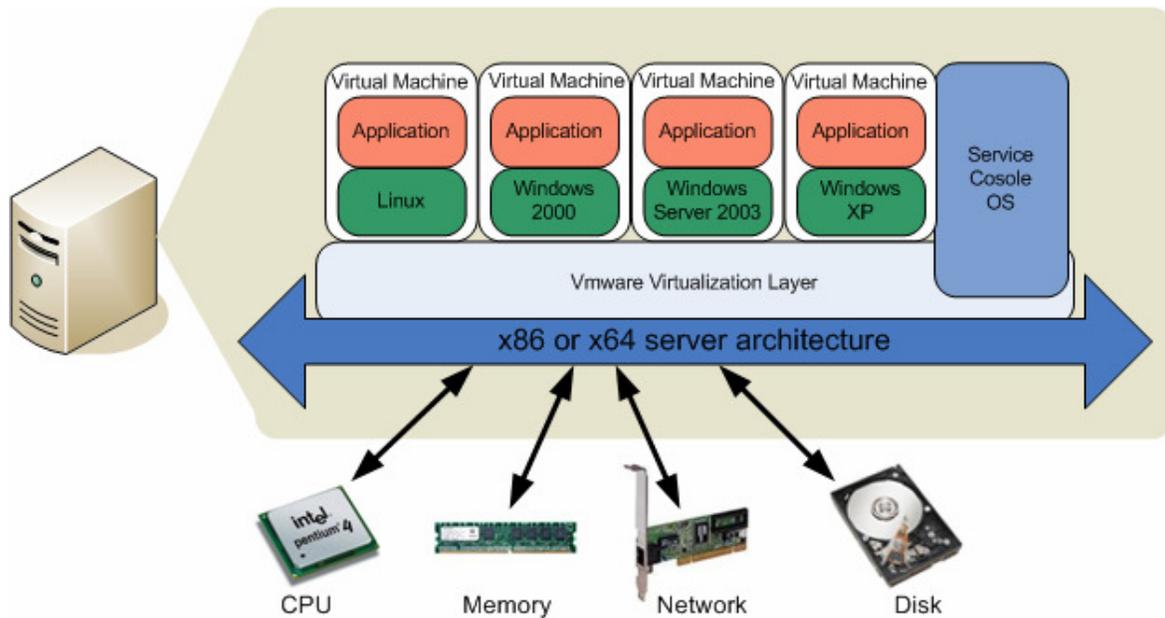
Figure 2: VMware ESX Server Architecture

VMware ESX Server is highly scalable and provides additional benefits in management, security, high availability, and performance beyond those in VMware Server.

VMware ESX Server runs on a wide variety of x86-based servers. For the most current VMware ESX Server requirements, refer to the *Installation & Upgrade Guide* for ESX Server and VirtualCenter 2.0.1 and additional resources found at:

http://www.vmware.com/vmtn/resources/esx_resources.html.

VMware ESX Server works with these additional VMware products and features to provide a virtual infrastructure:

- VirtualCenter
- VMotion
- DRS
- HA

VMware VirtualCenter

VMware VirtualCenter provides a single control center for VMware ESX Servers. VMware VirtualCenter allows you to:

- Manage hundreds of servers
- Use standard templates to provision new servers in minutes
- Apply access control to the virtual environment
- Perform zero downtime hardware maintenance with VMware VMotion

VMware VMotion is an optional feature enabled by VMware VirtualCenter. This technology allows for dynamic load balancing by automatically moving running virtual machines from heavily-loaded physical servers to lightly-loaded ones. This capability also makes it possible to perform zero-downtime maintenance by moving virtual machines across physical servers and storage as necessary to free hardware for maintenance. Figure 3 shows the VMotion architecture.
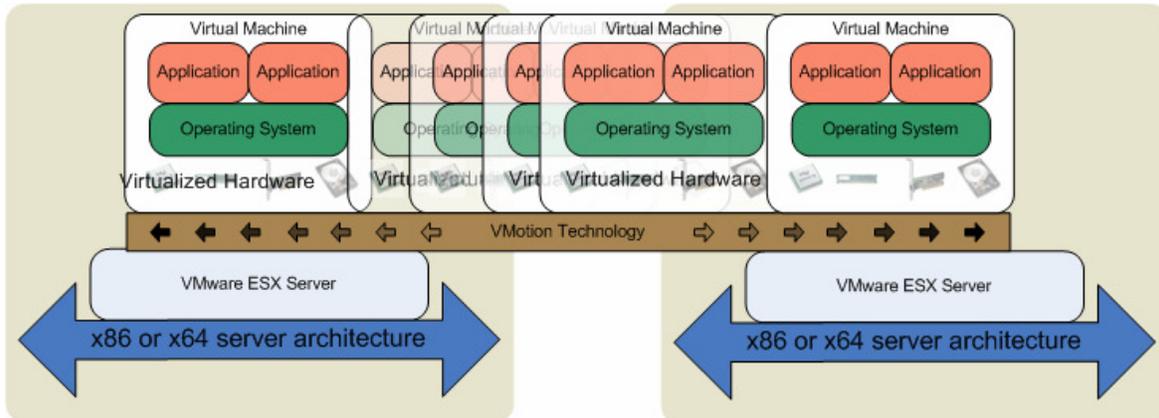
Figure 3: VMotion moving a virtual machine to a different server

VMware DRS

VMware DRS (Distributed Resource Service) tracks resource use across hosts and resource pools, and depending on how you have configured your virtual infrastructure, either recommends the migration of virtual machines to different hosts or uses VMotion to migrate the virtual machines automatically. DRS offers recommendations or automatically migrates virtual machines when you first power up a virtual machine, as well as when trying to balance loads across the virtual infrastructure.

VMware HA

VMware HA (High Availability) allows you to organize virtual machines into failover groups. When a server fails, all of its virtual machines that were in failover groups are automatically restarted on different host servers. This provides crash-consistent failover and requires that SAN storage be used.

Which should you choose?

While VMware Server and VMware ESX Server are both capable virtualization products, they are designed for different uses. The following table lists some of the key differences between the two products.

NOTE: For a more in-depth VMware Server product comparison, see:
http://www.vmware.com/products/server_comp.html

	VMware Server	VMware ESX Server
Target Environment	Individual developers, departmental or workgroup servers, branch offices	Enterprise data centers
Uses	Efficient software development and testing; rehosting of legacy operating systems; simplified server provisioning	Production server consolidation; enterprise software development and testing; business continuity preservation
System RAM	Limited by host OS with a maximum of 64 GB	Up to 64 GB
Virtual machine templates	No	Yes
SAN Support	Depends on host OS	Yes
VMotion	No	Yes
iSCSI Support	Depends on host OS	Hardware and software iSCSI support built in

The focus for the remainder of this technical report will be on VMware ESX Server.

EqualLogic iSCSI Arrays for Virtualized Storage

EqualLogic, a VMware Technology Alliance Partner, produces intelligent, enterprise-class, virtualized iSCSI (Internet SCSI) SANs that are compatible with all VMware products. EqualLogic PS Series iSCSI SANs bring the same kind of virtualization and dynamic operation to storage that VMware brings to servers. The EqualLogic PS Series iSCSI storage arrays are easy to deploy, operate, and manage. Deployable in 20 minutes, PS Series arrays provide intelligent automation of storage management.

The arrays present a single virtualized pool of storage resources to attached servers.

Additional arrays are seamlessly and automatically integrated into the storage pool without disruption of application or data availability.

VMware + EqualLogic = An adaptable virtual environment

EqualLogic PS Series storage arrays are a perfect complement to VMware server virtualization products. Both products virtualize their part of the environment with the intention of reducing TCO through:

- Optimized asset utilization
- Reduced deployment time
- Reduced management complexity
- High availability
- High scalability
- Increased flexibility

Optimized Asset Utilization

Many servers in corporate environments are used less than 10% of the time. VMware allows you to virtualize those servers, resulting in equal or better performance while using far fewer physical servers. A full VMware virtual environment (multiple ESX Server hosts plus a Virtual Center server) installation does even more, automatically moving VMs between multiple physical servers to optimize the use of resources.

EqualLogic PS Series storage arrays perfectly complement this process by dynamically balancing loads between multiple storage arrays as the usage changes.

Reduced Deployment Time and Effort

Installing physical servers is a time and resource-intensive process, often taking hours or days (or weeks if the hardware must first be purchased). Deploying virtual servers, on the other hand, takes only minutes.

EqualLogic PS Series arrays similarly reduce the time and effort required to deploy a SAN, with provisioning possible within twenty minutes of opening the box containing the array.

Reduced Management Complexity

VMware ESX Server with VirtualCenter simplifies server management by reducing the number of physical servers required and providing a single-pane management view of the entire virtual datacenter. With the optional VMware Distributed Resource Services (DRS) module, VMware intelligently balances VM workloads across the entire virtual datacenter without need for human intervention.

EqualLogic PS Series arrays simplify storage management by consolidating physical storage and providing a single-pane management view of the entire virtualized storage pool in the SAN. The SAN intelligently balances workloads across the available arrays without need for human intervention, automatically adapting to changes in workload caused by DRS.

High Availability

When virtual machines are stored on a SAN, VMware's High Availability (HA) module dynamically detects failed VMs and restarts them on another physical host server that can meet the VM's resource commitments.

EqualLogic storage arrays offer best in class reliability, with hot-swappable and fully redundant components, RAID 5/10/50 support and hot spares, along with support for clustering and MPIO.

High Scalability

Scaling the server side of a non-virtualized environment requires significant planning and infrastructure work. In a virtualized environment, scaling is much simpler. You can add new hardware to an existing group, and let VMware manage the migration of VMs to make the best use of the new computing resources.

EqualLogic PS Series storage arrays scale in much the same way as a VMware computing environment: make an additional array available and the SAN dynamically balances loads to optimize storage resources.

Increased Flexibility

The net result of all these features and capabilities is not only a reduced TCO, but increased flexibility. The ease and speed with which you can add new virtual servers or expand physical storage, combined with single-pane management and the security of a high-availability infrastructure, allows IT to respond quickly and flexibly to enterprise demands and initiatives.

Design Considerations

When designing a VMware environment that uses EqualLogic, Inc. PS Series storage arrays, you should consider a number of factors:

- Using independent ESX Servers or a Virtual Infrastructure using VirtualCenter

- Applying security

- Whether to boot the ESX Server from the SAN

- Which RAID level to implement on the SAN

- Backup Strategies

Independent ESX Servers or a Virtual Infrastructure with VirtualCenter

VMware VirtualCenter makes it possible to manage multiple ESX Servers through a single interface. It also enables VMotion in the environment, which in turn makes possible VMware HA and DRS. If you expect to grow your environment over time, using VirtualCenter and PS Series storage in a virtual infrastructure configuration makes such growth as simple as possible.

VirtualCenter is a Windows service that should be run on an independent server.

Implementing Security

Because the PS Series storage uses TCP/IP as a transport protocol for its iSCSI commands, you should strongly consider improving security by employing CHAP, the Challenge Handshake Authentication Protocol, in all iSCSI initiators.

ESX Server supports one-way CHAP authentication at the HBA level. The target (the PS Series storage) authenticates the initiator HBA (the ESX Server), but the initiator does not authenticate the target. The initiator has a single set of credentials that are used with all targets.

See the *Virtual Infrastructure Server Configuration Guide* for more on securing iSCSI connections.

Boot ESX Server from SAN or from Local Storage

Booting ESX Server from SAN provides a number of benefits. However, doing so requires the installation of hardware iSCSI HBAs in each physical server that will boot from the SAN.

SAN boot provides the following benefits:

- **Simplified recovery from server failures.** If a machine running ESX Server fails, you can avoid a lengthy restore process by booting the replacement physical server from the SAN using the failed server's original boot image. This will enable you to quickly and efficiently resume operation and access to data, with minimal interruption. In addition, you can use snapshots to capture point-in-time copies of the boot image, allowing for a quick, point-in-time recovery.

- **Server consolidation.** Booting from a SAN alleviates the need for each ESX Server to boot from its own direct-attached disk. By configuring each server to boot from a PS Series volume, you can deploy diskless servers that consume less facility space, require less power, and are less expensive to manage.

- **Centralized storage management and data protection.** All server data is protected by the hardware redundancy and RAID in the PS Series storage arrays.

- **Rapid disaster recovery.** By storing server boot images and production data in a PS Series SAN, you can replicate data to a secure offsite facility for an efficient and reliable disaster recovery solution. EqualLogic replication allows you to copy data from one group to another, which is typically at a remote location. If a disaster destroys data at the primary site, you can recover data at the recovery site. Servers can then be pointed to the new location of the data and can resume operation, thus minimizing downtime.

Storage Array RAID Levels

You should consider the workload in your virtual environment to determine which RAID level to use for the PS Series storage. In general, RAID 10 provides the best performance, at the expense of storage capacity. RAID 50 generally provides more usable storage, but performs less well in random I/O situations and its performance is degraded during failure scenarios. RAID 5 provides the most storage capacity at the expense of lower performance and availability. For more information on RAID levels in PS Series storage, consult the *Deploying Microsoft Windows Server 2003 in an iSCSI SAN* technical report.

Backup Strategies

You need a plan for backing up both ESX Servers and virtual machines. Standard snapshots can be used to back up ESX Server and virtual machine data. Or VMware Consolidated Backup can be used in conjunction with traditional backup software to provide quiesced back ups of virtual machines stored on the SAN. The *Backups in a SAN Environment* section of the VMware *SAN Configuration Guide* provides a good introduction to the issues involved in backing up SAN data in a VMware environment.

Preparing for a PS Series Deployment with VMware

This section contains information detailing specific requirements for PS Series Group integration within a VMware ESX Server or VMware virtual infrastructure environment.

PS Series Group Requirements

PS Series group requirements are as follows:

- PS Series Firmware. Each PS Series storage array must have at least one (and can have up to three) active network connections. Consult the EqualLogic *Network Connection and Performance Guidelines* technical report for information about the best way to connect arrays to the network and how to improve network performance.

- One or more volumes to provide for the VMware host datastore(s). The PS Series storage array volumes will support the VMware VMFS file system or can be configured as raw devices. A VMware environment can use three types of storage, all of which are supported by PS Series Arrays: VMFS (the VMware native format), Raw Device Mapping (RDM), or virtual SCSI access to iSCSI devices.

  RDM allows a special file in a VMFS volume to act as a proxy for a raw device. The mapping file gives some of the advantages of a virtual disk in the VMFS file system while keeping some advantages of direct access to physical devices. Raw device mapping may be required if you use Microsoft Cluster Service. It also enables scalable backup, offloading systems using the features inherent to a SAN.

  Virtual SCSI access is the mechanism by which ESX Server gives virtual machines access to data stored on iSCSI devices. ESX Server maps virtual SCSI storage over the iSCSI devices, which gives the virtual machine access to the data stored on the devices without giving the virtual machine direct access to the iSCSI HBAs.

For each volume to be used as a VMware datastore, one or more access control records that will permit volume access by the VMware host or virtual machines.

Procedures

The following section provides information on the activities involved in integrating PS Series array volumes within a VMware environment. Specific topics include:

- Deploying VMware Virtual Infrastructure with a PS Series SAN

- Managing iSCSI Connections

- Backing Up VMware ESX Server with Snapshots

- Backing Up Virtual Machines with VMware Consolidated Backup

- Replicating Data

- Expanding Volumes

Deploying VMware Virtual Infrastructure with a PS Series SAN

The basic steps for installing and configuring VMware Virtual Infrastructure (VMware ESX Server and the optional VMware VirtualCenter) to work with a PS Series SAN are listed here. Many steps contain references to other documents that provide more details on the activities involved in that step. Consult those documents if you need additional information or instructions on performing the tasks in a given step.

To deploy VMware Virtual Infrastructure, follow these steps:

1. **Set up the PS Series group.** You must install the PS Series hardware and connect the serial and network cables on the array that will be the first group member. See the PS Series *QuickStart* for detailed installation and setup information.

   Note: See the *Choose the Optimal RAID Level* section of the *Deploying Microsoft Windows Server 2003 in an iSCSI SAN* Technical Report for information about choosing the group RAID level that will give you the best performance under all conditions for your particular applications.

   If you want multipath access between ESX Servers and the PS Series group, connect and configure multiple network interfaces on each array that is a group member. Figure 4 shows a multipath I/O (MPIO) configuration providing dual physical paths between an ESX Server and PS Series array.
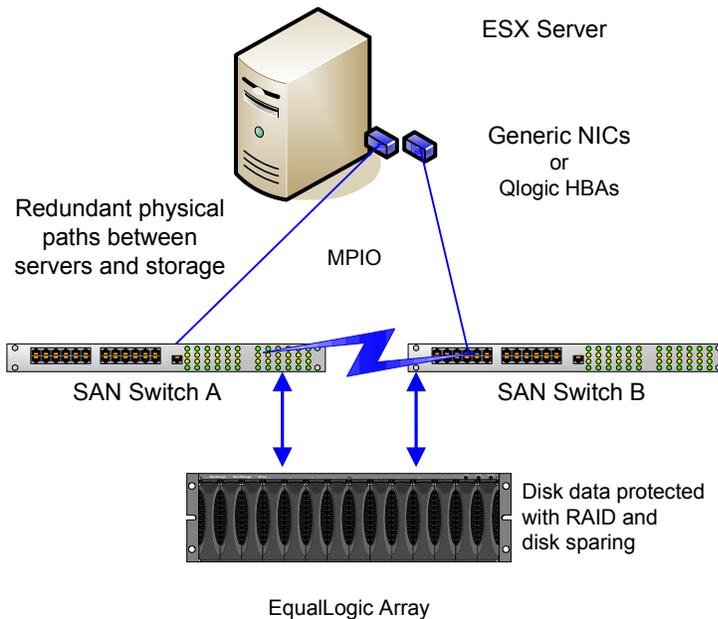
Figure 4: MPIO connections between an ESX Server and PS Series array

   Note: See *Configuring Multiple Network Interfaces on an Array* in the *Deploying Microsoft Multipath I/O in an iSCSI SAN* Technical Report on the EqualLogic Customer Support website for more information on configuring PS Series storage for multipath I/O

After you create the group, start the Group Manager (Figure 5), as described in the *Using the PS Series Group Manager* section of the *Deploying Microsoft Windows Server 2003 in an iSCSI SAN* Technical Report.
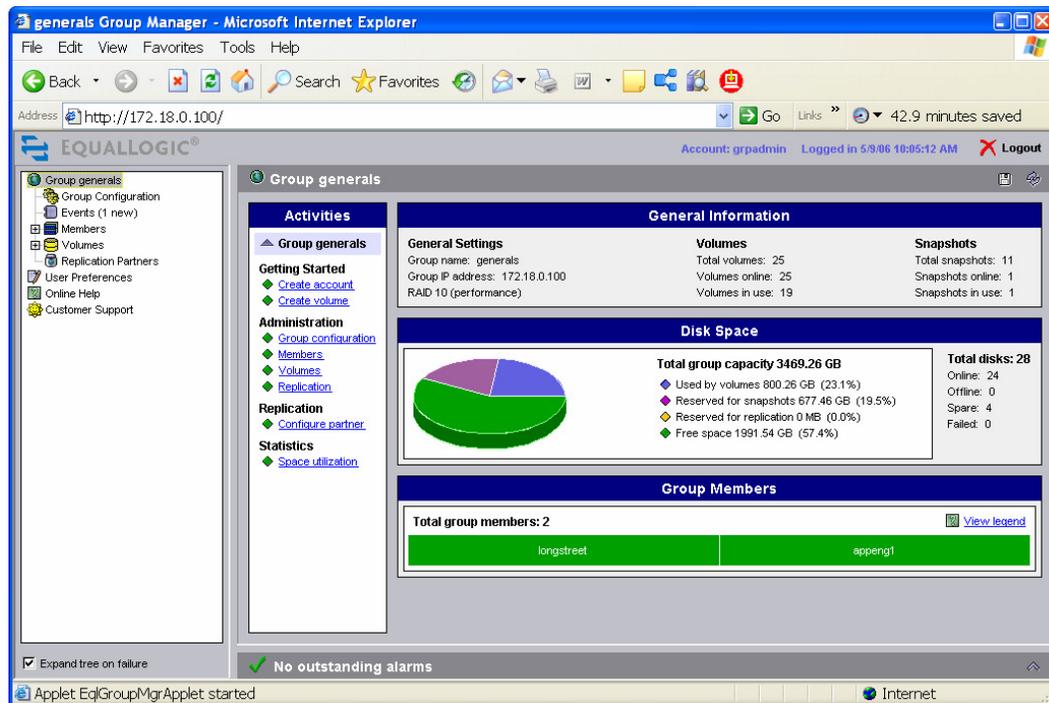
Figure 5: The Group Manager GUI

2. **Create volumes in the group.** Use the Group Manager GUI or CLI to create volumes. The volumes you create will depend on your applications and desired configuration. For example, you can create:

   − Data volumes. These volumes will hold the server file system data or application data.

   − Volumes for disk backup media. Required only if you want to backup data to a volume.

   − Volumes for SAN boot. Required only if you are using SAN boot.

   If you want to create snapshots of a volume, reserve snapshot space. In addition, for each volume, create one or more access control records that will permit access to authorized hosts, while denying access to other hosts.

   See the sections *Setting Up PS Series Volumes* and *Controlling Host Access to Volumes* of the *Deploying Microsoft Windows Server 2003 in an iSCSI SAN* Technical Report for more information. If you want to use CHAP to restrict host access to volumes, see the *Configuring CHAP in the Group* section.

3. **Set up the server hardware.** Install and configure the servers that will run VMware ESX Server and the optional VMware VirtualCenter (if this will be used). VirtualCenter is installed as a service on a Windows 2000 Server SP4, Windows XP Pro, or Windows Server 2003 (non-64-bit).

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If you want to boot VMware ESX Server from a PS Series SAN, a hardware HBA must be installed in the server. The current release of VMware ESX Server requires installation of a QLogic QLA4010 iSCSI HBA. The *QLA4010/4010c Users Guide* provides instructions on installing this card in the server. Ensure that the server is configured to boot from CD or DVD before any installed direct attached IDE or SCSI disk drives. Install the QLA4010 HBA for iSCSI boot according to the instructions in the QLogic users guide.

4. **Set up the VirtualCenter database.** If you are using multiple ESX Servers and managing them with VirtualCenter, you will need to install and configure a SQL Server or Oracle database to manage the VirtualCenter server information database. Follow the procedures in the *Preparing the VirtualCenter Server Database* section of the VMware Virtual Infrastructure *Installation and Upgrade Guide* to prepare the database.

   Note: For large installations, you can also install an optional VMware License Server.

5. **Install the VirtualCenter Server.** Install the VirtualCenter software on the designated server using the VirtualCenter CD. Consult the *Installing the VirtualCenter Server* section of the *Installation and Upgrade Guide for VMware Virtual Infrastructure* if you need more information.

6. **Install ESX Server.** Follow these steps to install ESX Server using the installation CD and configure the iSCSI hardware or software initiators to connect with the PS Series group:

   a. Verify the network cable is plugged into the Ethernet adapter that you are planning to use for the ESX Service Console. The ESX Server installer needs a live network connection to properly detect certain network settings, such as machine name under DHCP.

   b. Power on the machine with the VMware ESX Server CD in the CD-ROM drive. A screen appears asking you which installation mode (graphical or text) you wish to use. For this example, we used graphical mode installation.

   c. A series of installation messages scrolls past, including one that describes the loading of the QLA4010 driver, which indicates that the HBA was detected properly. The Test Media screen appears. If desired, you can select the test to have the installer inspect the installation CD media for errors.

   d. Click Next at the Welcome Screen.

   e. Select the keyboard language and click Next.

   f. Select the mouse type and click Next.

   g. Select the installation type, either Install or Upgrade. (This example assumes a fresh install to the ESX SAN boot volume).

   h. Read through the EULA (End User License Agreement) and accept the terms then click Next.

   i. Allow the installer to initialize your disk.

Note: An initialization warning appears (Figure 6) when the installer does not detect partitions on the iSCSI volume to be used as the primary hard disk. Click Yes to proceed with ESX Server installation.
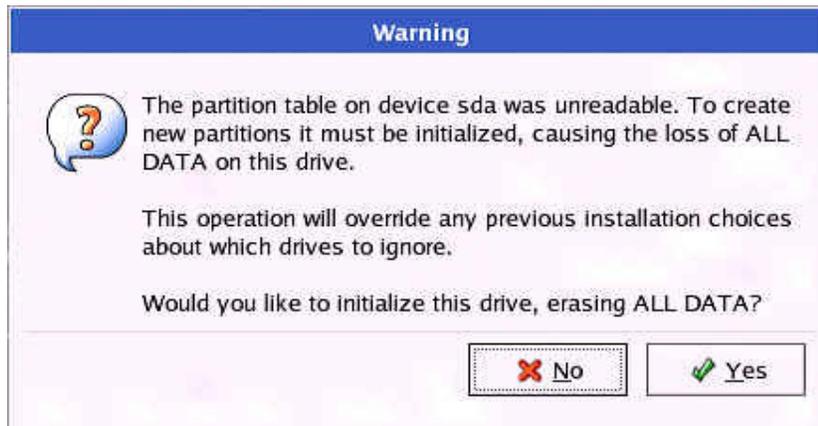
Figure 6: The iSCSI Boot Volume Discovered During ESX Server Installation

j.   The Partitioning Options dialog box appears with two options: Recommended or Advanced. Determine your partitioning options and click Next.

k.   Verify that the correct volume is selected within the Partitioning Options screen (Figure 7) for the ESX Server Installation. From this point forward, the installation continues in the standard manner. Follow the on-screen directions to complete the installation.
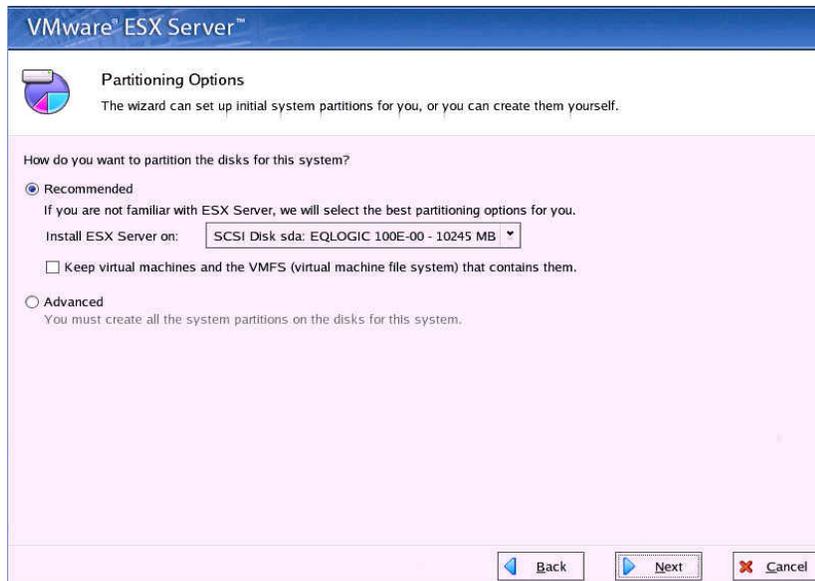
Figure 7: The Partitioning Options dialog box with an EqualLogic volume displayed

l.   After the ESX Server installation process is complete, access to and management of the QLogic QLA4050/4052 initiator is provided by the Virtual Infrastructure Client (Figure 8) by connecting directly to the ESX host, or by adding the new ESX host into an existing Datacenter through the VirtualCenter console.

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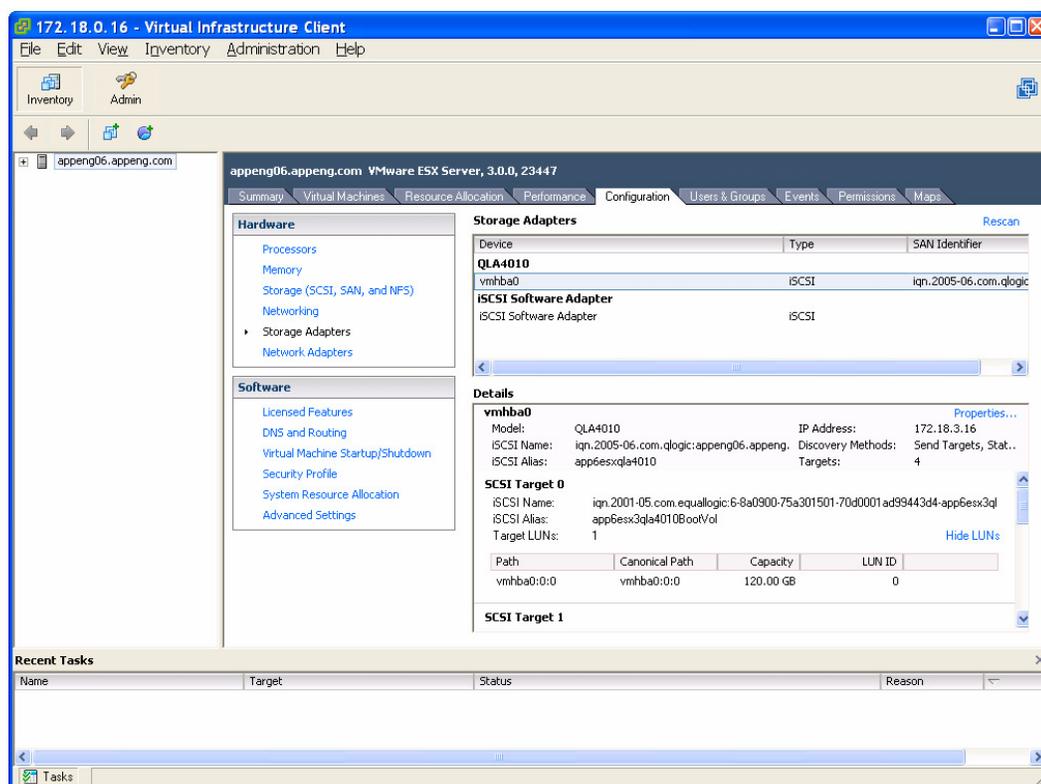
Figure 8: Work with the HBA through the Virtual Infrastructure Client

Note: For detailed information on installation and operation of the Virtual Infrastructure Client and VirtualCenter, refer to the following VMware documents: *Installation and Upgrade Guide for VMware VirtualCenter and ESX Server* and *Introduction to Virtual Infrastructure – Using VMware VirtualCenter and ESX Server*.

The *Installing VMware ESX Server Software* section of the *Installation and Upgrade Guide for VMware Virtual Infrastructure* provides more detailed information.

Note: If you want to use CHAP security, consult the *Configuring and Managing Storage* section of the VMware *Virtual Infrastructure Server Configuration Guide* for instructions.

Managing iSCSI Connections

You can view and modify hardware and software iSCSI connections for a given ESX Server using the Virtual Infrastructure Client. If using VMware VirtualCenter to manage an ESX Server, you should similarly manage that server's iSCSI connections through the VirtualCenter. To manage iSCSI connections:

1. Log onto the ESX Server or the VirtualCenter that is managing it.

2. Click the Configuration tab, then Storage Adapters in the Hardware section of the Configuration page.

3. Select the Storage Adapter you are interested in. Information about the adapter appears in the Details section of the page as shown in Figure 9.
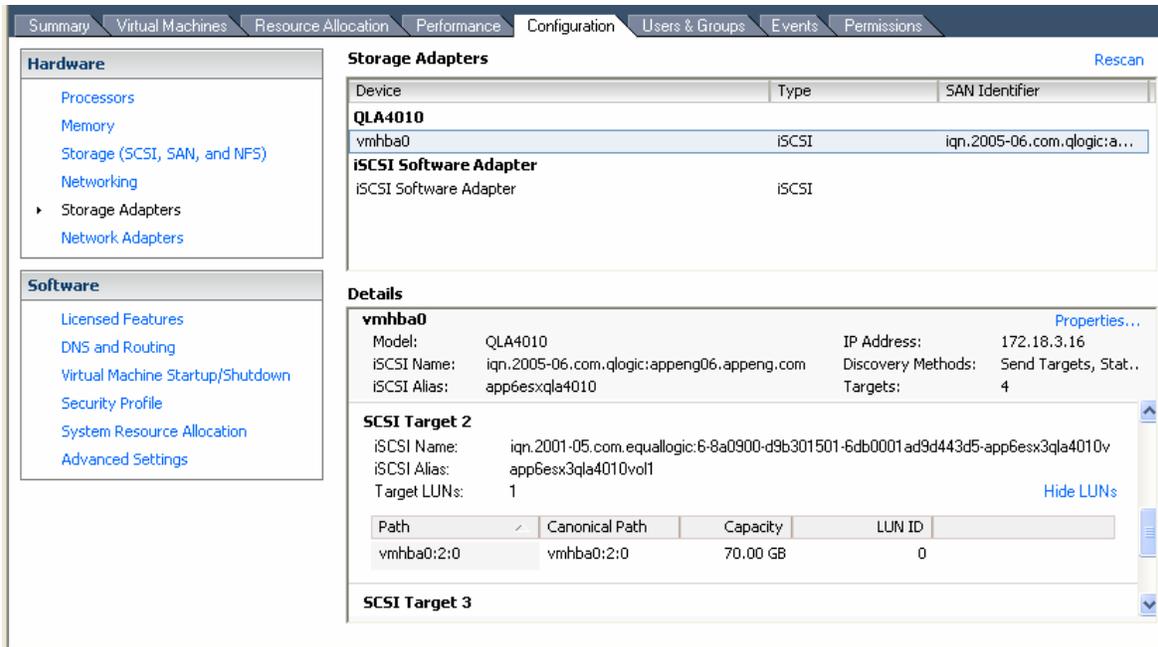
Figure 9: Select the adapter for the expanded volume

4. Click Properties to open the Initiator Properties dialog box (Figure 10) where you can manage the connection.
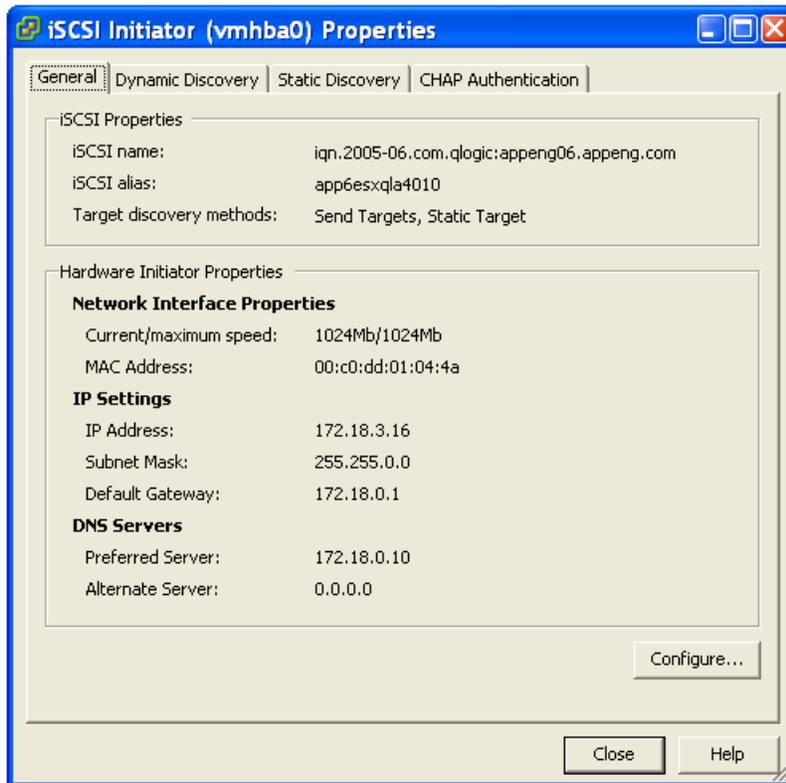
Figure 10: The iSCSI Initiator Properties Dialog Box

Backing Up VMware ESX Server with Snapshots

A PS Series group provides the ability to create snapshots, which are point-in-time copies of data. Snapshots enable you to quickly copy data at the disk (PS Series volume) level. This stable copy of data can then be used as the source for backup operations. Snapshot creation does not disrupt access to the volume. A snapshot is created nearly instantly and stored in the same group as the original volume, providing both high performance and low disk space utilization.

Backing Up Virtual Machines with Snapshots

ESX Server hosts allow you to create file system consistent snapshots of individual virtual machines using capabilities built-in to ESX Server. See the VMware *SAN Configuration Guide* for more information.

ESX Server also allows you to use supported third-party backup applications to create snapshots of virtual machines. See the VMware *Backup Compatibility Guide* to determine which backup applications are supported. The backup software you choose determines whether you can snapshot VMFS volumes in addition to RDM volumes.

Backing Up Virtual Machines with VMware Consolidated Backup

When backing up a VMware environment, it helps to think of two elements. The first element is VMware ESX Server. The second is the set of virtual machines. When backing up ESX Server, standard snapshot techniques are recommended, as described in the previous section. When backing up virtual machines in a SAN environment, using Consolidated Backup, a new feature in ESX Server 3.0, is the best practice as recommended by VMware.

Consolidated Backup uses third-party backup software, along with a physical Microsoft Windows 2003 server to handle the backup process. Consolidated Backup provides pre-backup and post-backup scripts that are run on a schedule determined by the third-party backup software and quiesces the virtual machines to allow the backup. This allows file-level backup of Windows guest virtual machines and full (image) backups of any virtual machines.

At a high level, the process works like this:

1. The third-party backup software schedules the backup job and runs it on the Windows 2003 Server proxy machine.

2. Consolidated Backup runs its pre-backup scripts on the proxy, preparing and mounting the virtual machine files to be backed up, then mounting them on the proxy server.

3. The third-party backup software backs up the files.

4. Consolidated Backup runs its post-backup script to unmount the snapshots from the proxy.

Detailed information on VMware Consolidated Backup and how to use it is contained in: *VMware Consolidated Backup* of the VMware *Virtual Machine Backup Guide*.

Replicating the volumes holding data from the VMware environment to a remote site using EqualLogic Auto-Replication Technology provides for a robust disaster recovery configuration. No special procedures are required to replicate the volumes used by VMware.

For more background information, see the *Use EqualLogic Auto-Replication Technology* section of the *Deploying Microsoft Windows Server 2003 in an iSCSI SAN* Technical Report, available on the EqualLogic Customer Support website. For detailed procedures on designing and implementing a replication system, see the EqualLogic PS Series *Group Administration* manual.

Expanding Volumes

As the storage requirements increase for the server applications and users, you can easily expand individual PS Series volumes and SAN capacity, online and without disruption.

Following the directions in the *Deploying Microsoft Windows Server 2003 in an iSCSI SAN* Technical Report, you can increase the size of a PS Series volume by using the Group Manager GUI or CLI. However, when you do this, you must perform an additional procedure to ensure that ESX Server can see and use the additional space in the volume.

Follow this procedure to make the expanded volume visible to ESX Server:

1. Once the volume has been expanded on the PS Series array, launch the VMware Virtual Infrastructure Client and select the ESX Server that uses the volume.

2. On the Configuration tabbed page, click Storage Adapters to open the Storage Adapters page shown in Figure 9.

3. Click Rescan to open the Rescan dialog box. Click OK to scan for the newly expanded volume.

4. Reselect the appropriate storage adapter, and in the Details section, confirm that the capacity for the drive has increased as expected.

5. While the adapter now sees the new space, the VMFS volume must still be expanded to use the new space. This requires adding an **extent**, which binds together the pre-existing and the new space into a single logical volume. In the Virtual Infrastructure Client, click Storage (SCSI, SAN, and NFS) to display the assigned volumes. Select the volume you have expanded.

6. Click Properties to open the Properties dialog box for the expanded volume (Figure 11). You should see an empty partition that corresponds to the space you added to the volume.
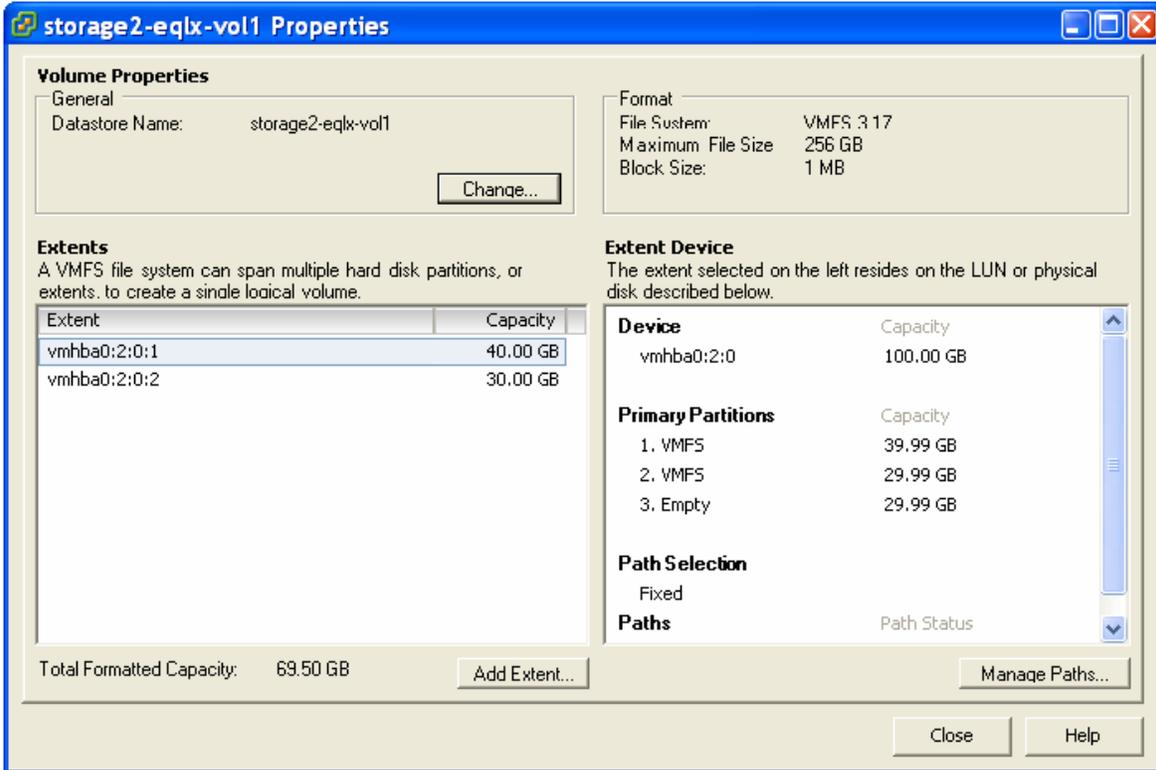
Figure 11: The Properties dialog box

7. Click Add Extent, which launches the Add Extent wizard shown in Figure 12.
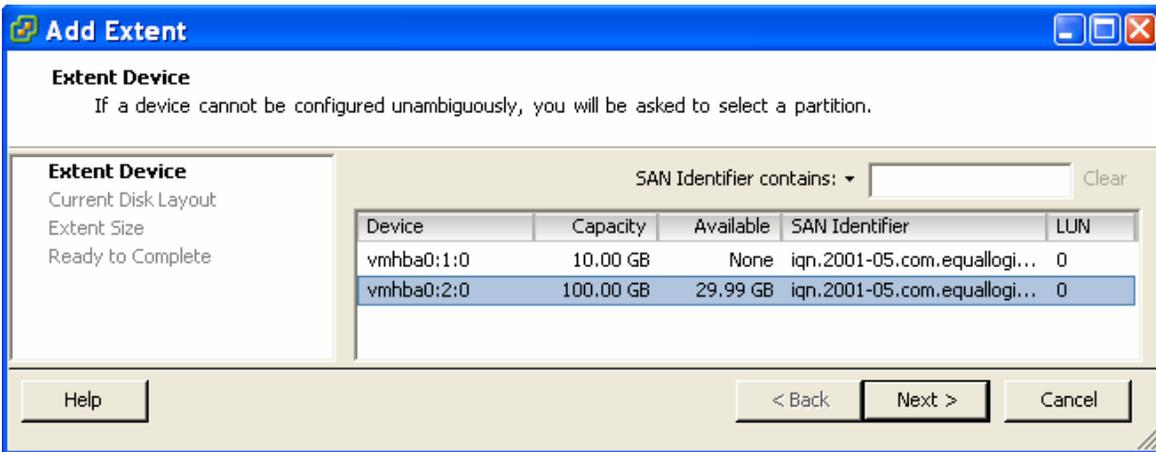
Figure 12: The Add Extent Wizard

8. Ensure that the device you want to add the extent to is selected, and then click Next.

9. On the Current Disk Layout screen (Figure 13), review the disk layout to ensure that you will be modifying the correct volume, and then click Next.
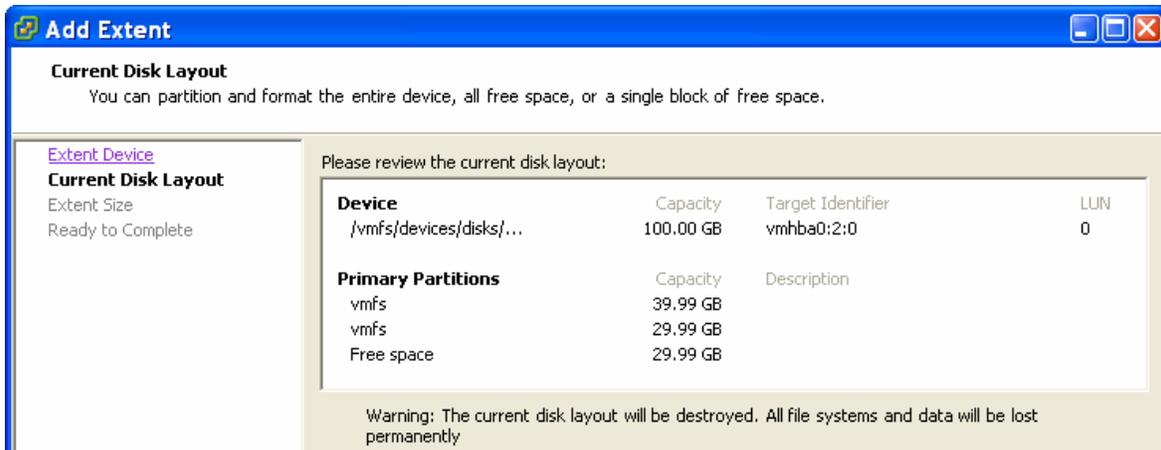
Figure 13: The Current Disk Layout window

10. On the Extent Size screen, specify whether you want to use all the available space or just a portion of it, and then click Next.

11. The Ready to Complete screen appears. Confirm that everything is as you want it, then click Finish. It may take several minutes for this process to finish and for the results to appear in the GUI.

More Information and Customer Support

Visit the EqualLogic Customer Support website, where you can download the latest documentation and firmware. You can also view FAQs, the Knowledge Base, and Technical Reports and submit a service request.

EqualLogic PS Series storage array documentation includes the following:

- **Release Notes**. Provides the latest information about PS Series storage arrays and groups.

- **QuickStart**. Describes how to set up the hardware and start using a PS Series storage array.

- **Group Administration**. Describes how to use the Group Manager GUI to manage a PS Series group. This manual provides comprehensive information about product concepts and procedures.

- **CLI Reference**. Describes how to use the Group Manager command line interface to manage a group and individual arrays.

- **Hardware Maintenance**. Provides information on maintaining the PS Series storage array hardware.

To access the Customer Support website, from the EqualLogic website (`www.equallogic.com`), click `Support` and log in to a support account. If you do not have an account, create one by clicking the link under the login prompt.

To contact customer support, send e-mail to `supportnp@equallogic.com`. If the issue is urgent, call 1-877-887-7337 to speak with a member of the customer support team.