WHITE PAPER

USING IOMEGA STORCENTER PRO ix4-200r NAS SERVER WITH VMWARE ESX SERVER 3.5

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EXECUTIVE SUMMARY

VMware® ESX Server is virtual infrastructure software for consolidating and managing systems. ESX Server accelerates service deployments and adds management flexibility by partitioning x86 servers into a pool of secure, portable and hardware-independent virtual machines. VMware Virtual Infrastructure and ESX Server have gained tremendous attraction and acceptance in the industry and are considered critical IT components for enterprises and small businesses alike.

Iomega® StorCenter™ Pro ix4-200r NAS Server is an integrated storage device that offers both NAS and iSCSI functionality to allow customers flexible deployment options. The product targets small- to medium-sized businesses with a rich set of features and simplicity of management. The StorCenter ix4-200r is powered by EMC® LifeLine™ software to allow businesses to protect and share data with EMC's world class storage and security technologies.

This white paper examines how StorCenter ix4-200r can be used to present storage to VMware ESX Server in a virtual environment. The paper also provides detailed procedures that illustrate how to create storage on a StorCenter ix4-200r in different forms and then utilize the storage on a VMware ESX Server.

INTRODUCTION

VMware Infrastructure 3 supports NAS storage devices using the NFS and iSCSI protocols. StorCenter NAS devices can present NFS-exported shares and iSCSI LUNs to VMware ESX Server to create Datastores for virtual machines and virtual disks. An Iomega StorCenter NAS offers greater reliability, ease of use, and ease of management characteristics that are designed specifically for the needs of small businesses.

VMware ESX Server can connect to iSCSI targets using either software or hardware iSCSI initiators. The LUNs presented by a target can then be formatted in the proprietary VMFS format. VMware ESX can also use iSCSI LUNs in the form of RDM to provide direct raw disk access to virtual machines. VMFS is the native storage option on VMware ESX Server, It's also how SAN storage and local disks are utilized to create datastores.

NFS is another compelling option for VMware ESX for many reasons. With NFS, VMWare ESX Server supports advanced features including VMotion, Distributed Resource Scheduler (DRS), high availability (VMHA), and VMware Consolidated Backup (VCB). NFS offers a highly simplified management model that reduces cost and management complexity. VMware encapsulates virtual machines into a small number of .vmdk files. NFS is an optimized file-serving protocol with operational granularity at the file level as opposed to the LUN level.

Iomega StorCenter NAS satisfies requirements for both storage options on VMware ESX Server and is certified in the VMware Hardware Compatibility List (HCL) with certifications in both NAS and Software iSCSI categories. A StorCenter NAS device is a proven storage platform for small businesses that want to deploy VMware ESX Server.

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AUDIENCE

Information contained in this white paper is intended for Iomega customers, partners, and service personnel involved in planning, architecting, or administering a VMware environment with an Iomega StorCenter NAS as the storage device. The readers are expected to have experience with ESX Server and an Iomega StorCenter NAS devices that run EMC Lifeline software.

TERMINOLOGY

▶ **Datastore**: A file system, either VMFS or NFS, that serves as a virtual representation of an underlying pool of physical storage resources. These physical storage resources can be comprised of SCSI disks from a local server, Fibre Channel SAN disk arrays, iSCSI SAN disk arrays, or NAS storage arrays.

▶ **Internet SCSI (iSCSI)**: A protocol for sending SCSI packets over TCP/IP networks.

▶ **iSCSI LUN**: iSCSI LUN (Logical Unit Number) is a virtual disk that processes SCSI commands, such as reading from and writing to storage media.

▶ **Network File System (NFS)**: A distributed file system providing transparent access to remote file systems. NFS allows all network systems to share a single copy of a directory.

▶ **Raw Device Mapping (RDM)**: RDM includes a combination of a pointer, which is a .vmdk file that resides on a VMFS volume, and a physical raw device that the .vmdk file points to. RDM can either be physical compatibility mode or virtual compatibility mode.

▶ **Virtual Machine**: A virtualized x86 PC on which a guest operating system and an associated application run. A VM is also a set of discrete files that primarily include a .vmx configuration file and one or more .vmdk virtual disk files.

▶ **Virtual Machine File System (VMFS)**: A VMware proprietary file system installed onto data stores and used by ESX Server to house virtual machines.

SOLUTION CONFIGURATION

This section lists hardware and software resources for provisioning StorCenter ix4-200r storage to VMware ESX Server 3.5, as illustrated in this white paper.

HARDWARE

Table 1 lists the hardware resources used in the testing environment for the paper

Hardware	Quantity	Configuration
Iomega® StorCenter™ Pro NAS ix4-200r NAS	one	•Four 500 GB or 1TB (7200 rpm) SATA disks •RAID 5 across the disks •One GbE network connection
Dell PowerEdge 1850	one	•Two Intel Xeon 3.00GHz CPUs •8 GB of memory •One 146 GB 15k internal SCSI disk •Four 10/100/1000 MB Ethernet NICs

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SOFTWARE

Table 2 lists the software resources used in the testing environment.

Software	Quantity	Configuration
EMC Lifeline 2.0	one	EMC firmware that runs the Iomega StorCenter Pro ix4-200r NAS
VMware ESX Server 3.5	one	Installed on a Dell PowerEdge 1850 machine
VMware Virtual Infrastructure 2.0	one	Installed on a Windows client

DEPLOYMENT ROADMAP

Following its installation and initial configuration, the ESX Server can be connected to shared storage that is presented from the StorCenter ix4-200r over the NFS and the iSCSI network protocols. Figure 1 highlights the steps that should be followed when connecting the StorCenter ix4-200r storage device to the ESX Server.
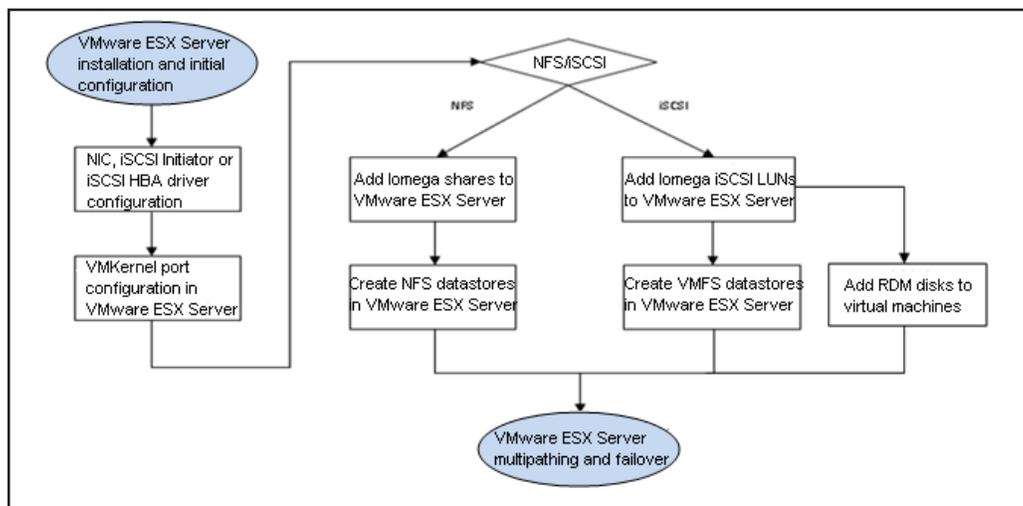
Figure 1 High-level roadmap for connecting the ESX Server to a StorCenter ix4-200r

This white paper provides further information on each of these steps as follows:

· NIC and iSCSI initiator configuration in the ESX Server – configuring the physical NIC, software iSCSI initiator or the iSCSI HBA that will be used to connect the ESX Server to a StorCenter ix4-200r.

· VMkernel port configuration in the ESX Server – configuring the ESX Server for IP storage connections to a StorCenter ix4-200r for both the NFS and iSCSI network storage protocols.

· Adding Iomega shares to the ESX Server – for NFS, creating and exporting Iomega shares to the ESX Server.

· Creating NFS datastores in the ESX Server – for NFS, configuring NFS datastores in the ESX Server on the exported shares from a StorCenter ix4-200r.

· Adding iSCSI LUNs to the ESX Server – for iSCSI, creating and sharing Iomega iSCSI LUNs to the ESX Server.

· Creating VMFS datastores in the ESX Server – for iSCSI, configuring VMFS datastores over the iSCSI LUNs that were provisioned from a StorCenter ix4-200r.

· Adding RDM disks to virtual machines – for iSCSI, alternatively making the LUNs available as RDM disks to the virtual machines.

· Multipathing and failover in the ESX Server – best practices for designing highly available network architecture in the ESX Server.

NIC AND ISCSI INITIATOR CONFIGURATION

The NIC and iSCSI HBA drivers provided by VMware as part of the ESX Server distribution should be utilized when connecting the ESX Server to a StorCenter ix4-200r storage device.

For iSCSI, both the ESX Server software iSCSI initiator and the iSCSI HBA can be used to connect to StorCenter ix4-200r iSCSI targets. When using iSCSI HBA, two models by QLogic are currently supported. They are QLA4050c and QLE4060c; both are certified in the VMware I/O Compatibility Guide for ESX Server 3.5 (http://www.vmware.com/pdf/vi35_io_guide.pdf).

VMKERNEL PORT CONFIGURATION

A VMkernel port allows for the usage of both iSCSI and NFS storage. When the storage has been configured on a StorCenter ix4-200r, the ESX server host must have a VMkernel port defined with network access to the Iomega device.

1.   Click **Configuration** >**Networking** > **Add Networking**.
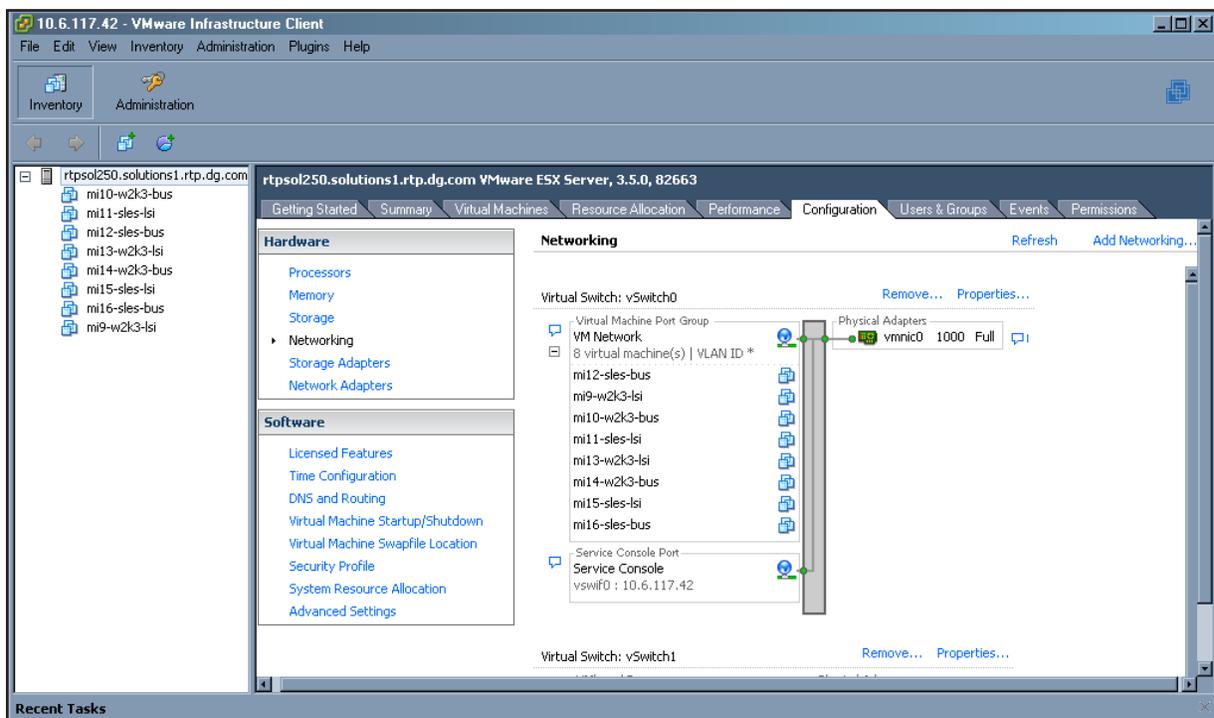
Figure 2 Add network

2. Select the VMkernel connection type as shown in Figure 3.
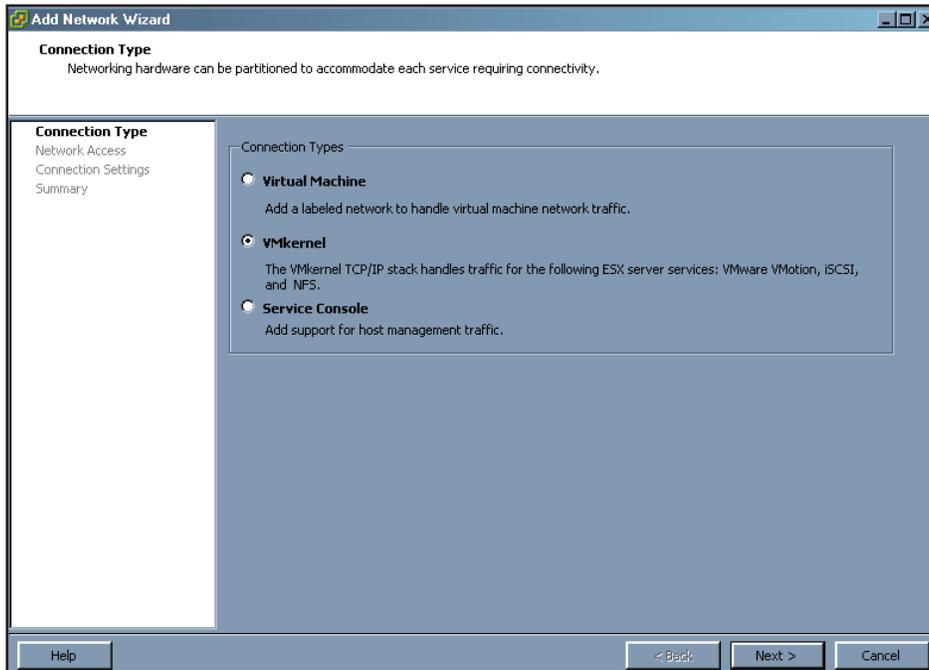
Figure 3 VMkernel selection

3. Select a virtual switch to handle the VMkernel port traffic
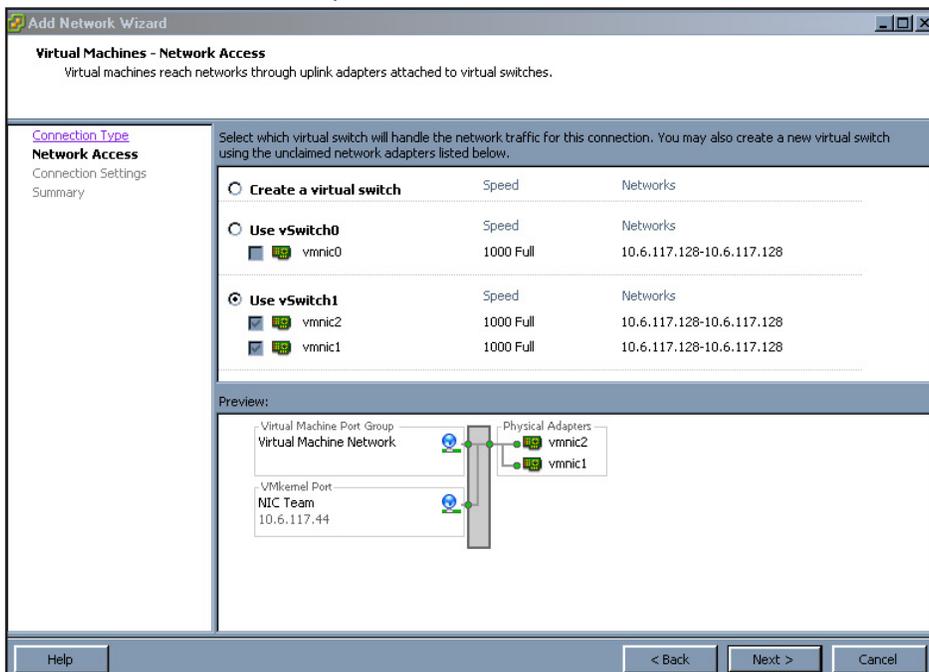

Figure 4 Select virtual switch

4. Name the new VMkernel port group and optionally the VLAN ID for the network.
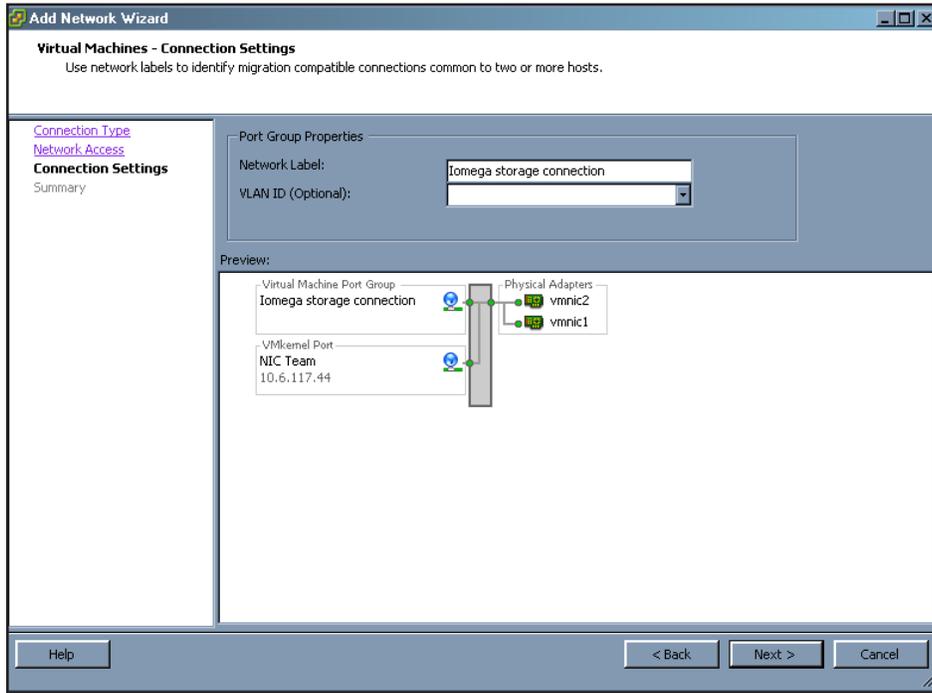
Figure 5 Name the VMkernel port group

5. Verify the settings and finish creating the VMkernel port.
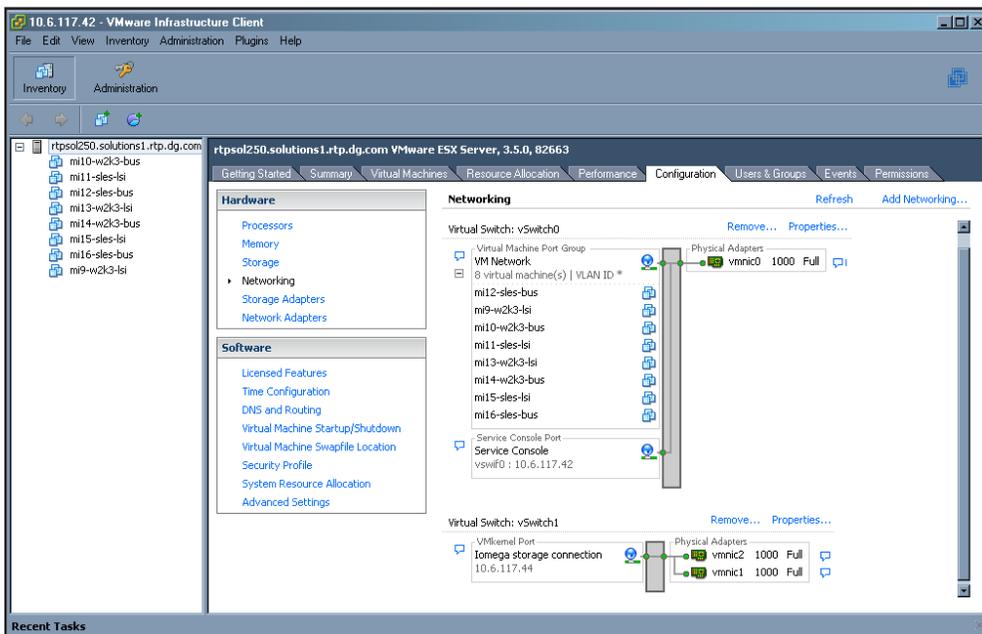
Figure 6 VMkernel port group created

ADDING A SHARE ON AN IOMEGA STORCENTER NAS DEVICE

When using NFS storage, you need to add a share on a StorCenter ix4-200r. Appropriate access permissions must be set for the VMkernel port on the ESX Server to mount an NFS share. These access permissions are:

· Host access – provide the VMkernel port mount access to the share.
· Read/write access – provide the VMkernel port read/write access to the share.
· Root access – provide the VMkernel port root access to the share.

NFS exports directories with root_squash turned on. This means that root on the client machine will be mapped to the anonymous UID, which is commonly nobody. The result is that root on the client machine will not be able to access anything in the exported entry. The no_root_squash option prevents this behavior. Therefore, if you want to secure the share to be used by ESX, you must enable root account access on your Lifeline. If you choose to leave the share non-secured, then nothing special needs to be done.

1.   From **Settings** > **Network Services** > check **Enable NFS Service** on StorCenter ix4-200r. Also, check "**Allow Root Account Access**" if you intend to secure the NFS share so that the ESX server can access it using the default root account.
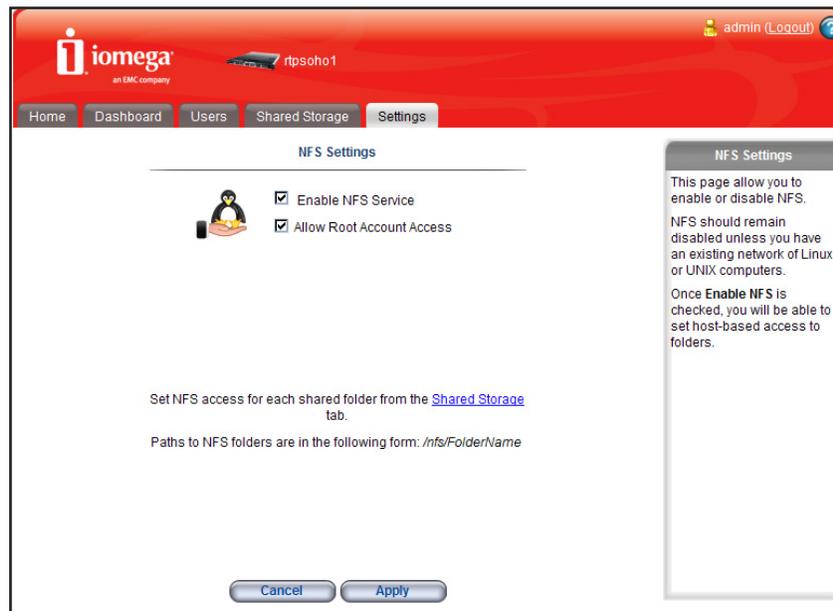
Figure 7 Enable NFS service on the StorCenter ix4-200r

2.   Go to **Shared Storage** and click **Add** to create a new share and optionally enable security on it.
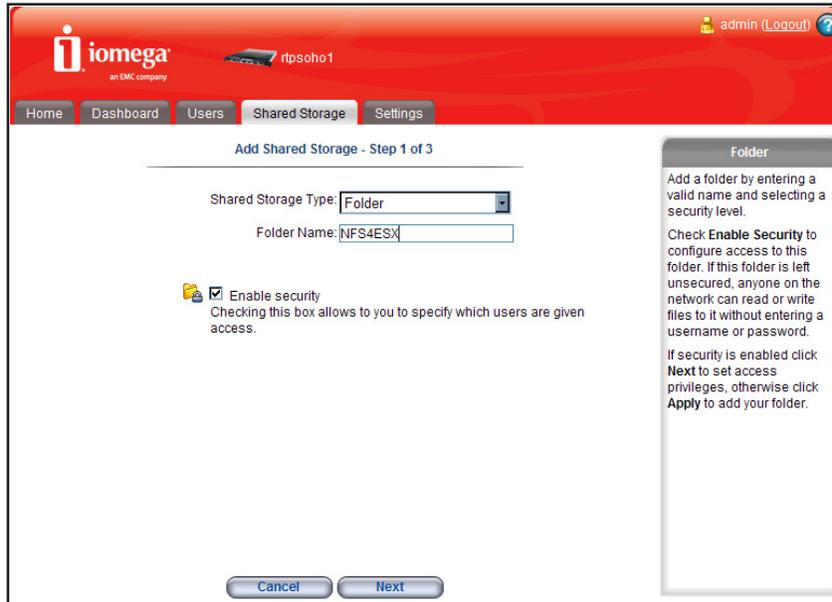

Figure 8 Create a new share

When creating the share, ensure Folder is the shared storage type and that Enable security is not checked.

3.   Click **Next** to specify user access to the secured share.
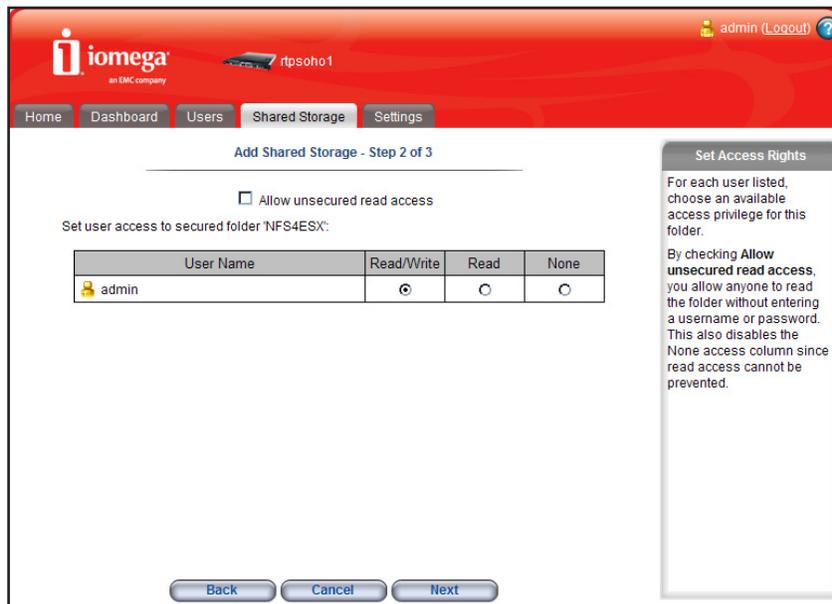
Figure 9 Specify user access

4.   Click **Next** to specify host access to the secured share. Make sure you enter the IP address of the VMKernel port created previously, not the service console port.
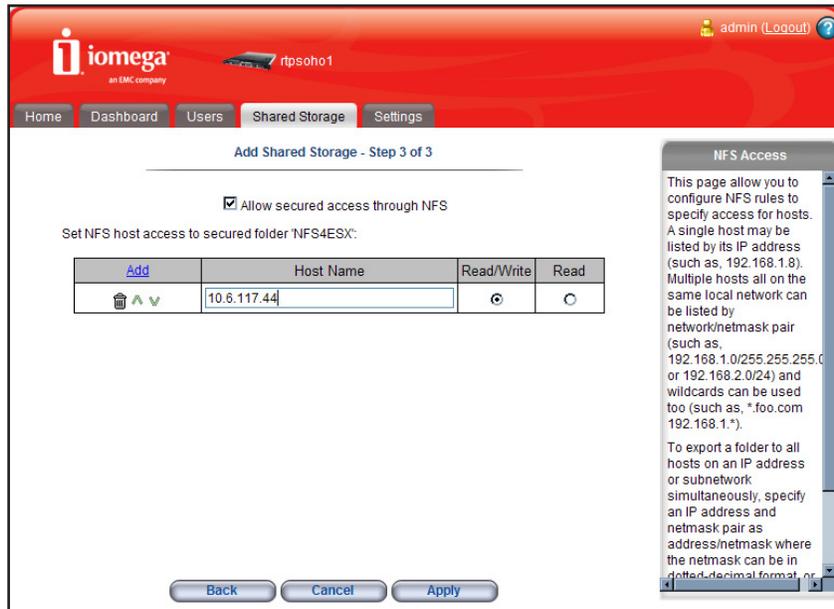
Figure 10 Specify host access

5.   Click **Apply** and a confirmation page should display.
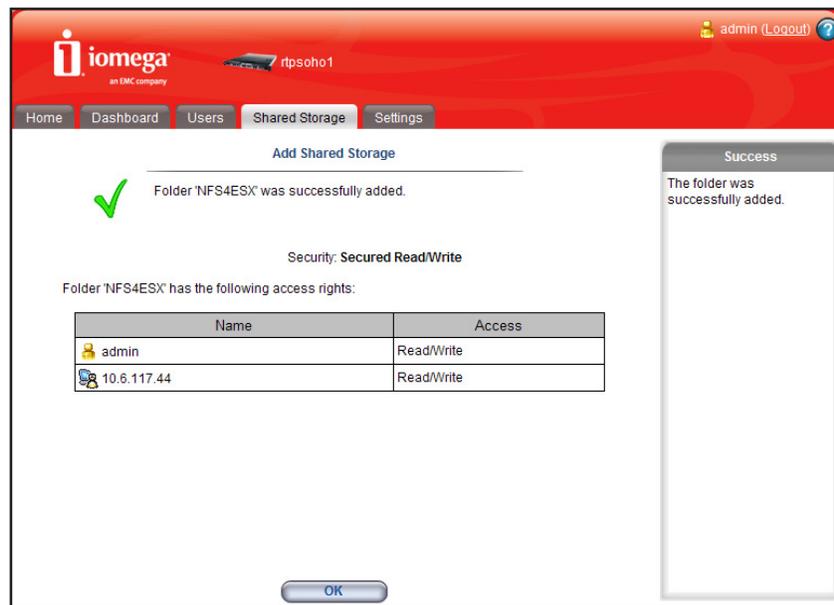
Figure 11 New share created

CREATING AN NFS DATASTORE ON ESX SERVER

VMware Infrastructure 3 management utilities are used to configure and mount NFS shares from the StorCenter ix4-200r. The VI client is also used to assign a datastore name to the export. The datastore name is the key reference that is used to manage the datastore within the ESX environment.

The NFS datastore is viewed as a pool of storage space to support virtual disks. One or more virtual disks are created within the datastore and assigned to virtual machines. Each virtual machine will use the primary virtual disk to install the guest operating system and boot information. The additional disks are used to support application and user data.

By default, the ESX Server allows a maximum of eight NFS datastores to be created. To create more NFS datastores, please change the NFS.MaxVolumes setting to a number no greater than 32. The following settings are recommended for NFS connections:

> *NFS.MaxVolumes = 32*
> *NFS.HeartbeatFrequency = 12*
> *NFS.HeartbeatTimeout = 5*
> *NFS.HeartbeatMaxFailures = 10*
> *Net.TcpipHeapSize = 30*

The three heartbeat options control heartbeat counts and timeouts. In the event of a brief network connection loss, reboot, or failure of the NFS server, the ESX Server will not simply fail the NFS datastores. The NFS client in ESX relies on heartbeats to verify the NFS shares are available. Therefore, increasing the NFS heartbeat frequency will ensure the NFS datastore I/O can resume much sooner, once the NFS server comes back.
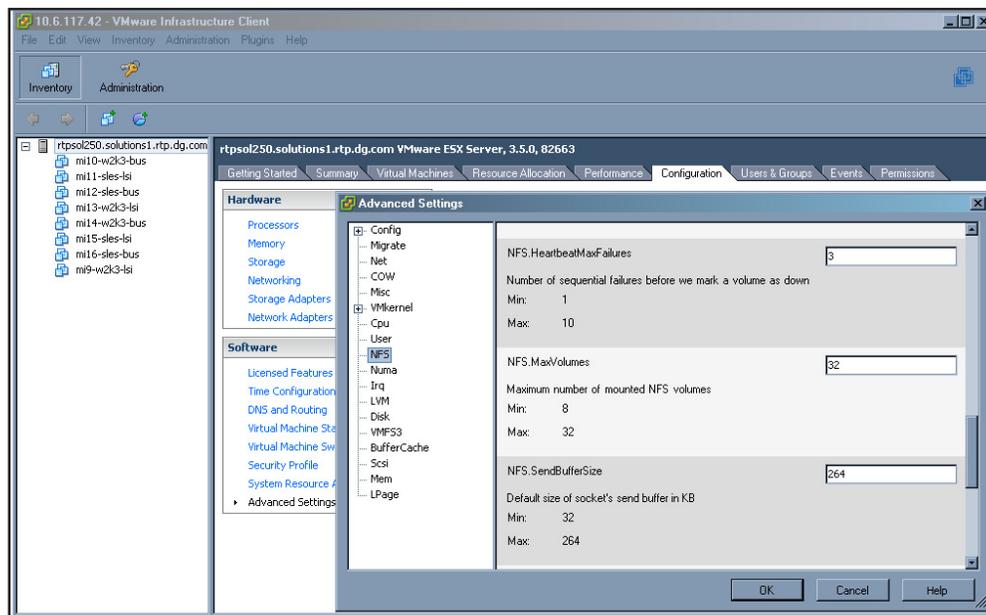

Figure 12 Modify NFS options on ESX Server

The TCP/IP heap is memory used for TCP/IP buffers for NFS, iSCSI, VMotion, etc. The default NFS.SendBufferSize is 264KB, and the default NFS.ReceiveBufferSize is 128KB. So with two sockets per volume, the total heap needed per volume is 784KB. If you want to create a total of 32 NFS datastores, then you need approximately 25MB in heap size. If you set the heap size to 30MB, you will ensure the best NFS datastore performance when the maximum number of datastores are created.
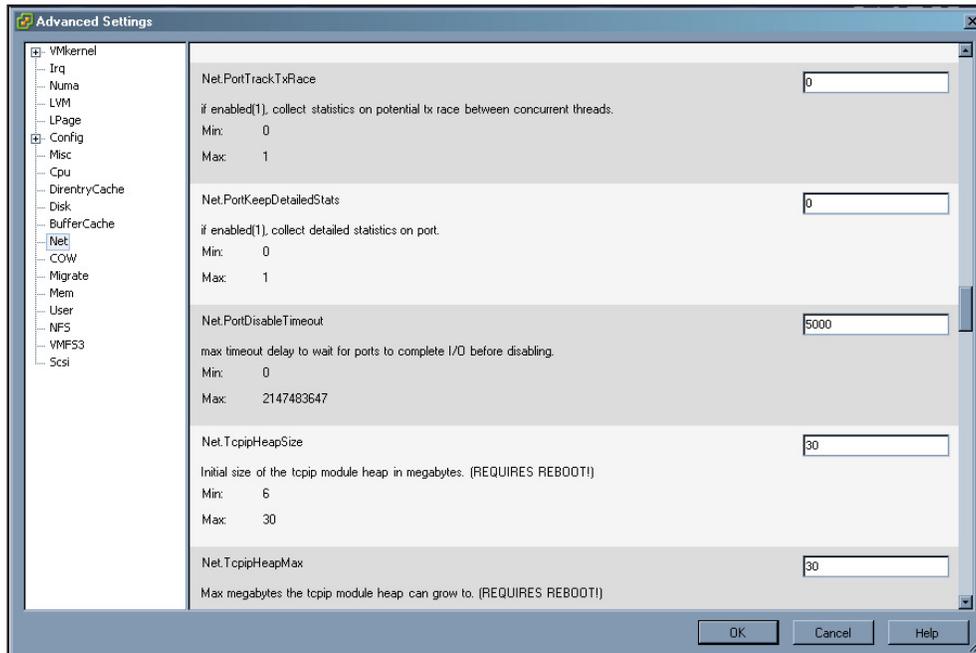

Figure 13 Modify TCP/IP heap size

1. Go to **Configuration** > **Storage** > **Add Storage**…
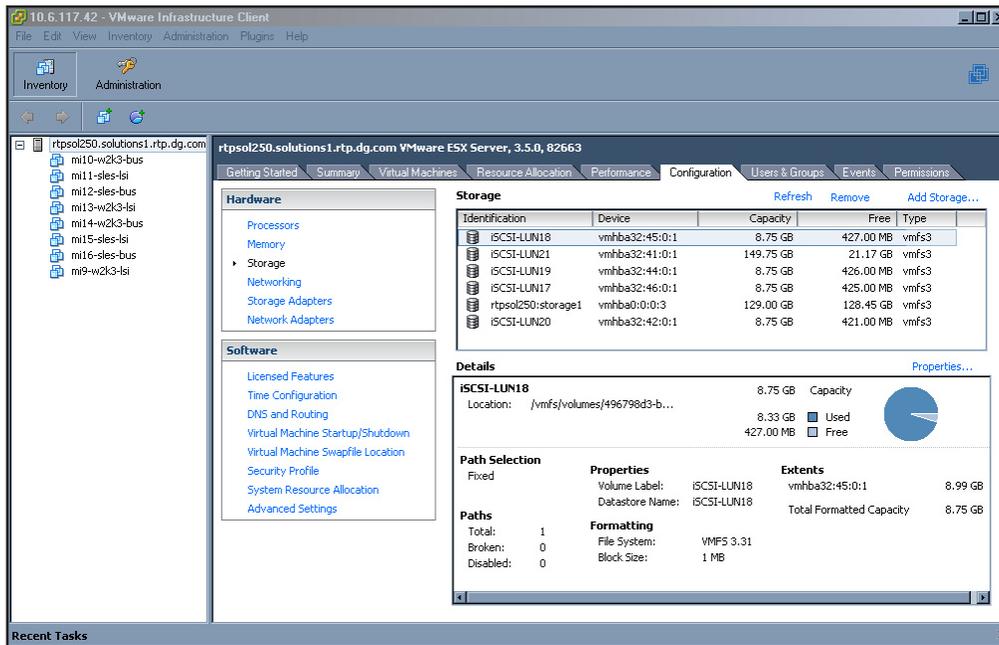
Figure 14 Add storage to ESX Server

2. Select the **Network File System** option.
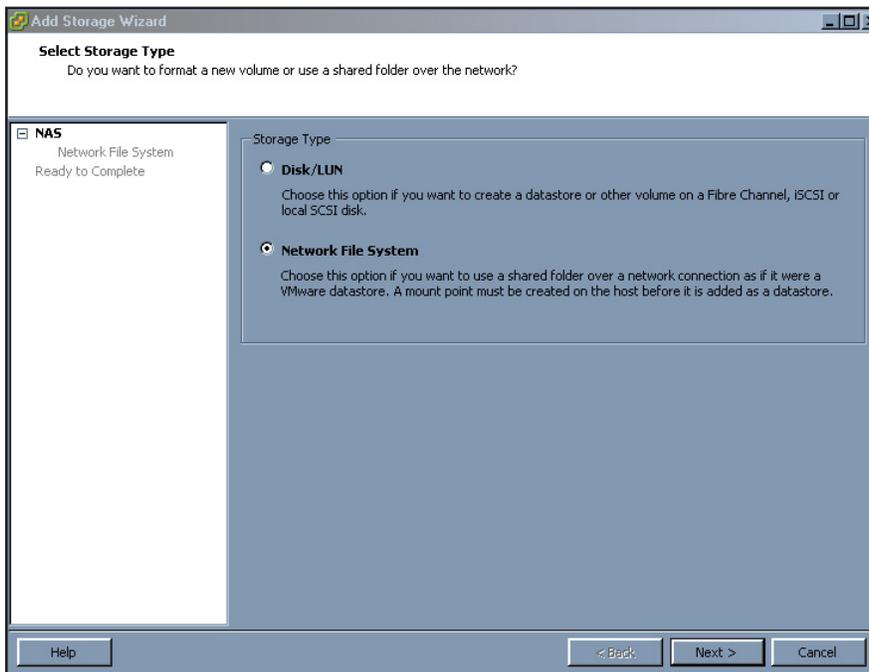
Figure 15 Select NFS type

3. Enter the NFS server and share information on StorCenter ix4-200r.
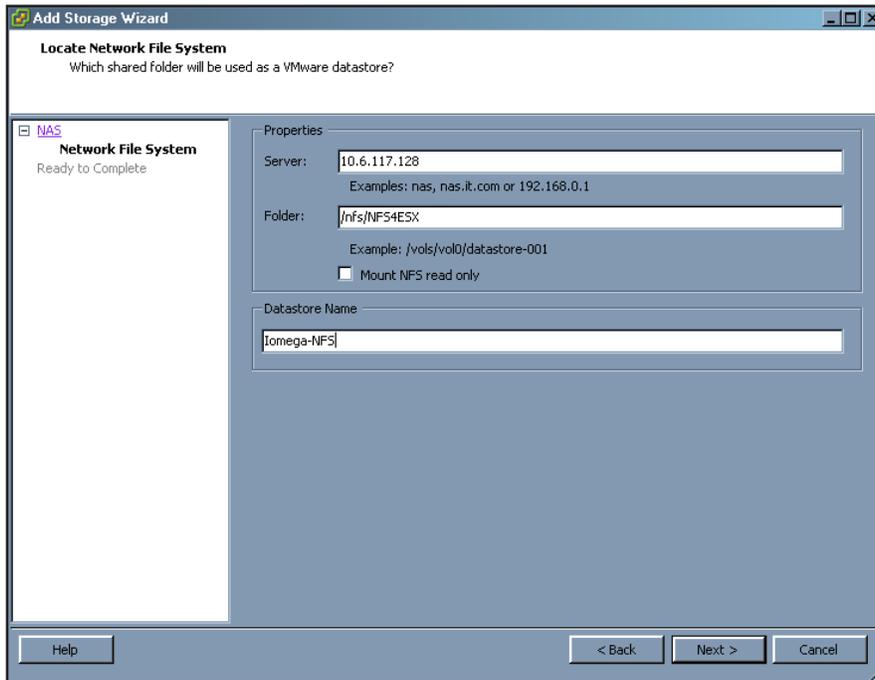
Figure 16 Mount the NFS share

Either the hostname or the IP address of the StorCenter ix4-200r can be entered here. Ensure that "/nfs" is specified in the folder path so Lifeline can export an NFS share. A meaningful datastore name is recommended to clearly identify it in ESX Server.

4. Click **Next** and confirm the settings to create the datastore.
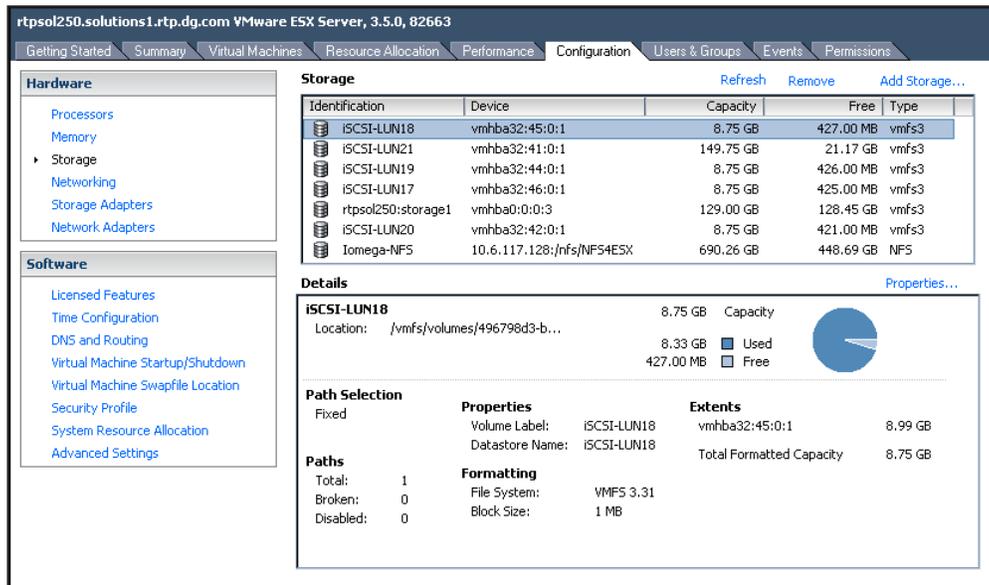
Figure 17 Create NFS datastore

ADDING AN ISCSI LUN ON AN IOMEGA STORCENTER NAS DEVICE

When using iSCSI storage, you need to add an iSCSI LUN on a StorCenter ix4-200r. A total of 32 iSCSI targets can be created on an StorCenter ix4-200r, with each target holding one single LUN. An iSCSI LUN can be protected by setting user access controls and iSCSI authentication methods.

The StorCenter ix4-200r supports two methods of target discovery: the SendTargets command, and the Internet Storage Name Service (iSNS) server. The SendTargets command technique requires that an initiator know the IP address and port number of the target. It is the simple and default discovery method. The VMware ESX Server only supports SendTargets; therefore, this is the discovery method used.

After target discovery, an iSCSI initiator can log on with or without authentication. A StorCenter ix4-200r supports the CHAP authentication method. When CHAP is enabled and an iSCSI LUN is secured, an initiator will need to provide the CHAP secret to log on. However, if the LUN is not secured, no authentication is required even if the global CHAP setting is enabled. Iomega customers are recommended to secure iSCSI LUNs, and this is the practice followed in the white paper.

1. From **Settings** > **Network Services** > check **Enable iSCSI** on a StorCenter ix4-200r. Optionally enable iSNS discovery.
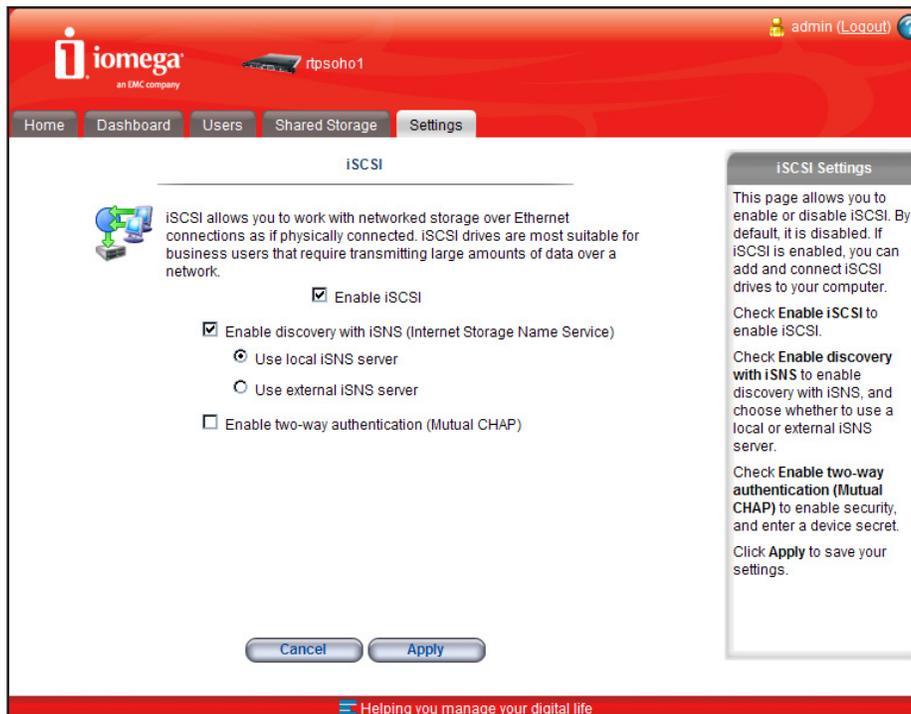
Figure 18 Enable iSCSI service

2. Click **Shared Storage** and click **Add** to create a new iSCSI LUN and enable security on it.


Figure 19 Add new LUN

3. Proceed to set user access to the LUN.
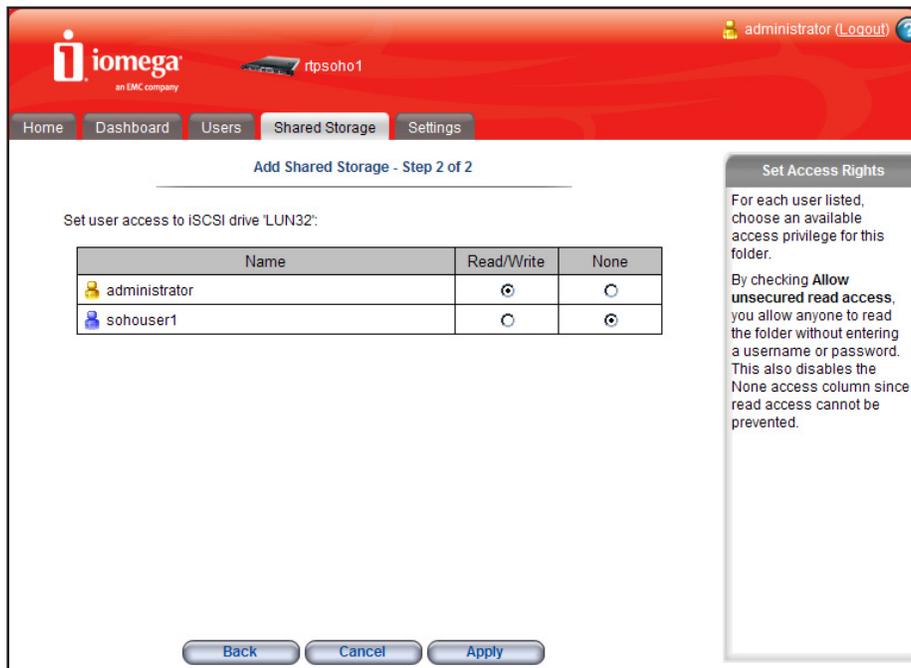
Figure 20 Set user access to the LUN

In this example, the user account Administrator is given read/write access to the LUN, but other users have no access to it. This Administrator user account and its password will be the CHAP logon credentials to be used by ESX Server.

4. Click **Apply** and a confirmation page should display.
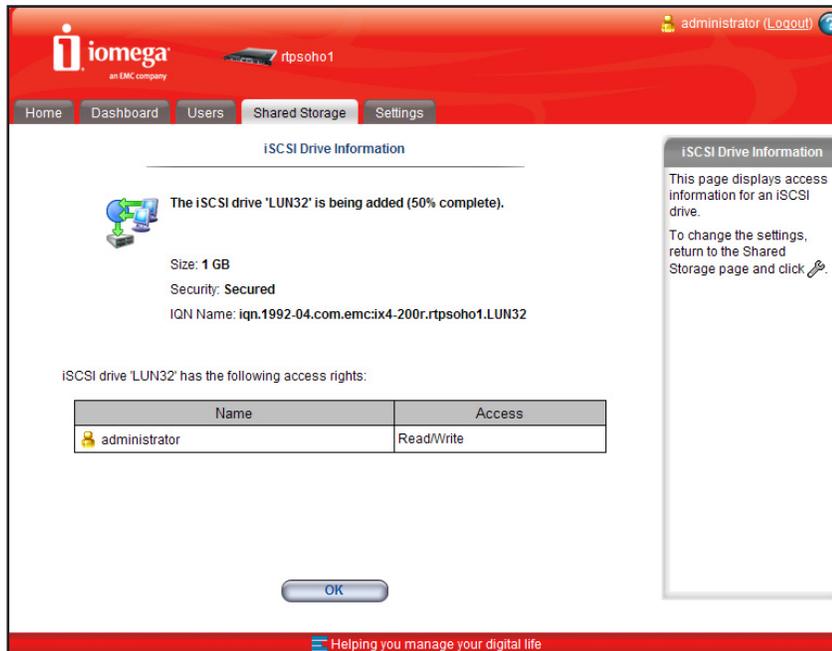
Figure 21 Confirmation of the LUN creation

CREATING A VMFS DATASTORE ON THE ESX SERVER

Prior to adding an iSCSI device on the ESX Server, an iSCSI initiator must be installed. Two types of initiators, software and hardware, can be used in the ESX Server. Each type has a distinct installation method. After installation, however, both initiators use the same process to discover targets, log on to the targets, scan for new iSCSI LUNs, and create VMFS datastores using those LUNs. In this white paper, the software iSCSI initiator is used to illustrate the process.

1. Enable the iSCSI client in the VMware ESX firewall. Go to **Configuration** > **Security Profile** > **Properties**...
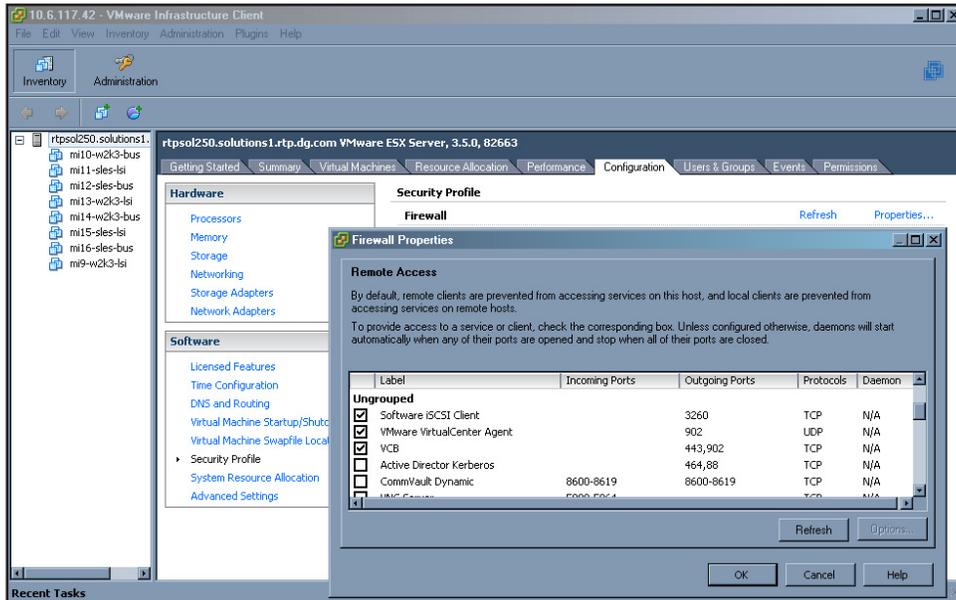

Figure 22 Enable iSCSI client

2. Click **Configuration** > **Storage Adapters**
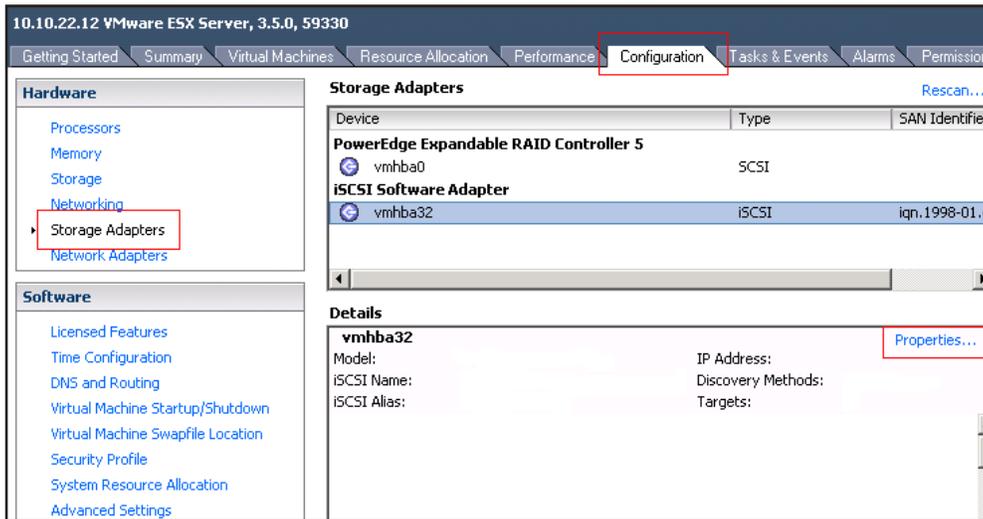
Figure 23 iSCSI Software Adapter

3. Click the **vmnba32** iSCSI software adapter and then click **Properties**. If the iSCSI initiator is not enabled yet, click **Configure** to enable the initiator and use the default iSCSI name.
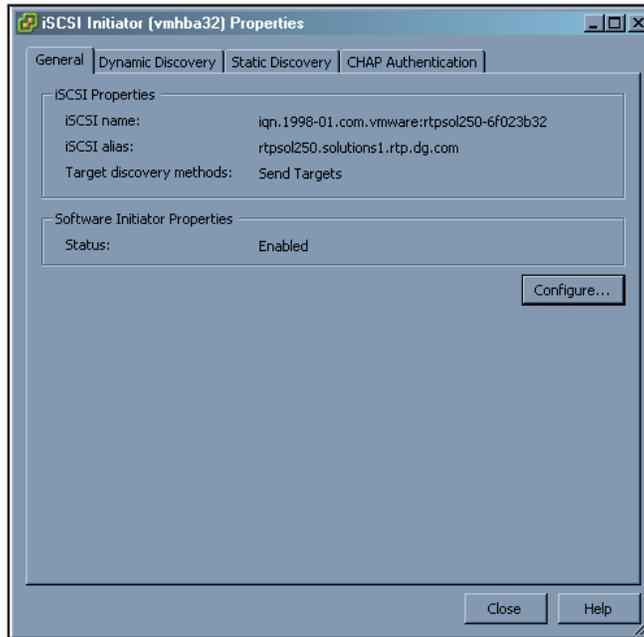

Figure 24 iSCSI initiator properties

4. Click **Dynamic Discovery** > **Add** to enter the iSCSI server information. As mentioned previously, the SendTargets discovery method is used.
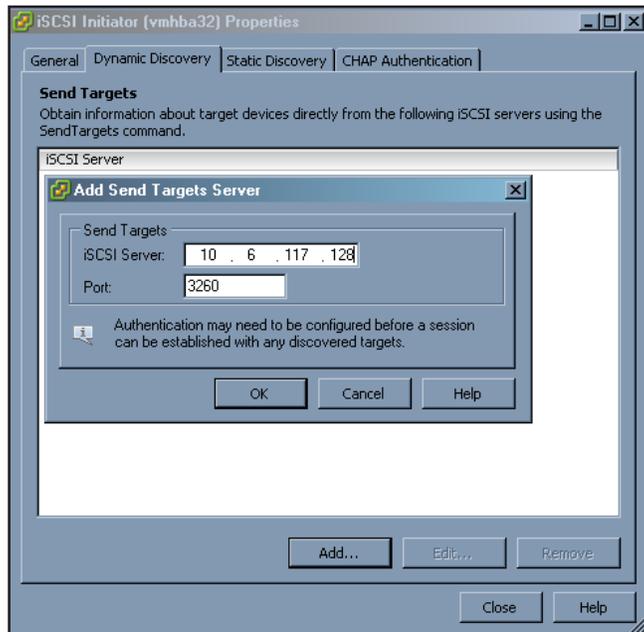
Figure 25 Specify iSCSI server information

5. Click **CHAP Authentication** > **Configure** to enter the CHAP authentication credentials for logon to the iSCSI targets on the StorCenter ix4-200r. The CHAP name should be the user name that is granted read/write access to an iSCSI LUN. In this example, it's Administrator. The CHAP secret is the password of the user account as set on the ix4-200r. A CHAP secret is required to have 12-16 characters if IPSec is not used. Therefore, if the user password is shorter than 12 characters, increase its length with the asterisk "*" character.
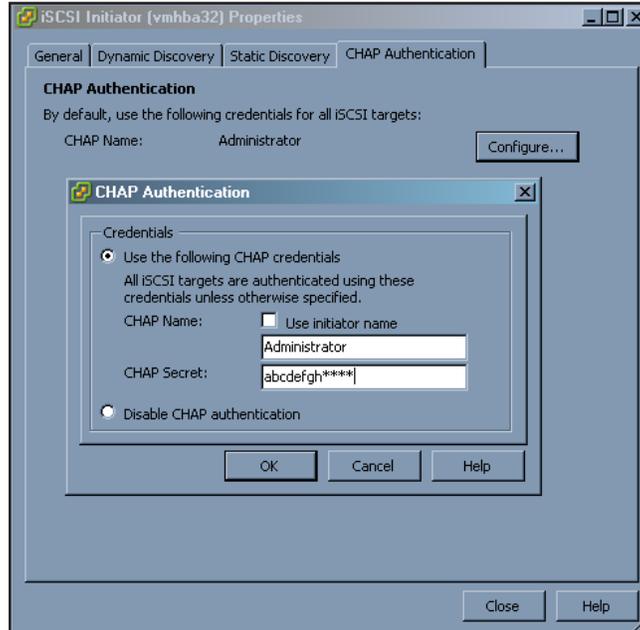
Figure 26 Supply CHAP authentication information

6. Go to **Configuration** > **Storage Adapters** and click Rescan to discover targets and LUNs on the StorCenter ix4-200r.
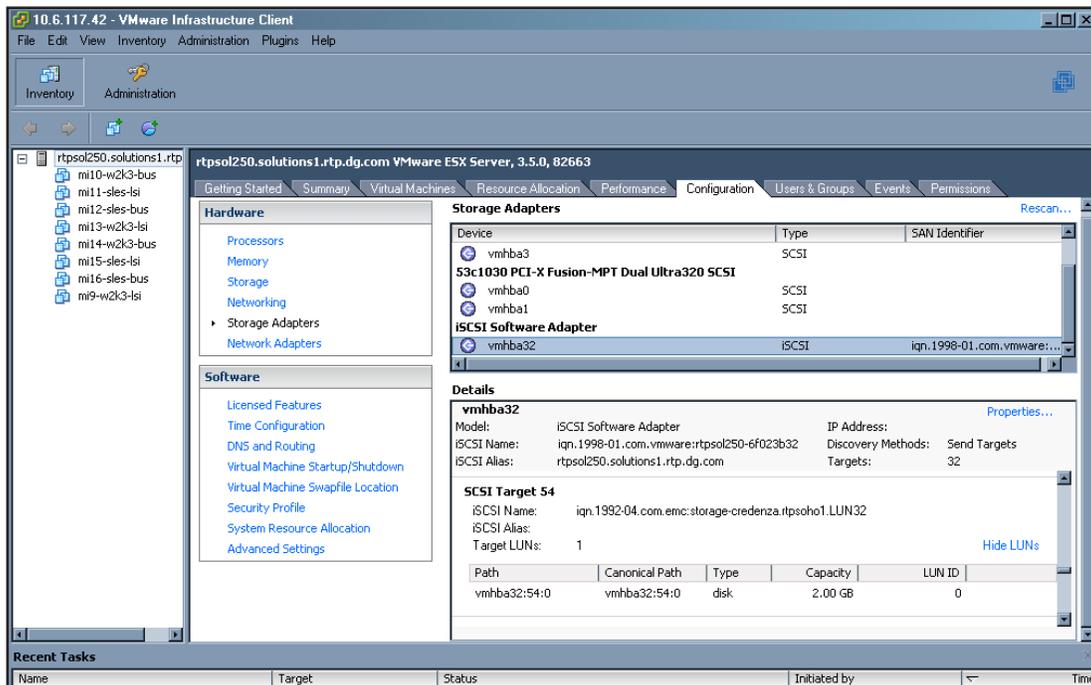

Figure 27 Target and LUN discovery

All the targets and LUNs that are either unsecured or granted access to the Administrator user will show up as disks in the VMware ESX.

7. Go to **Configuration** > **Storage** > **Add Storage**... again to create VMFS datastore.
8. Select the Disk/LUN option.
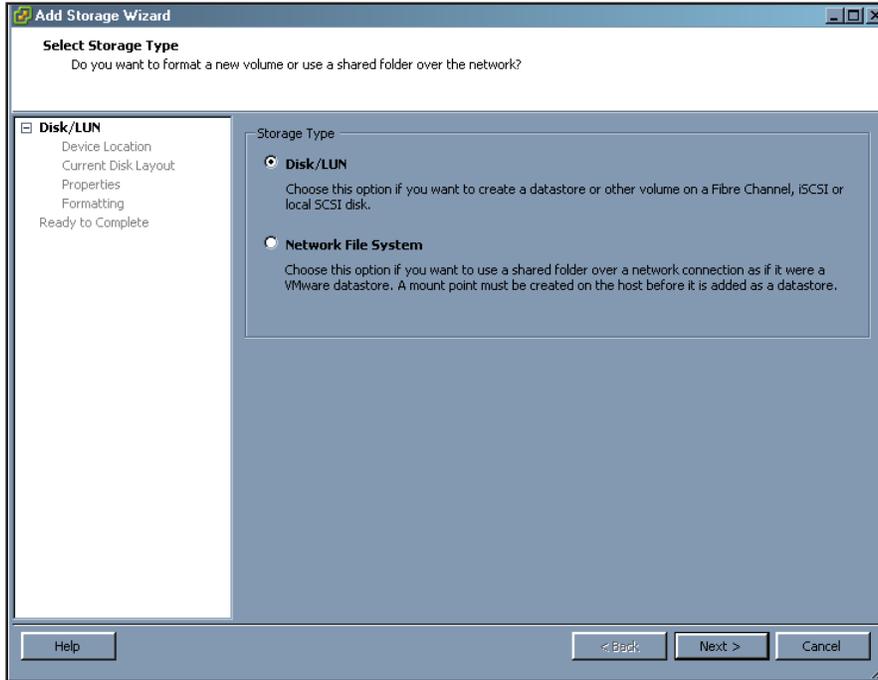
Figure 28 Select VMFS type

9. Select the iSCSI LUN to create VMFS on.
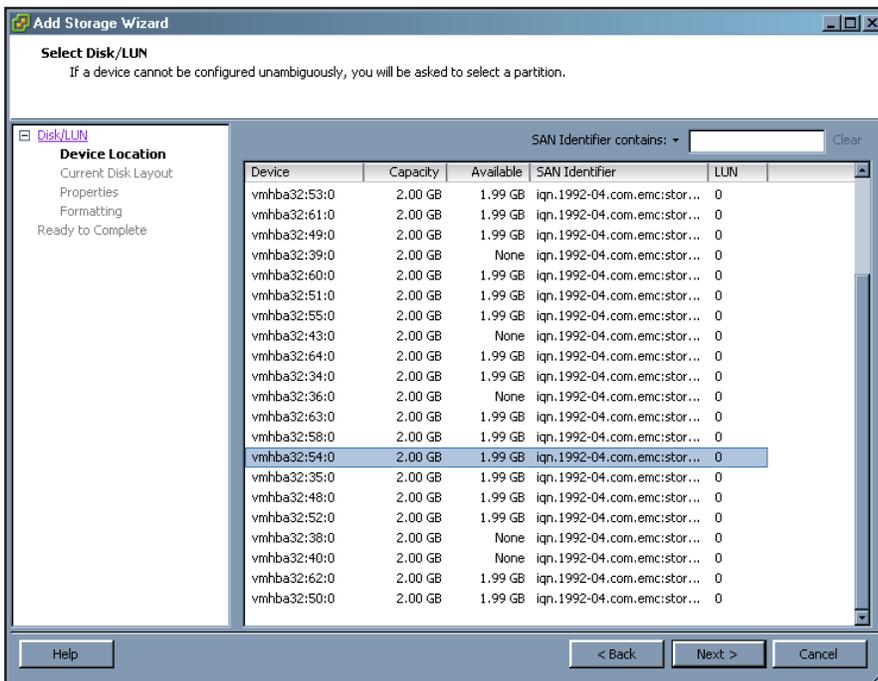
Figure 29 Select the LUN to be used

10. Review the current disk layout on the disk and proceed
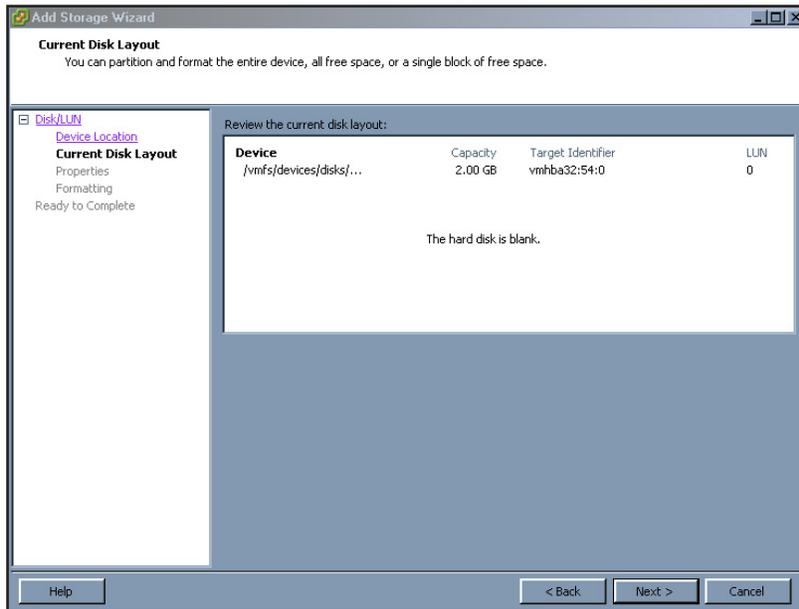

Figure 30 Review disk layout

11. Name the VMFS datastore to be created. Again, give it a meaningful name so it can be easily identified
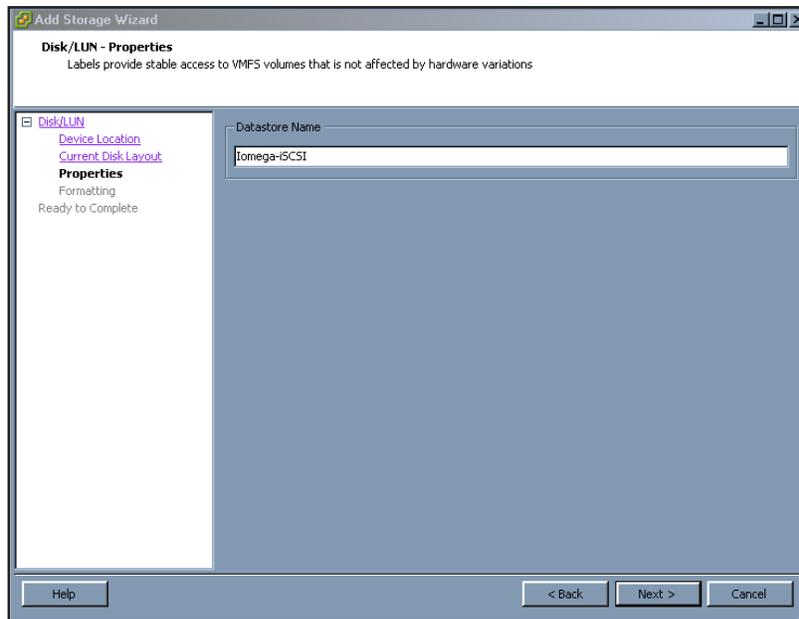

Figure 31 Name the VMFS datastore

12. Specify the maximum file size allowed on the datastore and the maximum capacity on the datastore
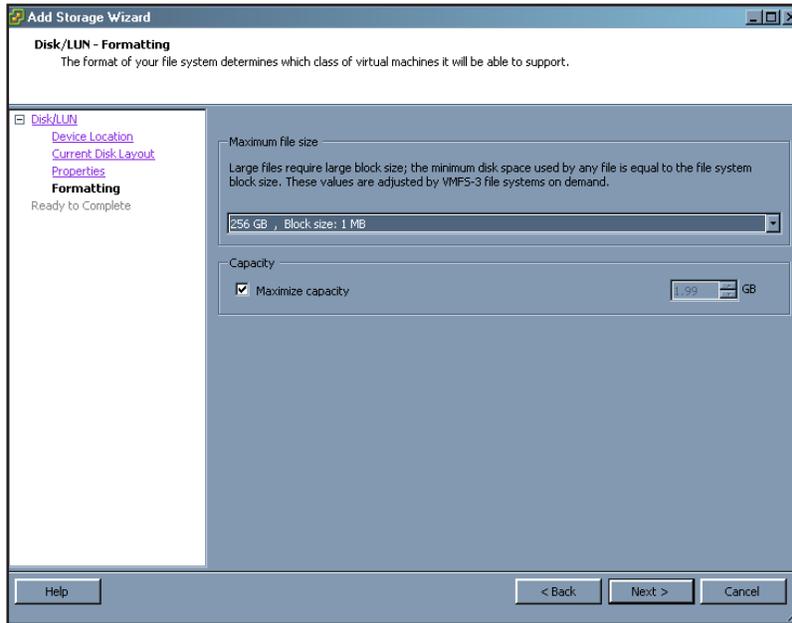

Figure 32 Specify file size and capacity

13. Review the summary and proceed to create the VMFS datastore.
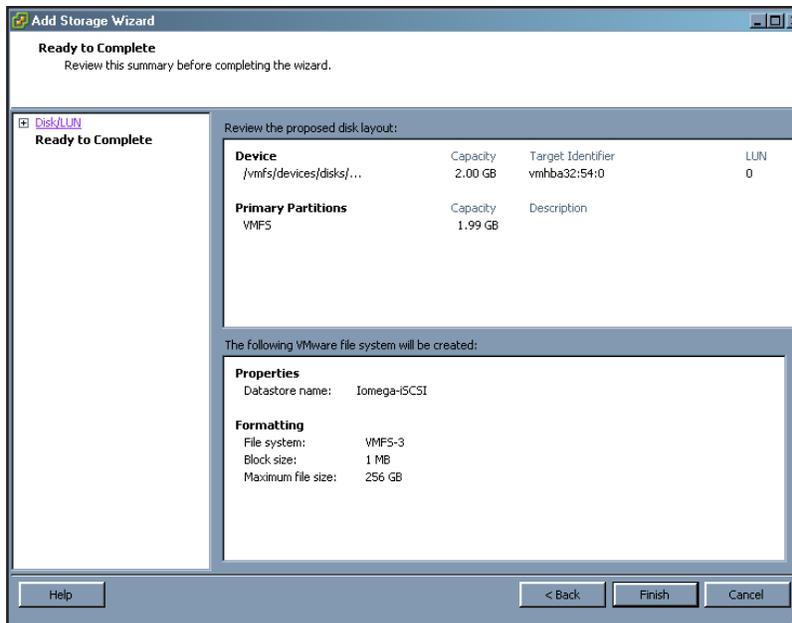
Figure 33 Create VMFS datastore

ADDING AN RDM DISK TO VIRTUAL MACHINE

A raw device mapping (RDM) is a special file in a VMFS volume that acts as a proxy for a raw device. The RDM provides some of the advantages of a virtual disk in the VMFS file system, while keeping some advantages of direct access to raw devices. VMware recommends RDM when a virtual machine must interact with a real disk on the SAN or iSCSI SAN. Two compatibility modes are available for RDM. The physical compatibility mode (a.k.a. pass-through mode) allows direct access of a SCSI device for those applications that need lower-level control. The virtual compatibility mode (a.k.a. non pass-through mode) allows an RDM to act exactly like a virtual disk file.

Prior to adding RDM, we need to create a virtual machine first. An iSCSI LUN on an Storcenter ix4-200r can then be assigned to the virtual machine in either compatibility mode.

1. Go to **Inventory** > **Host** > **New Virtual Machine**… to create a new virtual machine. After naming the virtual machine, select a datastore in which to store the files for the virtual machine. For illustration purposes, the "Iomega-NFS" datastore created previously is used in the following figure.
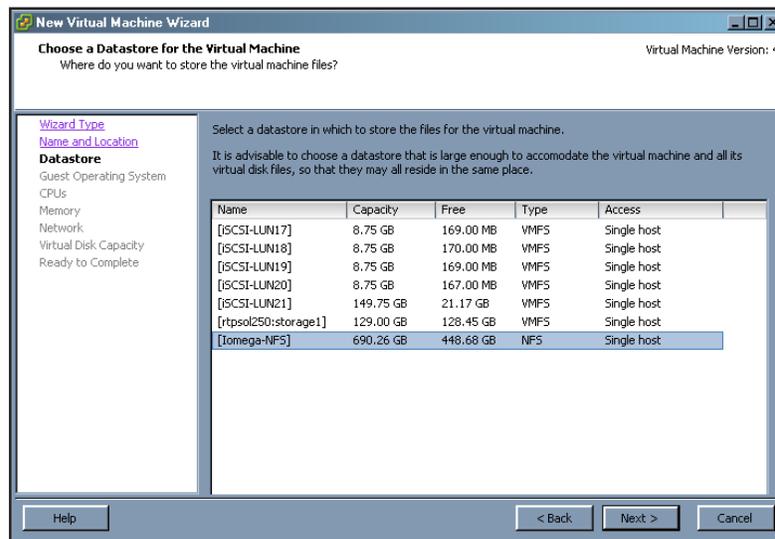

Figure 34 Choose the datastore to hold the virtual machine

2. Follow the instructions on setting the Guest Operating System, CPUs, Memory, Network, and Virtual Disk Capacity to complete the process of virtual machine creation.

3. Install the guest Operating System using a CD/DVD or ISO image. Power on the virtual machine after installation to finish all virtual machine configurations.

4. Go to **Summary** > **Edit Settings** with the virtual machine powered on or powered off. When in the Virtual Machine Properties window, click Add to add a new hardware to the virtual machine.
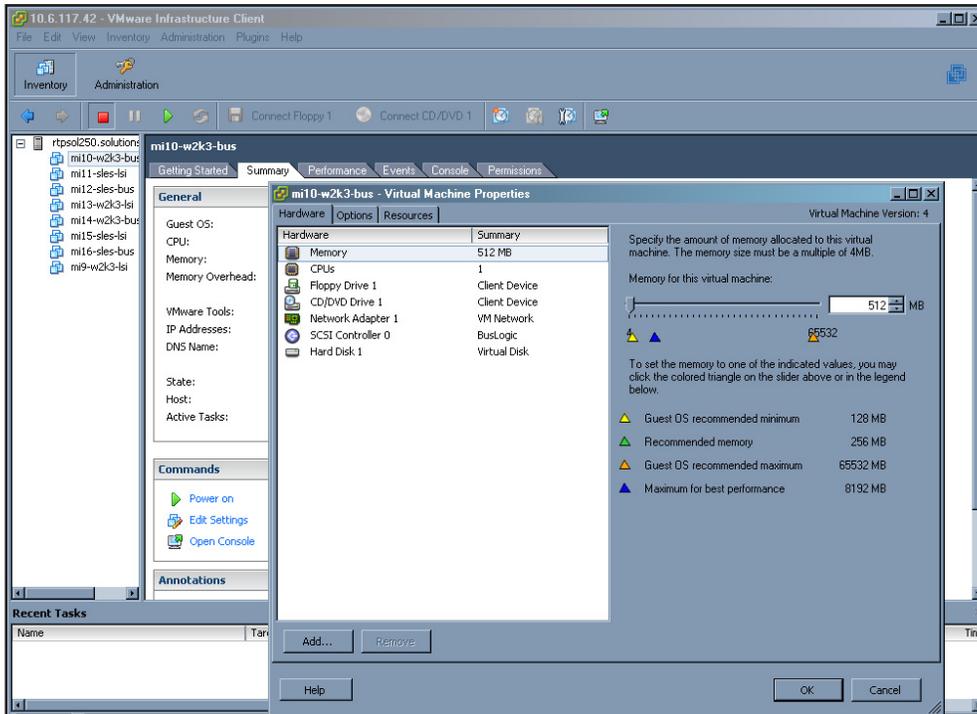

Figure 35 Edit virtual machine settings

5. Select Hard Disk as the hardware to add.
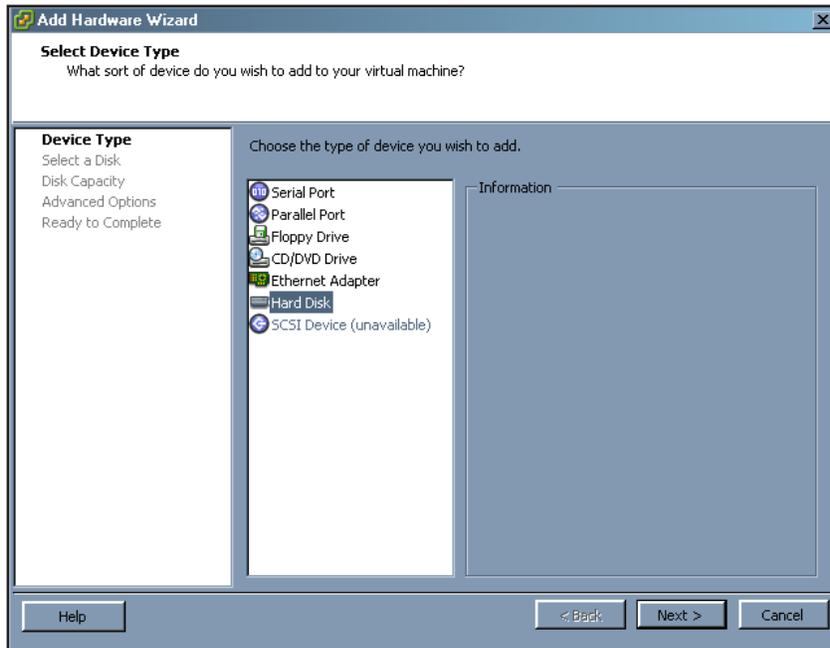
Figure 36 Add a hard disk to virtual machine

6. Choose Raw Device Mappings as the virtual disk type.
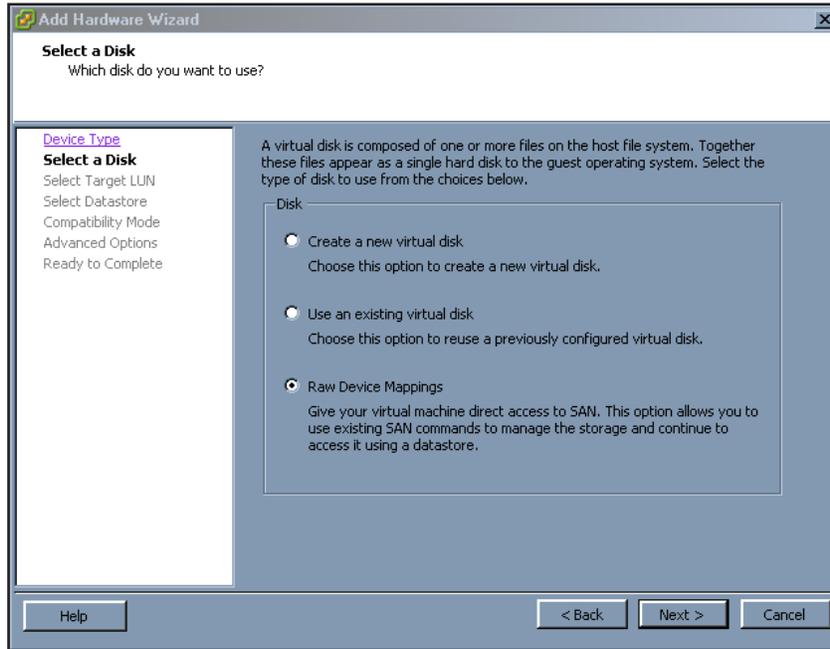
Figure 37 Select RDM as the disk type

7. Select the iSCSI LUN on the Storcenter ix4-200r to be used as an RDM disk.
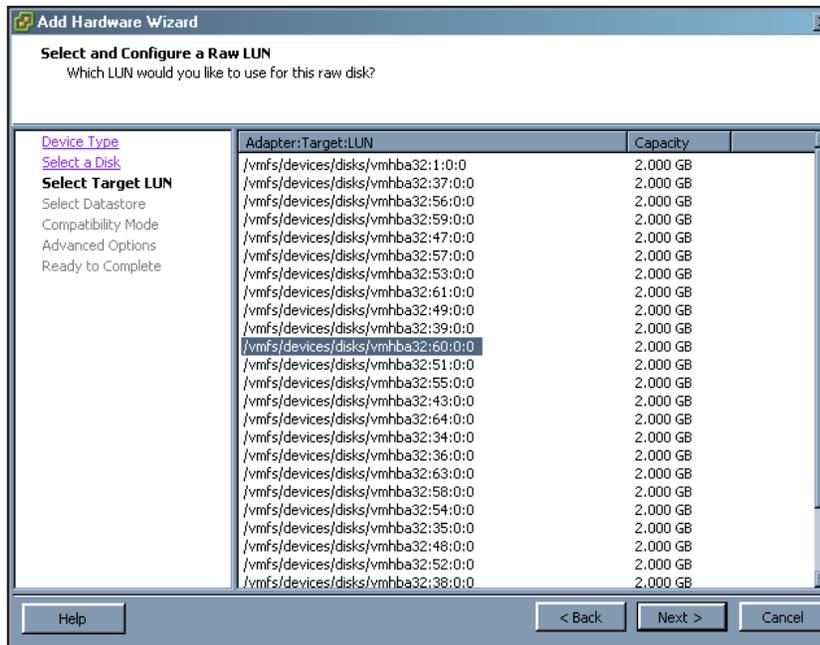
Figure 38 Select the LUN to be used as the RDM

8. Choose which datastore to map to the RDM. The default is to store the RDM with the virtual machine in the same datastore.
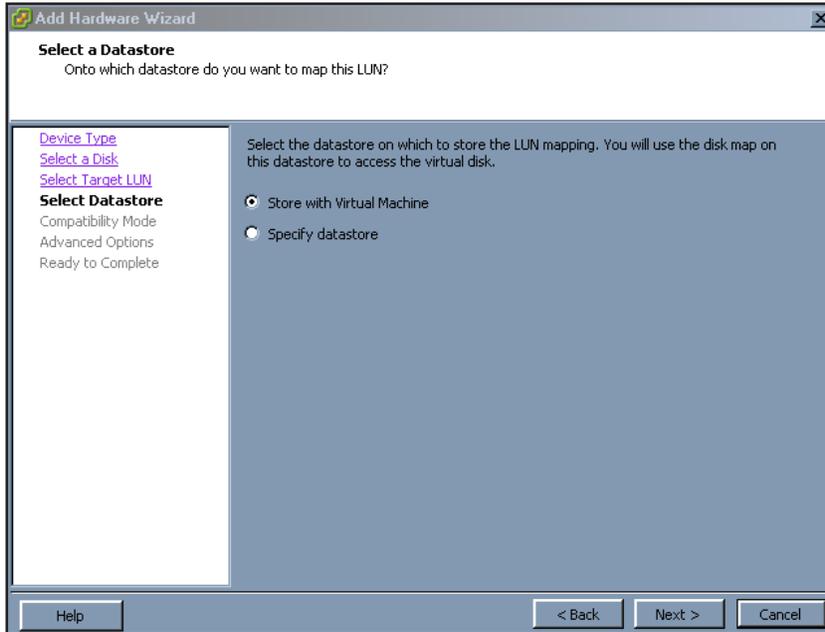

Figure 39 Decide where to map the RDM

9. Select which RDM compatibility mode to use.
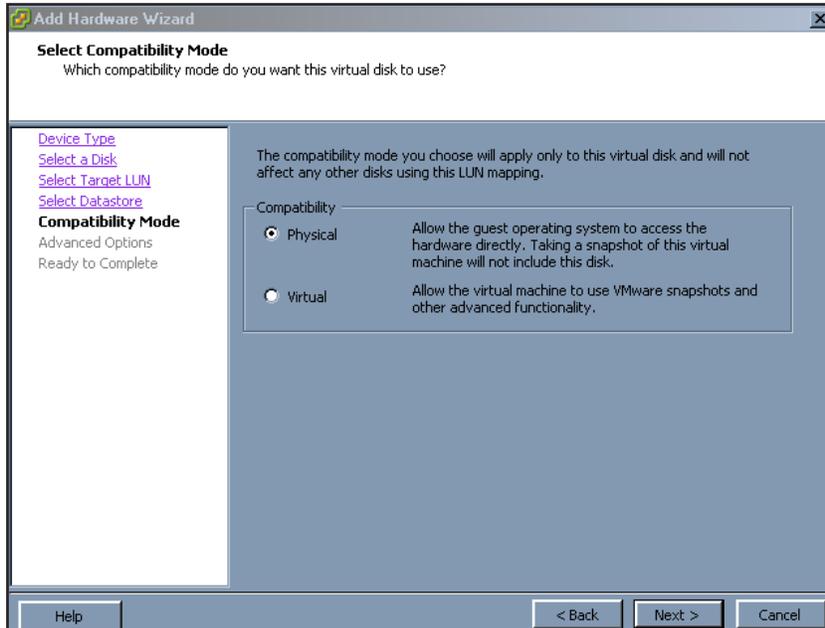
Figure 40 Select the compatibility mode

10. Choose the default virtual device/SCSI node and have the RDM disk added into the virtual machine.

11. After the RDM disk is added from ESX Server, the virtual machine needs to rescan its SCSI bus to discover the new disk. Afterwards, partitions can be created and formatted with a file system type. For a Windows guest, use the Disk Manager utility; for a Linux guest, use the fdisk utility and file system formatting tools such as mkreiserfs.

MULTIPATHING AND FAILOVER CONSIDERATIONS

An important aspect when configuring an ESX Server network is to ensure that there is redundancy to the ESX Server's storage. This redundancy is available when the storage is being accessed by either the NFS protocol or the iSCSI protocol.

StorCenter ix4-200r has single Gigabit Ethernet on the device; this makes it impossible to configure redundant network on the device to allow multiple paths into storage. However, highly available network can still be configured on the ESX Server side to prevent access to storage being lost in case of a NIC or switch failure.

The mechanism on the ESX Server is to configure NIC Teaming between two or more NICs connected to the same subnet. Additionally, two Ethernet switches configured with the same subnet and connected by an uplink can be configured.

CONCLUSION

VMware Virtual Infrastructure dramatically improves the efficiency and availability of resources and applications in organizations of any sizes. VMware customers typically save 50-70% on overall IT costs by lowering both capital and operational costs and improving operational efficiency and flexibility. This is especially important to small businesses that normally have a very limited IT budget.

The Iomega StorCenter Pro ix4-200r NAS Server is a high-performance, ease-of-use, and highly reliable storage dev ice specifically designed to meet the storage challenges that small businesses face daily. The device supports the NFS protocol and iSCSI protocol, the two predominant ways of utilizing IP storage by the VMware ESX Server. Customers' total infrastructure costs are further reduced by using an existing Ethernet infrastructure.

The Iomega StorCenter ix4-200r is certified in the VMware Hardware Compatibility List as both NAS and Software iSCSI storage. It provides reliable and proven storage solutions to small businesses that plan to deploy VMware Virtual Infrastructure.