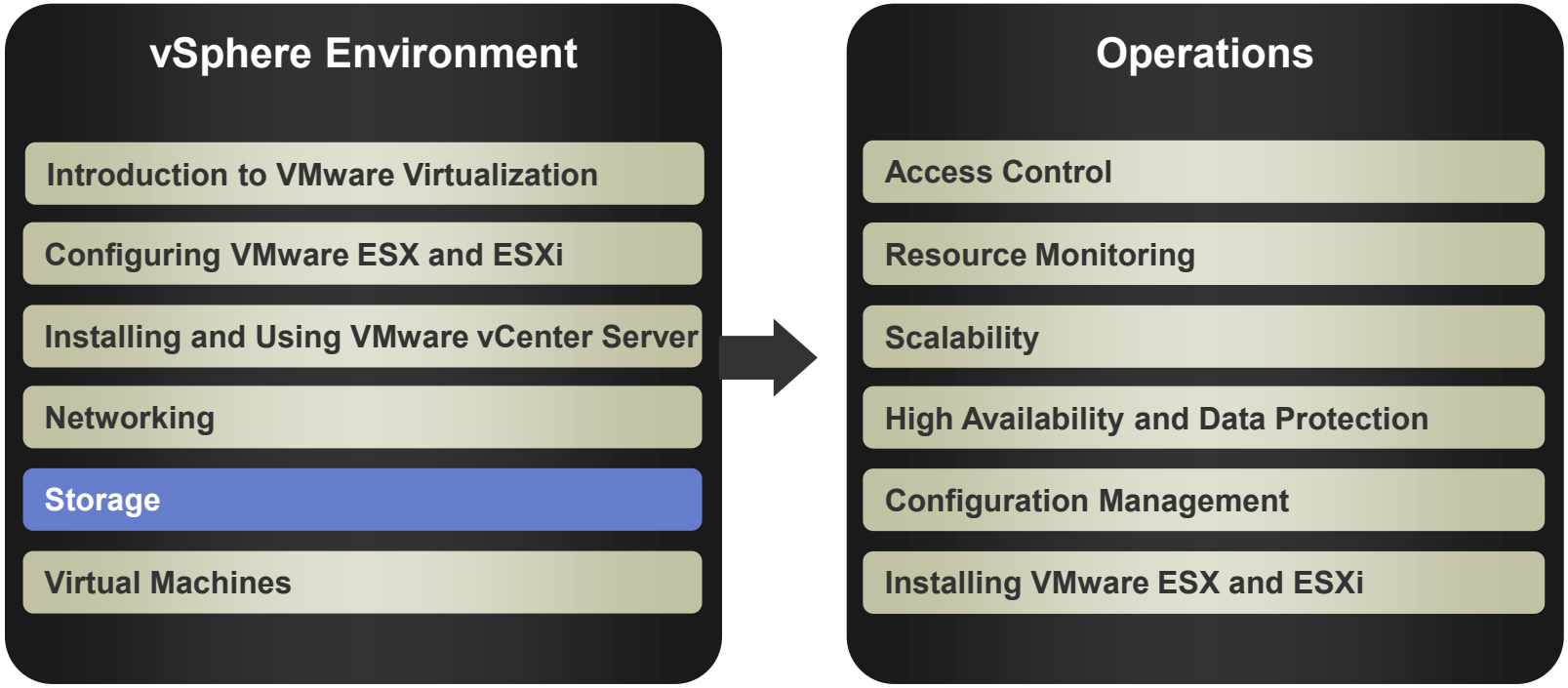
Storage

Module 6

Copyright © 2009 VMware, Inc. All rights reserved.

You Are Here



Copyright © 2009 VMware, Inc. All rights reserved.

Importance

- Storage options give you the flexibility to set up your storage based on your cost, performance, and manageability requirements. Shared storage is useful for disaster recovery, high availability, and moving virtual machines between hosts.

Copyright © 2009 VMware, Inc. All rights reserved.

Module Lessons

Lesson 1: Storage Concepts

Lesson 2: Fibre Channel SAN Storage

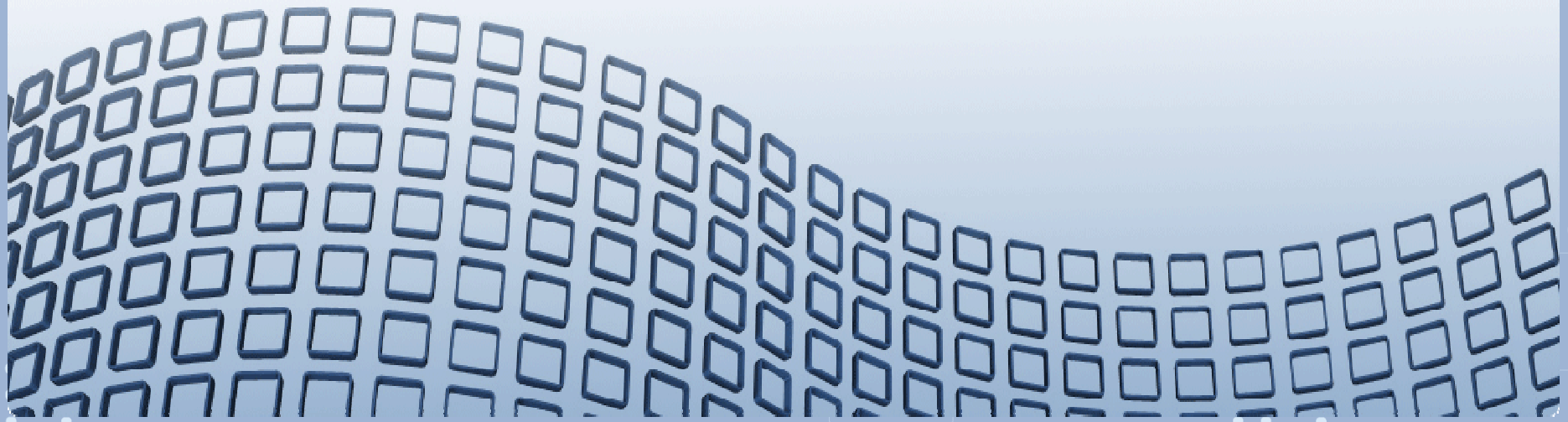
Lesson 3: iSCSI Storage

Lesson 4: VMFS Datastores

Lesson 5: NAS Storage and NFS Datastores

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson 1:
Storage Concepts



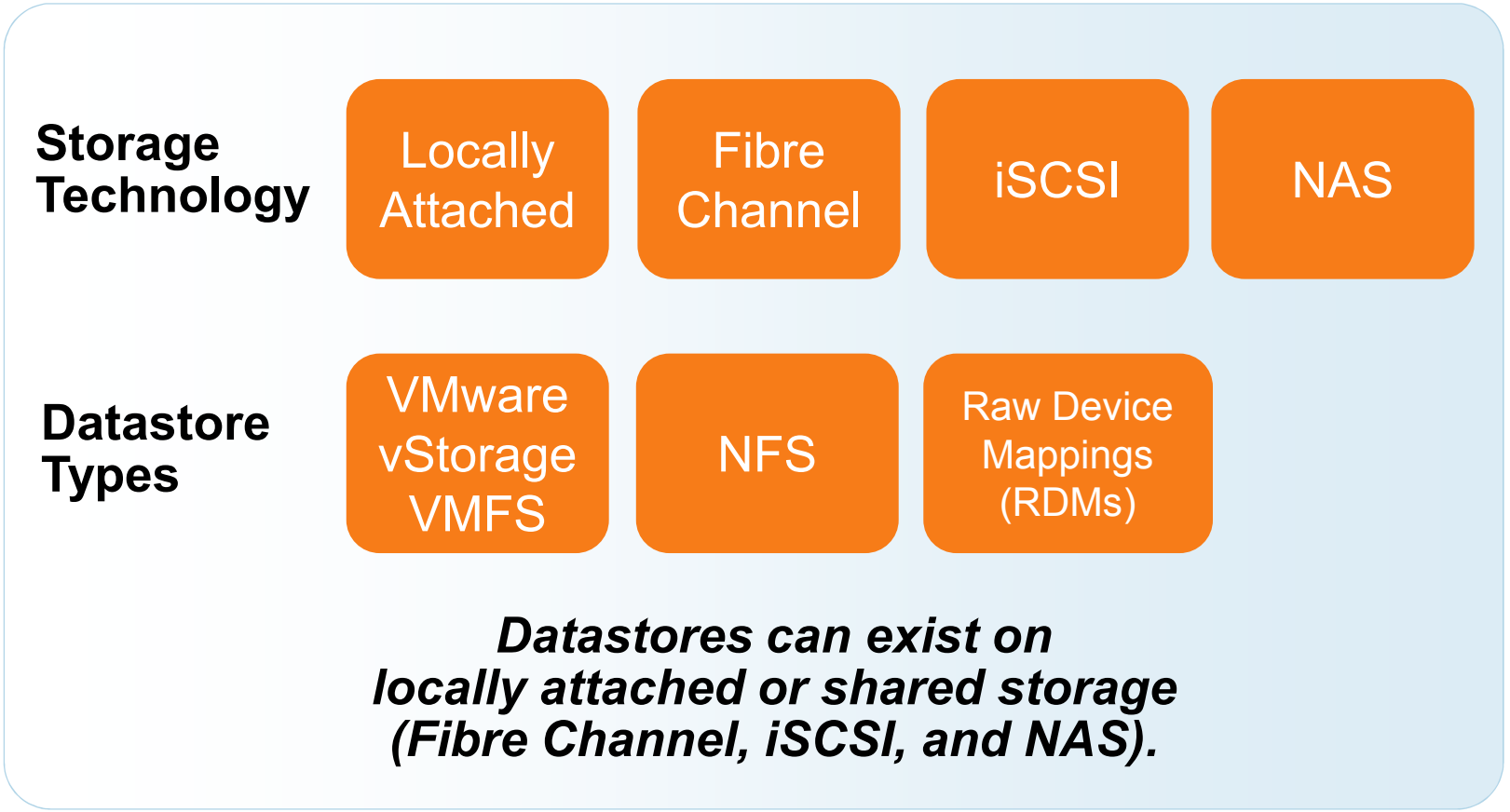
Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Objectives

- Describe VMware® vSphere™ storage technologies and datastores
- Describe the various ways to view storage information
- Understand the storage device naming convention

Copyright © 2009 VMware, Inc. All rights reserved.

Storage Overview



Copyright © 2009 VMware, Inc. All rights reserved.

Storage Technology Overview

Locally-attached storage – Internal or external storage disks or arrays attached to the host through a direct connection

Fibre Channel – A high-speed SCSI transport protocol used for storage area networking (SAN)

- Fibre Channel switches interconnect multiple nodes to form the “fabric” in a Fibre Channel SAN.

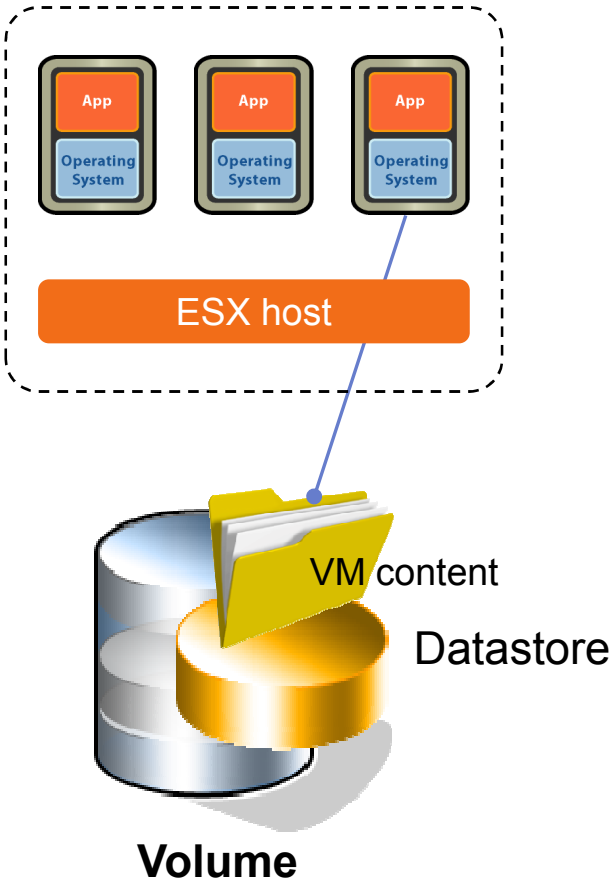
iSCSI – A SCSI transport protocol, enabling access to storage devices over standard TCP/IP networks

- iSCSI maps SCSI block-oriented storage over TCP/IP.

Network-attached storage (NAS) – Storage shared over the network at the file system level

Copyright © 2009 VMware, Inc. All rights reserved.

Datastores



A *datastore* is a logical storage unit, which can use disk space on one physical device or one disk partition, or span several physical devices.

Types of datastores:

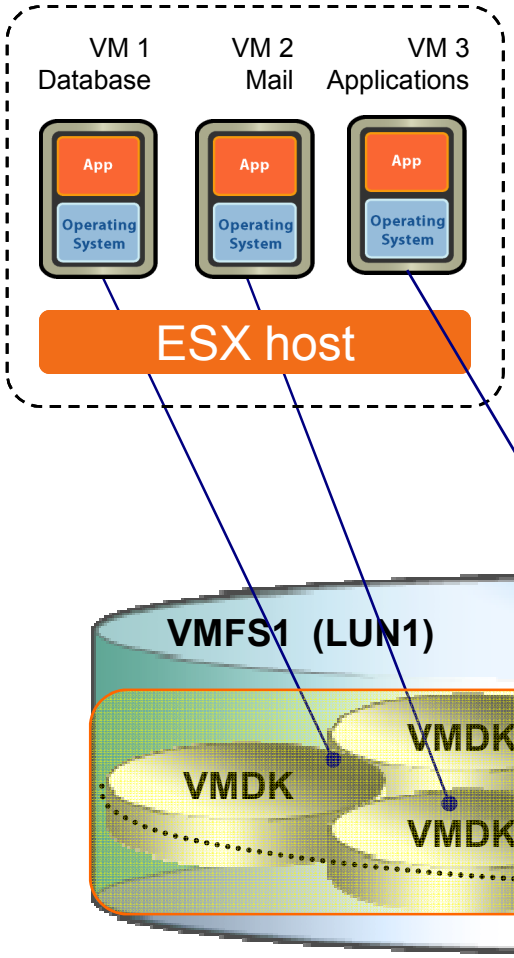
- VMware Virtual Machine File System (VMFS)
- Network File System (NFS)

Datastores are used to hold virtual machines, templates, and ISO images.

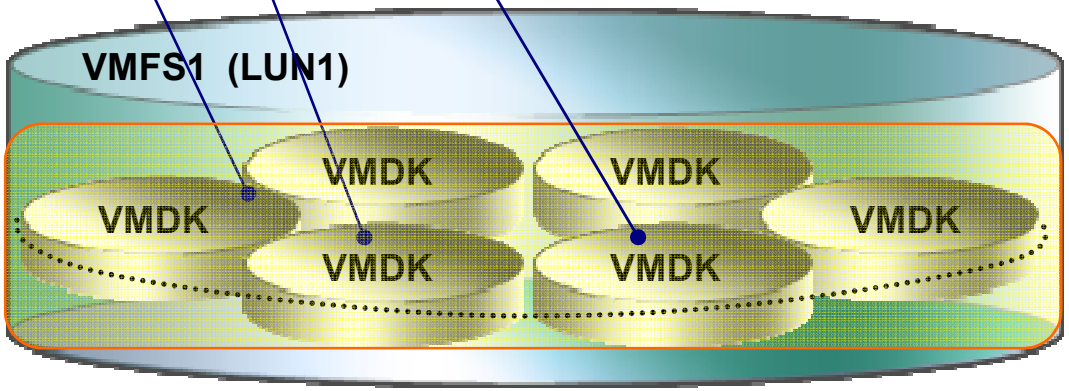
A VMFS datastore can also hold a raw device mapping (RDM), used to access raw data.

Copyright © 2009 VMware, Inc. All rights reserved.

VMFS



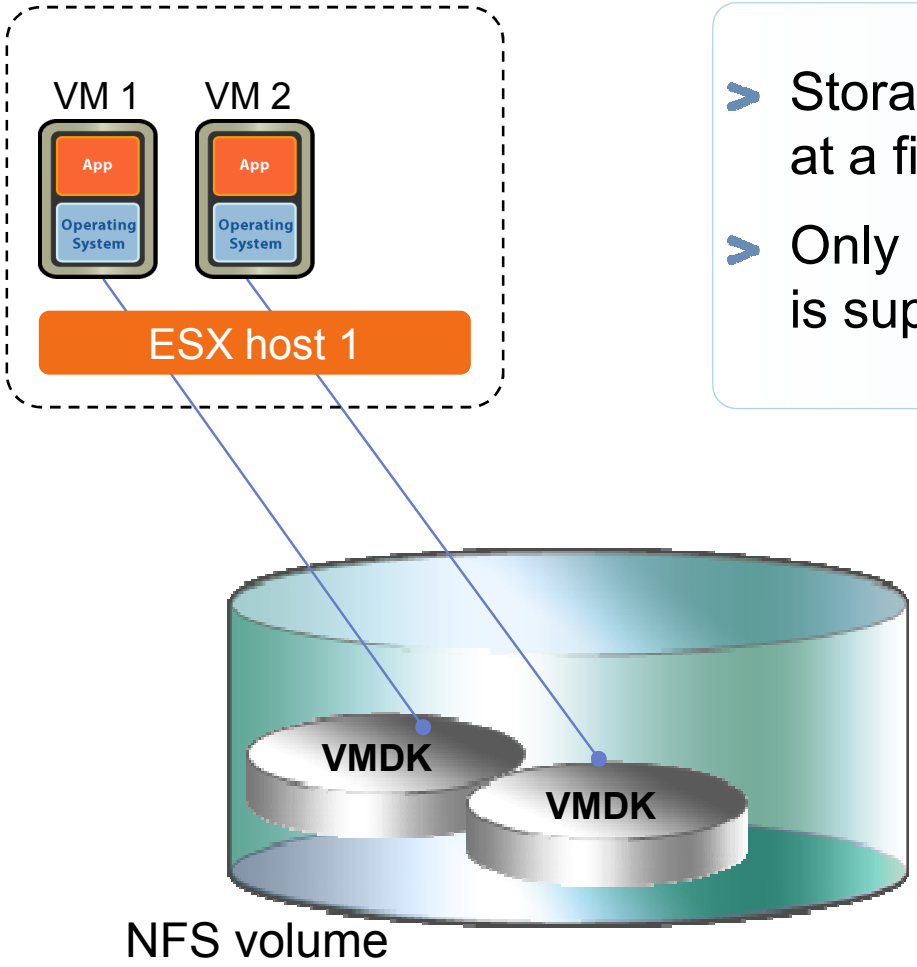
- Clustered file system
- Underlying technology for VMotion, VMware HA, and DRS
- Allows concurrent access to shared storage
- Provides on-disk locking
- Can reside on local, Fibre Channel, or iSCSI storage



VMFS Volume

Copyright © 2009 VMware, Inc. All rights reserved.

NFS

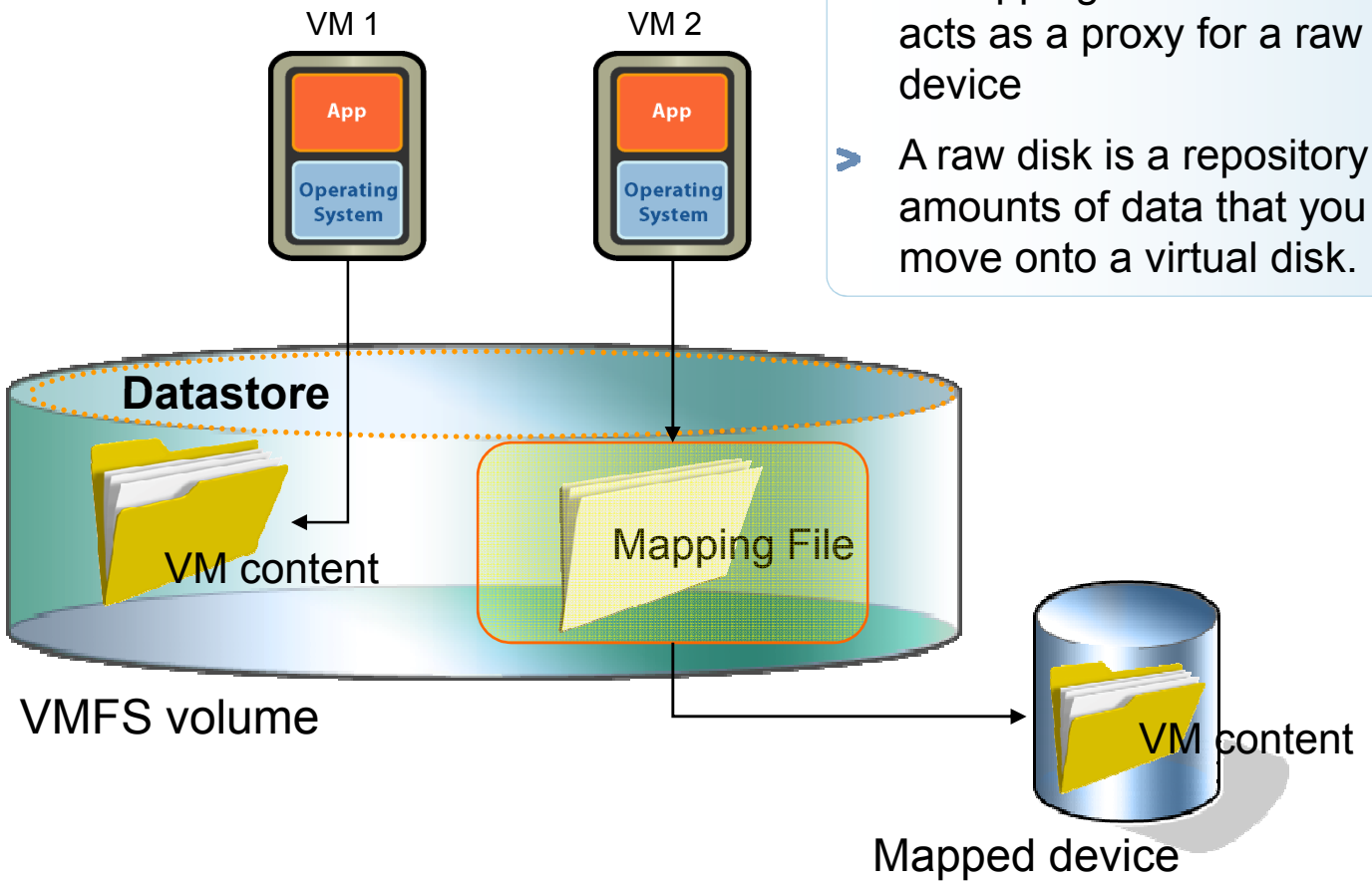


- Storage shared over the network at a file system level
- Only NFS version 3 over TCP/IP is supported.

Copyright © 2009 VMware, Inc. All rights reserved.

Raw Device Mapping (RDM)

- A mapping file in a VMFS volume that acts as a proxy for a raw physical device
- A raw disk is a repository for large amounts of data that you do not want to move onto a virtual disk.



Copyright © 2009 VMware, Inc. All rights reserved.

Local versus Shared Storage

Advantages of using local storage:

- Easy to physically move the box
- Most common location for installing ESX
- Ideal for small environments

Advantages of using shared storage:

- Central repository
- Scalable and recoverable implementation
- Multiple hosts can access the same storage space.
- Virtual machines can be clustered across physical hosts.
- Virtual machines can take advantage of vSphere features like VMware VMotion™.
- Allows data replication

Copyright © 2009 VMware, Inc. All rights reserved.

Storage Device Naming Conventions

Storage devices are identified in several ways:

- SCSI ID – Unique SCSI identifier
- Canonical name – The Network Address Authority (NAA) ID is a unique LUN identifier, guaranteed to be unique across reboots.
  - For those devices without a unique ID, a VMware mpx reference is used instead.
- Runtime name – Uses the convention vmhbaN:C:T:L. This name is not persistent through reboots.

SCSI ID	Canonical Name	Runtime Name	Lun
0000000000766d686261303a303a30	mpx.vmhba0:C0:T0:L0	vmhba0:C0:T0:L0	0
0100010000202045737853637369 2d...			
02000000005006016 0c1e0eb0a5006...	naa.50060160c1e0eb0a50060160c1e0eb0a	vmhba1:C0:T0:L0	0
02000600006006016 0d2b02000bcb9...	naa.60060160d2b02000bcb96451d6b1dd11	vmhba1:C0:T0:L6	6

Copyright © 2009 VMware, Inc. All rights reserved.

Physical Storage Considerations

Discuss vSphere storage needs with your storage administration team:

- LUN sizes
- I/O bandwidth
- Disk cache parameters
- Zoning and masking
- Identical LUN presentation to each VMware ESX™/ESXi host
- Active-active or active-passive arrays
- Export properties for NFS datastores

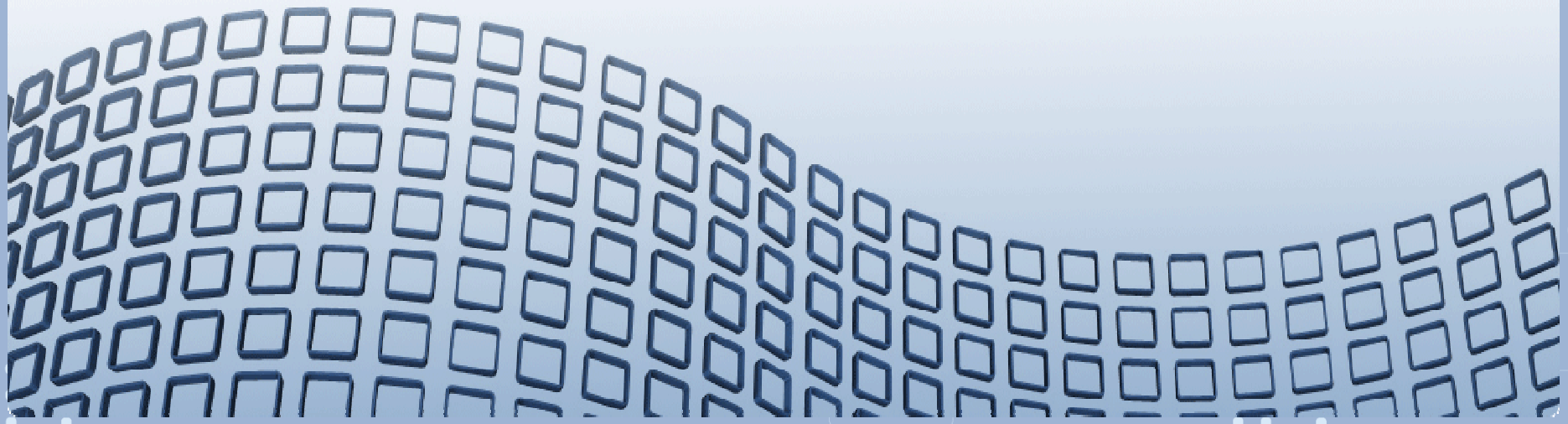
Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Summary

- vSphere supports Fibre Channel, iSCSI, and NAS storage technologies.
- vSphere supports VMFS datastores, RDMs, and NFS datastores.
- View storage information from the host's Configuration tab or the Storage Views tab.
- Storage devices are uniquely identified using the NAA ID.

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson 2:
Fibre Channel SAN Storage



Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Objectives

- Describe uses of Fibre Channel with ESX/ESXi
- Describe Fibre Channel components and addressing
- Access Fibre Channel storage
- View Fibre Channel storage information

Copyright © 2009 VMware, Inc. All rights reserved.

Using Fibre Channel with ESX/ESXi

Uses of Fibre Channel SAN LUNs:

- VMFS datastores to hold virtual machines, ISO images, and templates
- RDMs to hold a virtual machine's raw data
- Supports vSphere features such as VMotion, VMware High Availability, and VMware Distributed Resource Scheduler (DRS)
- To boot ESX from a SAN LUN

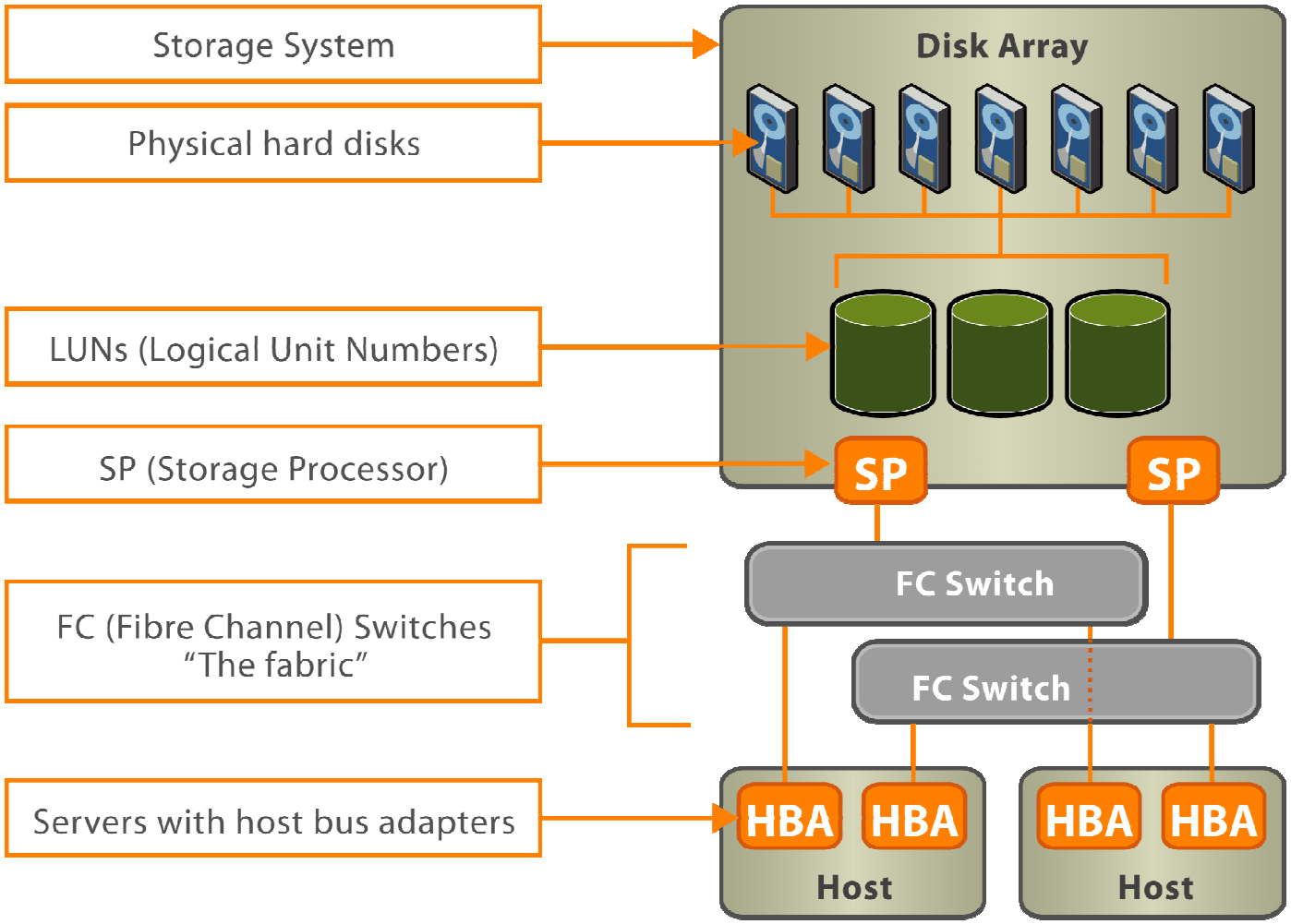
ESX/ESXi supports:

- 8GB Fibre Channel
- Fibre Channel over Ethernet (FCoE)

Copyright © 2009 VMware, Inc. All rights reserved.

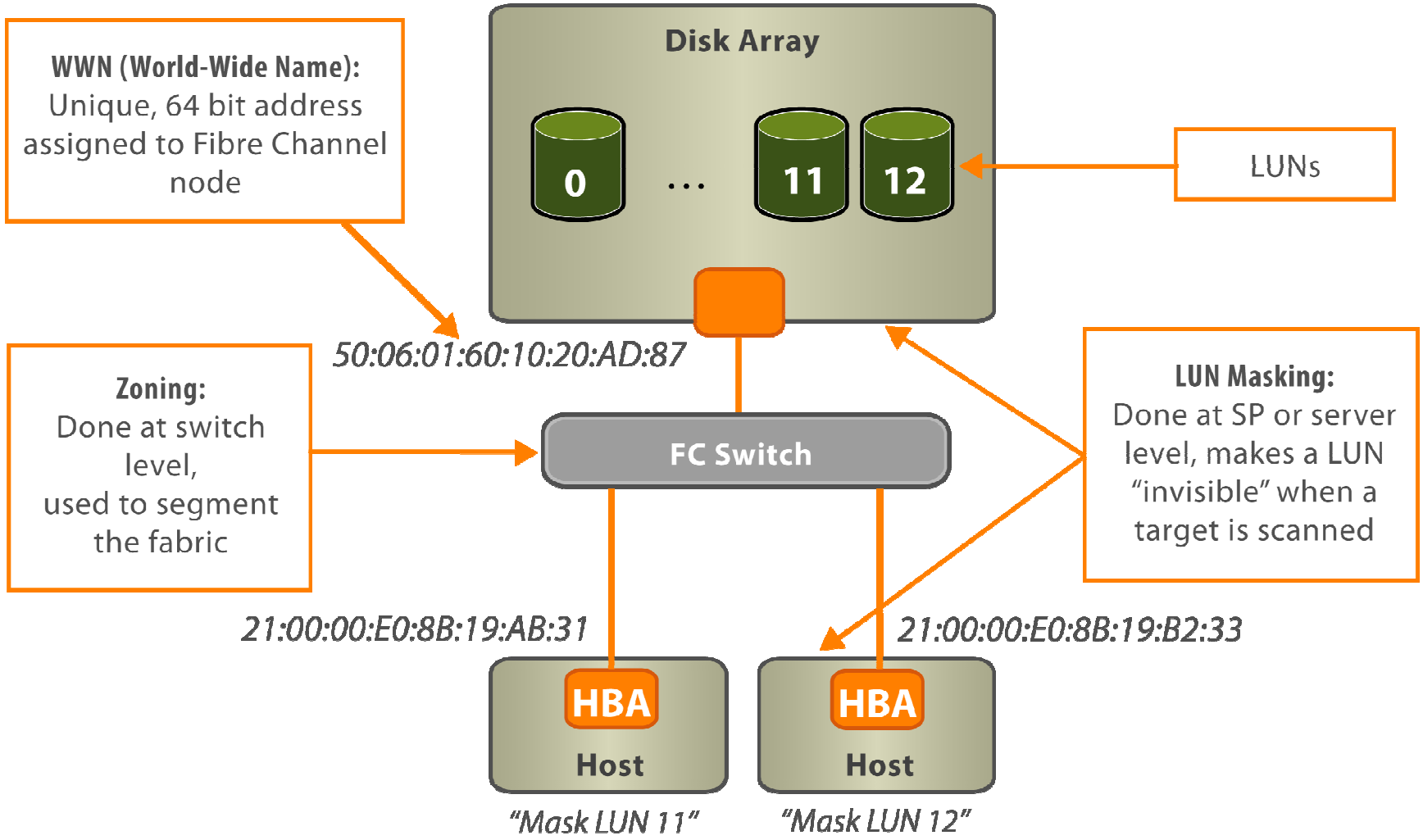
vmware

Fibre Channel SAN Components



Copyright © 2009 VMware, Inc. All rights reserved.

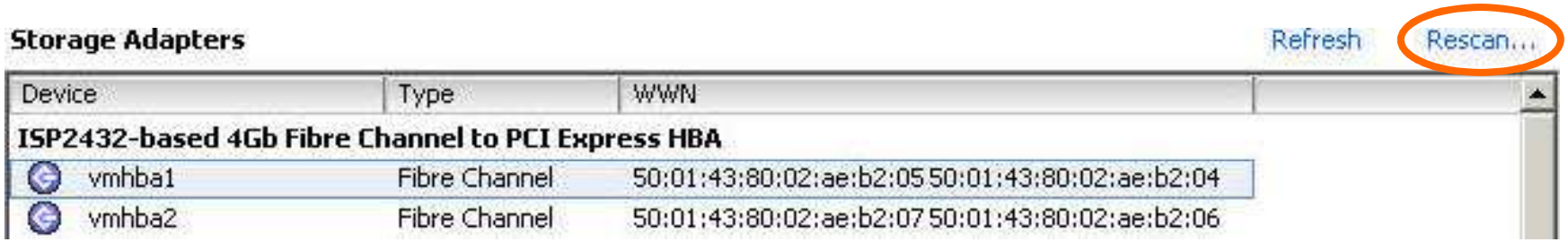
Fibre Channel Addressing and Access Control



Copyright © 2009 VMware, Inc. All rights reserved.

Accessing Fibre Channel Storage

- Install Fibre Channel adapters.
- During the boot sequence, the adapters are recognized by the ESX/ESXi host.

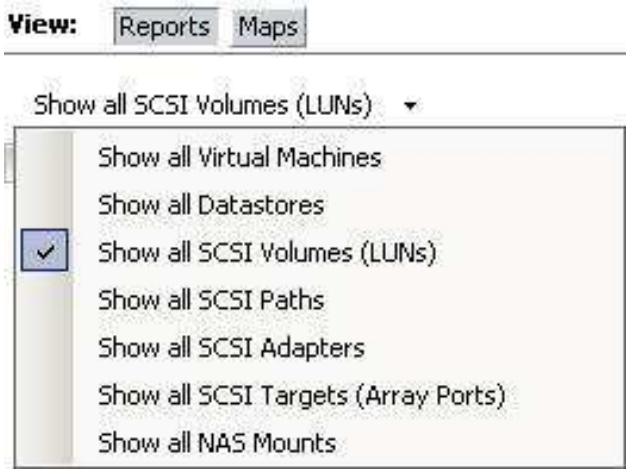


- Clicking the **Rescan** link allows the ESX/ESXi host to rescan all host bus adapters for new storage devices.
  - An ESX/ESXi host supports up to 256 LUNs and 16 HBAs.

Copyright © 2009 VMware, Inc. All rights reserved.

Viewing Fibre Channel Storage Information

The Storage Views **tab provides information about all SCSI adapters and NAS mounts.**



Getting Started | Summary | Virtual Machines | Performance | Configuration | Tasks & Events | Alarms | Permissions | Maps | Storage Views | Hardware Status

Storage Views are generated periodically and may be out of date. To update to the most recent inventory, please click "Update...".

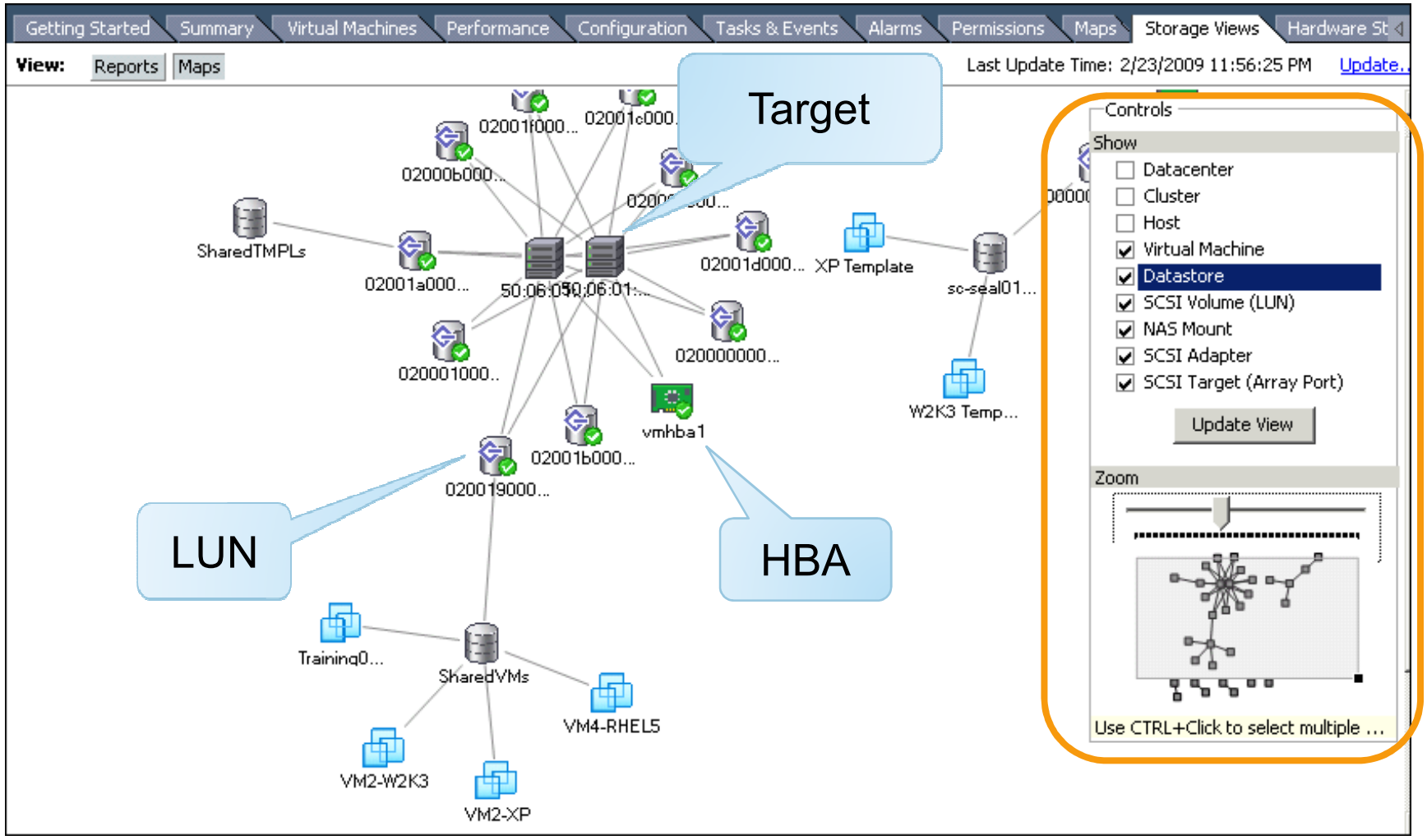
View: Reports Maps — Last Update

Show all SCSI Volumes (LUNs) — SCSI ID, Canonical Name or Runtime Name c

SCSI ID	Canonical Name	Runtime Name	Lun	Status	Host status	Size	Volume Name	Vendor	Device type
0000000000766d6...	mpx.vmhba0:C0:T0:L0	vmhba0:C0:T0:L0	0	Up	Up	136.70 GB	Local VMware Disk (mpx.vmhba0:C0:T0:L...	VMware	Disk
020000000050060...	naa.50060160c1e0eb...	vmhba1:C0:T0:L0	0	Up	Up	0.00 B	DGC Fibre Channel Disk (naa.50060160c1...	DGC	Disk
020006000060060...	naa.60060160d2b020...	vmhba1:C0:T0:L6	6	Up	Up	10.00 GB	DGC Fibre Channel Disk (naa.60060160d2...	DGC	Disk
020015000060060...	naa.60060160d2b020...	vmhba1:C0:T0:L21	21	Up	Up	10.00 GB	DGC Fibre Channel Disk (naa.60060160d2...	DGC	Disk
020016000060060...	naa.60060160d2b020...	vmhba1:C0:T0:L22	22	Up	Up	10.00 GB	DGC Fibre Channel Disk (naa.60060160d2...	DGC	Disk
020019000060060...	naa.60060160d2b020...	vmhba1:C0:T0:L25	25	Up	Up	100.00 GB	DGC Fibre Channel Disk (naa.60060160d2...	DGC	Disk

Copyright © 2009 VMware, Inc. All rights reserved.

Viewing Fibre Channel Storage Maps



Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Summary

- Fibre Channel storage devices can be used to hold VMFS datastores or raw data.
- Clicking the Rescan link allows the ESX/ESXi host to rescan all HBAs for new storage devices.
- Fibre Channel storage information is available from the reports provided in the Storage Views tab.

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson 3:
iSCSI Storage

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Objectives

- Describe uses of iSCSI storage with ESX/ESXi
- Describe iSCSI components and addressing
- Configure iSCSI initiators
- View iSCSI storage information

Copyright © 2009 VMware, Inc. All rights reserved.

Using iSCSI with ESX/ESXi

Uses of iSCSI SAN LUNs:

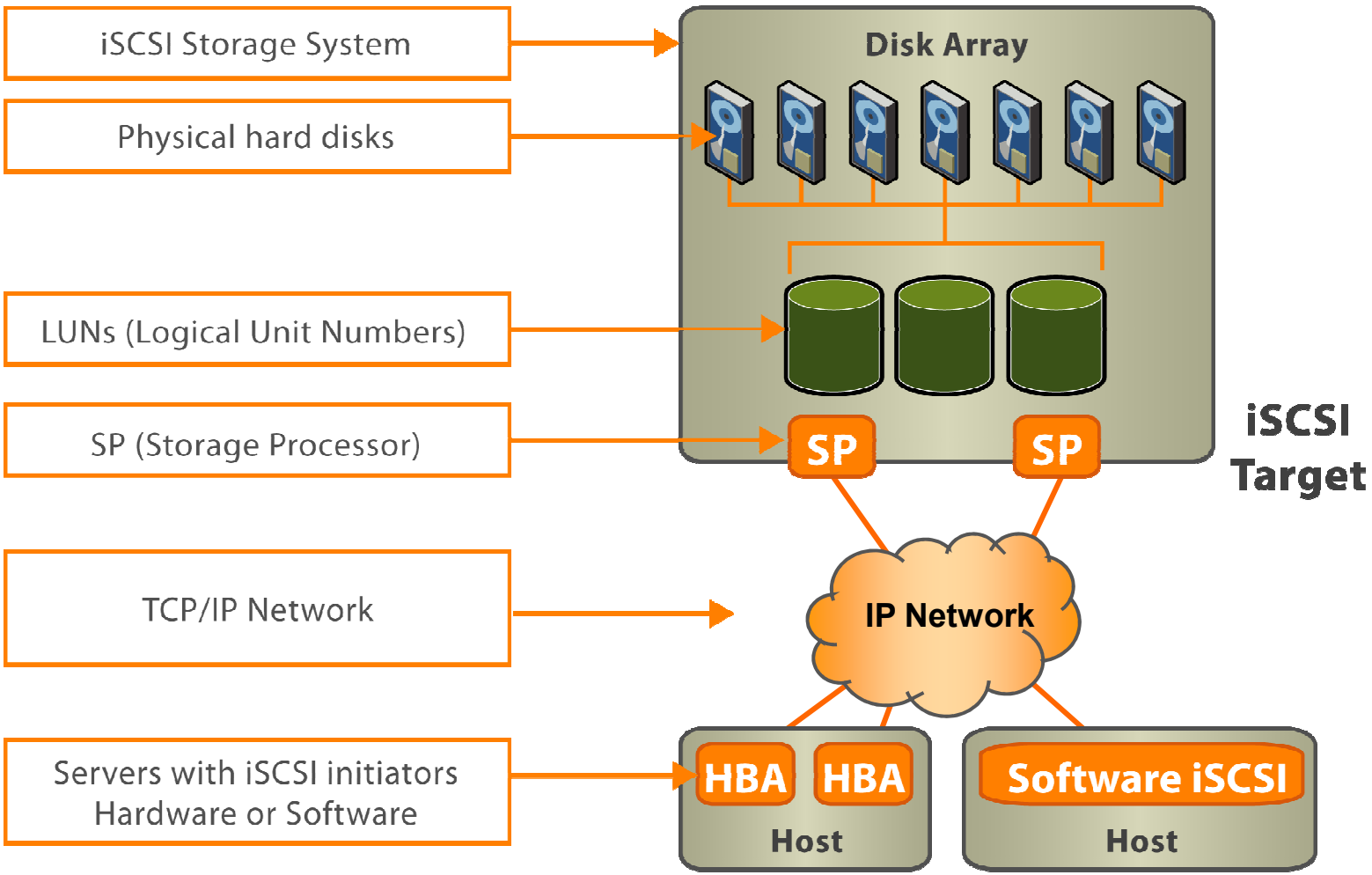
- VMFS datastores to hold virtual machines, ISO images, and templates
- RDMs to hold a virtual machine's raw data
- Supports vSphere features such as VMotion, VMware HA, and DRS
- To boot ESX from a SAN LUN (hardware initiator only)

ESX/ESXi supports:

- iSCSI over a 10GbE interface

Copyright © 2009 VMware, Inc. All rights reserved.

iSCSI Components



Copyright © 2009 VMware, Inc. All rights reserved.

iSCSI Addressing

iSCSI target name:
iqn.1992-08.com.netapp:stor1-37bf2c23 or eui.fedcba9876543210

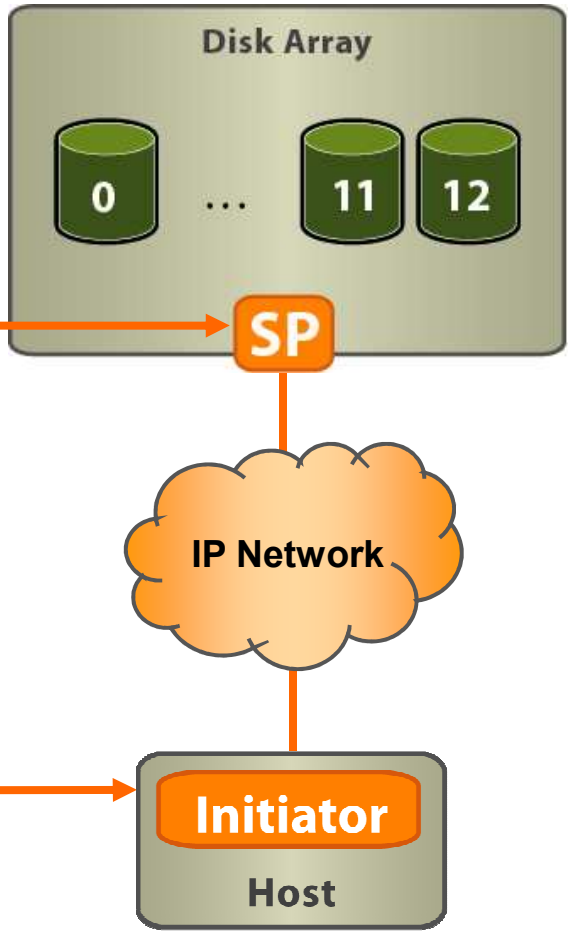
iSCSI alias: **stor1**

IP address: **192.168.36.101**

iSCSI initiator name:
iqn.1998-01.com.vmware:train1-64ad4c29 or eui.1234567890abcdef

iSCSI alias: **train1**

IP address: **192.168.36.88**

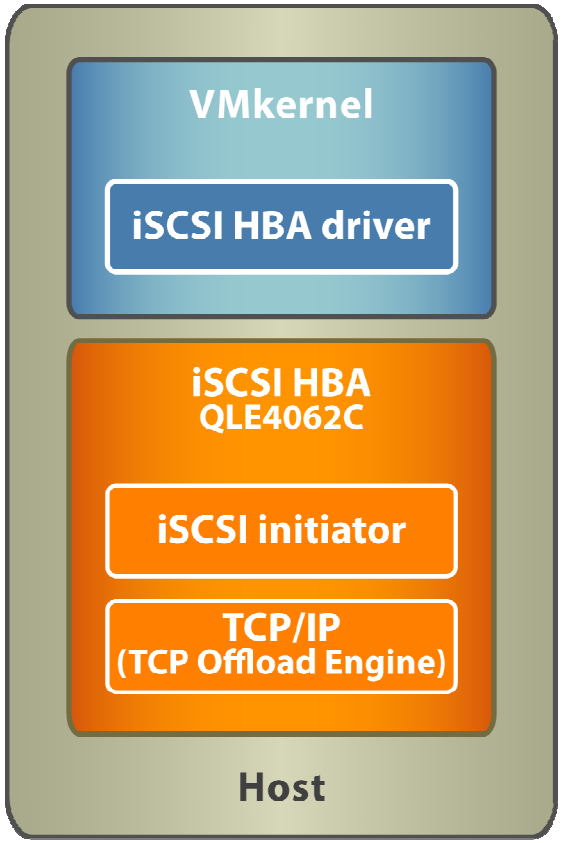


Copyright © 2009 VMware, Inc. All rights reserved.

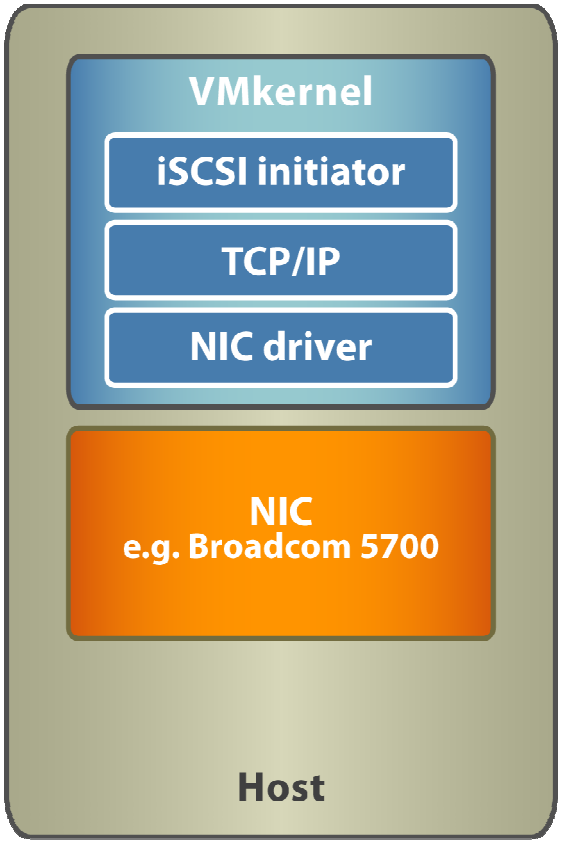
iSCSI Initiators

ESX/ESXi hosts use iSCSI initiators to access remote targets.

- **Hardware initiator**: An iSCSI HBA responsible for all iSCSI processing and management
- **Software initiator**: Code built into the VMkernel that allows ESX/ESXi to connect to the iSCSI storage device



Hardware Initiator



Software Initiator

Copyright © 2009 VMware, Inc. All rights reserved.

Steps to Configure Software iSCSI

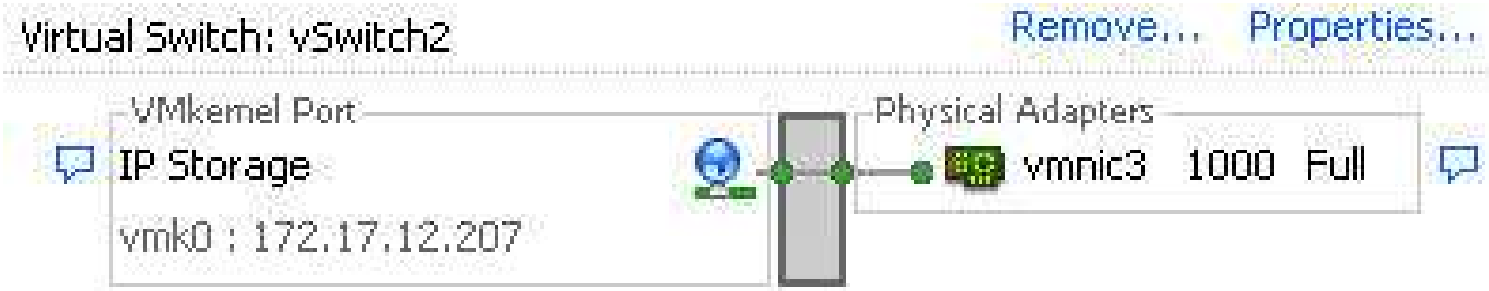
To configure the iSCSI software initiator:

1. Configure a VMkernel port for accessing IP storage.
2. Enable the iSCSI software adapter.
3. Configure iSCSI target addresses.
4. Configure iSCSI security (CHAP).

Copyright © 2009 VMware, Inc. All rights reserved.

Configuring Network for Software iSCSI

Create a VMkernel port on a vSwitch for access to IP storage (for example, iSCSI and NFS).



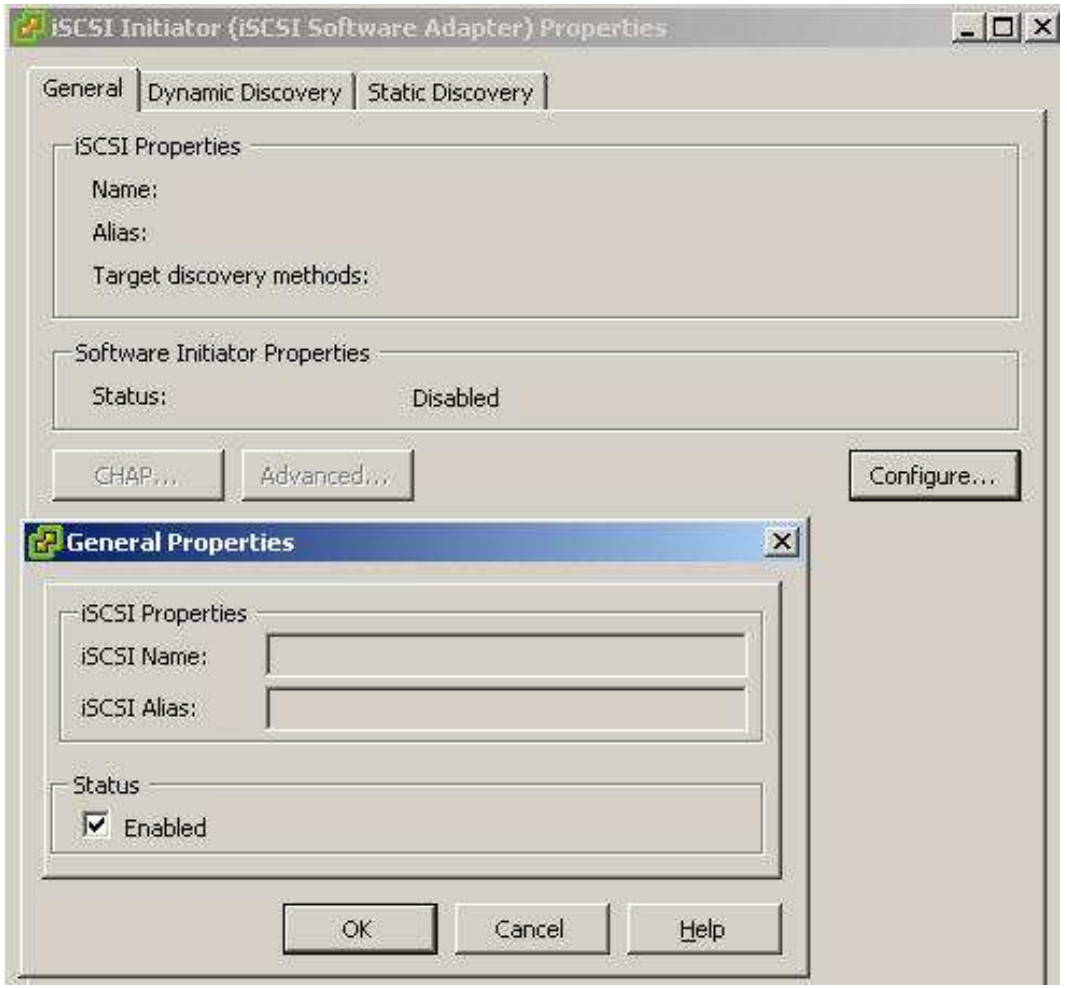
To optimize your vSphere networking setup:

- Separate network services like iSCSI and NFS access.
  - Physical separation is preferred.
  - If not possible, use VLANs.

Copyright © 2009 VMware, Inc. All rights reserved.

Enabling the iSCSI Software Adapter

In the Storage Adapters **link of the ESX/ESXi host's** Configuration **tab, click** Properties**.**



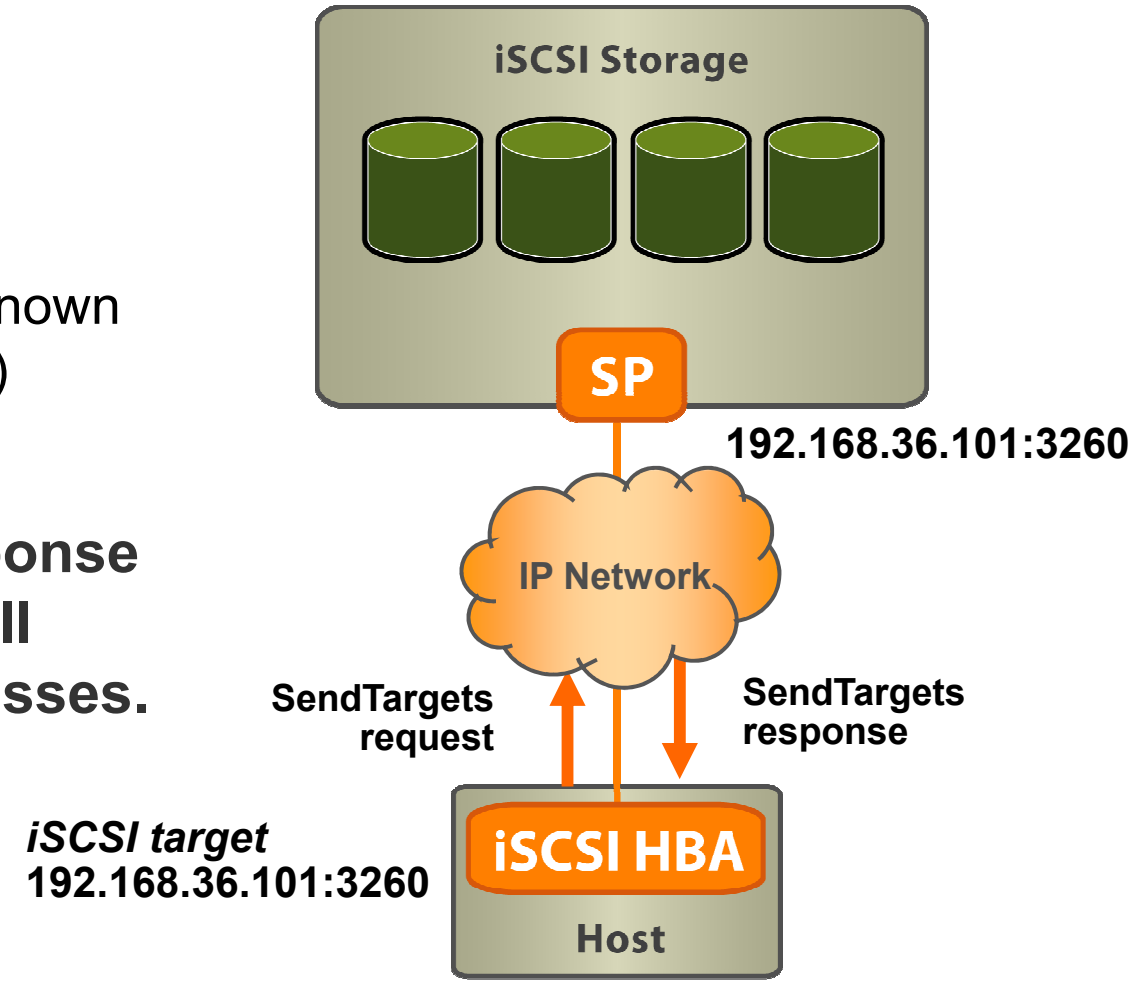
Copyright © 2009 VMware, Inc. All rights reserved.

iSCSI Target-Discovery Methods

Two discovery methods are supported:

- Dynamic (also known as SendTargets)
- Static

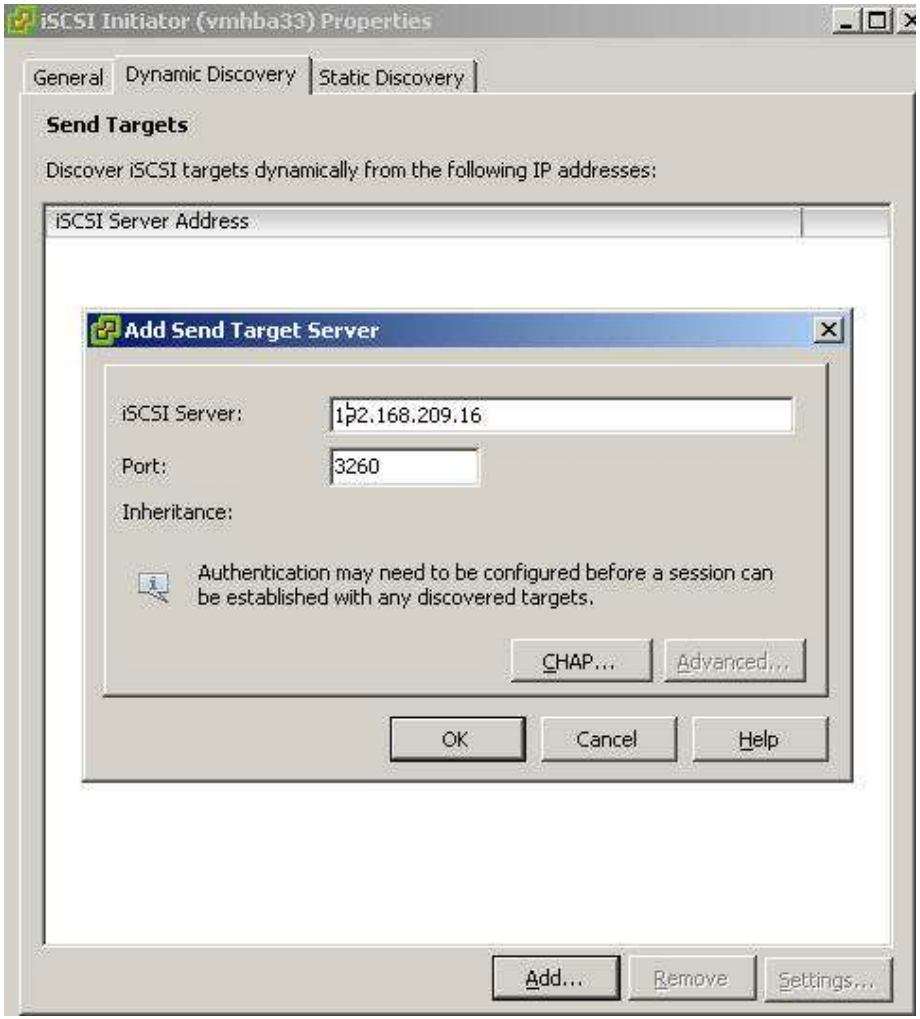
SendTargets response returns IQN and all available IP addresses.



Copyright © 2009 VMware, Inc. All rights reserved.

Configuring iSCSI Target Addresses

In the Dynamic Discovery **tab, enter the IP address or DNS name of each target server for which the initiator establishes a discovery session.**



Copyright © 2009 VMware, Inc. All rights reserved.

iSCSI Security: CHAP

iSCSI initiators can use Challenge Handshake Authentication Protocol (CHAP) for authentication purposes.

ESX/ESXi supports unidirectional and bidirectional CHAP authentication.

- Unidirectional – Target authenticates initiator, but initiator does not authenticate target.
- Bidirectional (or mutual) – Target authenticates initiator, and initiator authenticates target.

ESX/ESXi also supports per-target CHAP authentication.

- This enables you to configure different credentials for each target.

Copyright © 2009 VMware, Inc. All rights reserved.

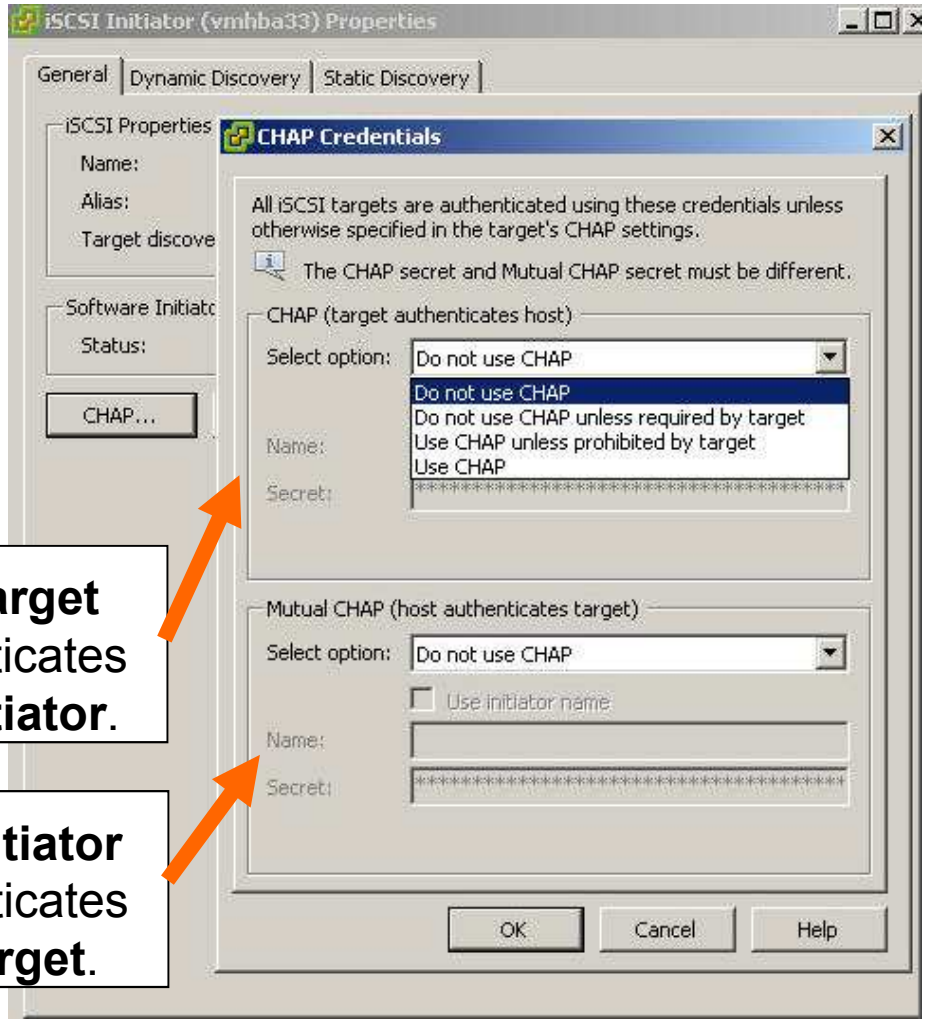
vmware

Configuring iSCSI Security: CHAP

By default, CHAP is not configured.

CHAP options:

- Do not use CHAP
- Do not use CHAP unless required by target
- Use CHAP unless prohibited by target
- Use CHAP



The **target** authenticates the **initiator**.

The **initiator** authenticates the **target**.

Copyright © 2009 VMware, Inc. All rights reserved.

Steps to Configure Hardware iSCSI

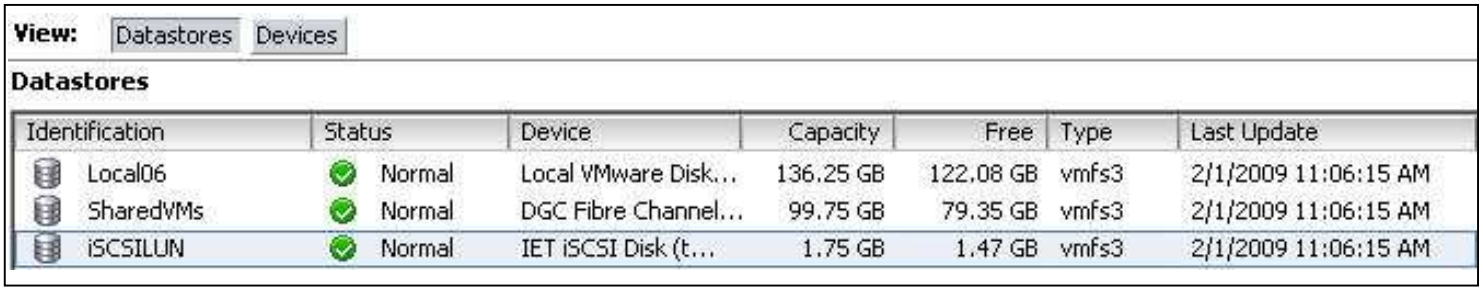
To configure the iSCSI hardware initiator:

1. Install the iSCSI hardware adapter.
2. Modify iSCSI name and configure iSCSI alias.
3. Configure iSCSI target addresses.
4. Configure iSCSI security (CHAP).

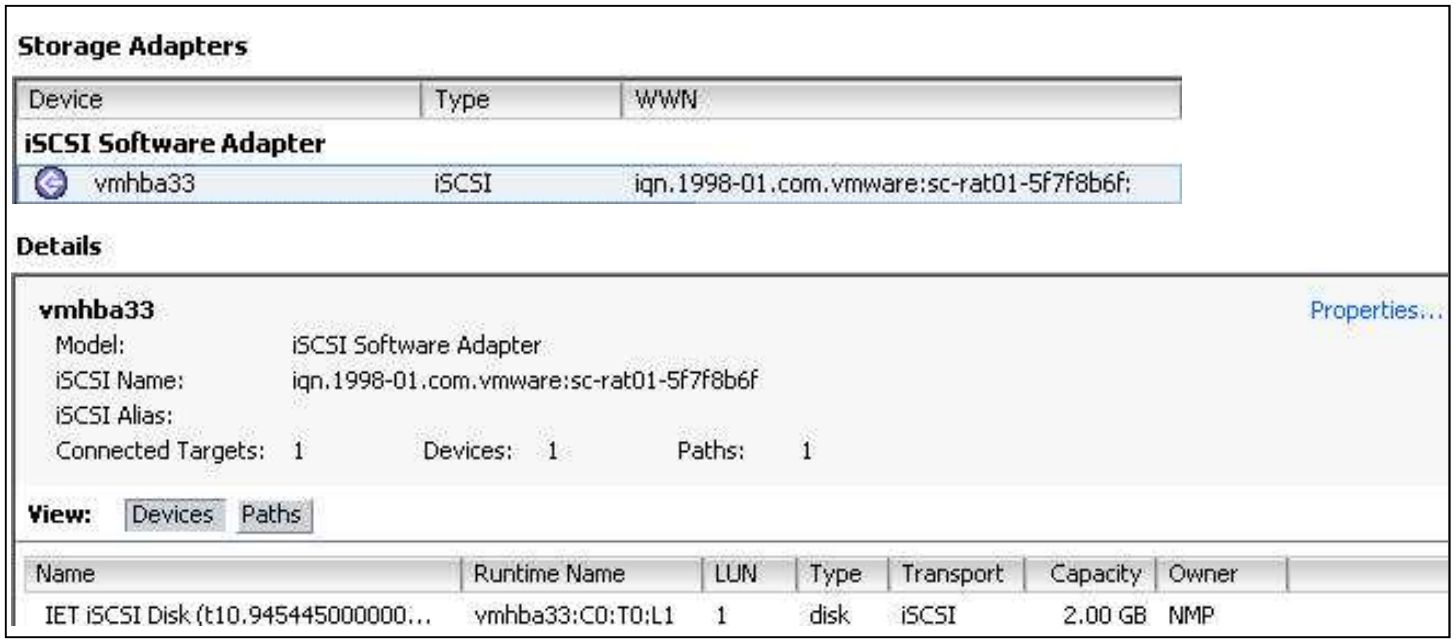
Copyright © 2009 VMware, Inc. All rights reserved.

Viewing iSCSI Information

Storage **link in the** Configuration **tab**



Storage Adapters **link in the** Configuration **tab**



Copyright © 2009 VMware, Inc. All rights reserved.

Lab 6

In this lab, you will configure access to an iSCSI datastore.

1. Create a VMkernel port on the standard switch, vSwitch0.
2. Configure the iSCSI software adapter.
3. View iSCSI storage information.

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Summary

- ESX/ESXi hosts support both hardware initiators and software initiators.
- For the iSCSI software initiator, a VMkernel port on a distributed switch or standard switch must be configured.
- iSCSI security is achieved by isolating the iSCSI network from other networks as well as by configuring CHAP.

Copyright © 2009 VMware, Inc. All rights reserved.

vmware

Lesson 4:
VMFS Datastores

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Objectives

- Create a VMFS datastore
- Grow a VMFS datastore
  - Using Volume Grow
  - Using Extent Grow
- Delete a VMFS datastore

Copyright © 2009 VMware, Inc. All rights reserved.

Using a VMFS with ESX/ESXi

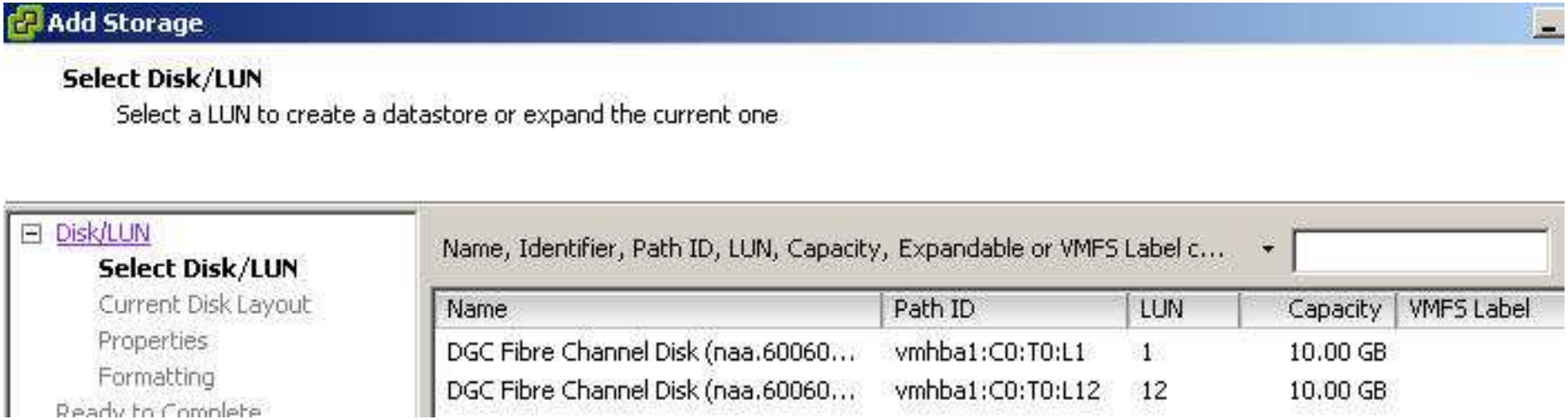
Use VMFS datastores whenever possible:

- VMFS is optimized for storing and accessing large files.
- A VMFS can have a maximum volume size of 64TB.
- NFS datastores are great for storing virtual machines. However, some functions are not supported.
- Use RDMs if your virtual machine
  - Is performing SAN snapshotting
  - Is clustered to a physical machine using Microsoft Cluster Service (MSCS)
  - Has large amounts of data that you do not want to convert into a virtual disk

Copyright © 2009 VMware, Inc. All rights reserved.

Creating a VMFS

To create a VMFS, use the Add Storage wizard.



Select LUN.

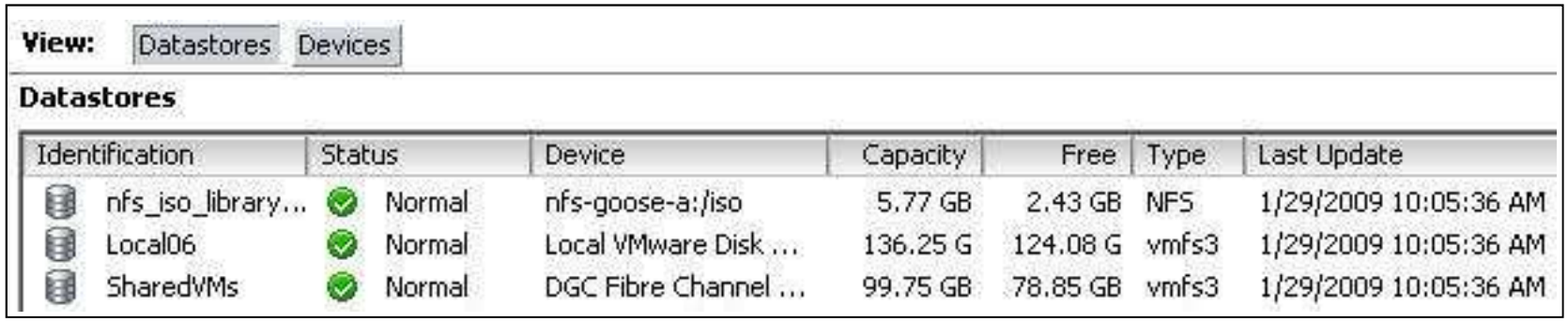
Specify datastore name.

Specify datastore size – use full or partial LUN

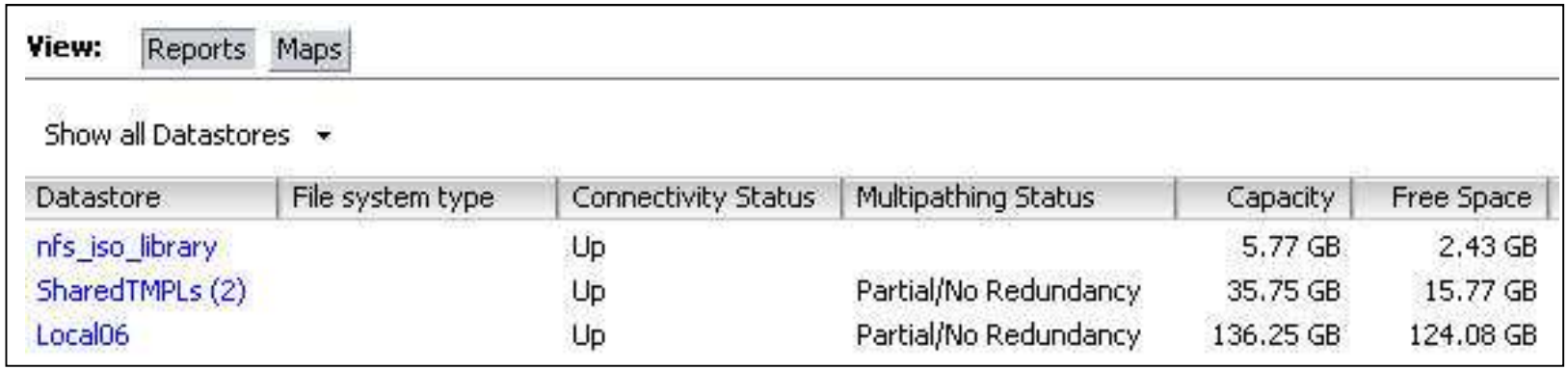
Copyright © 2009 VMware, Inc. All rights reserved.

Viewing VMFS Datastores

Storage **link in the** Configuration **tab**



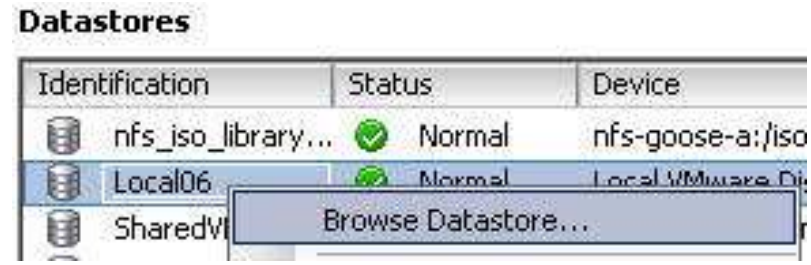
Storage Views **tab**

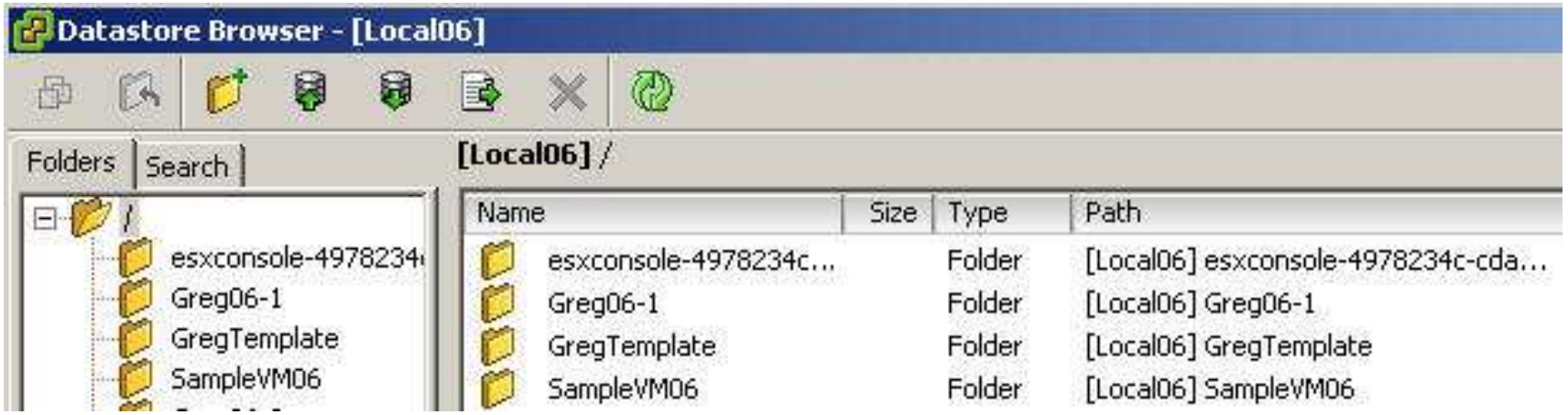


Copyright © 2009 VMware, Inc. All rights reserved.

Browsing Datastore Contents

Right-click the datastore in either the host's Summary tab or the Storage link in the Configuration tab.





Copyright © 2009 VMware, Inc. All rights reserved.

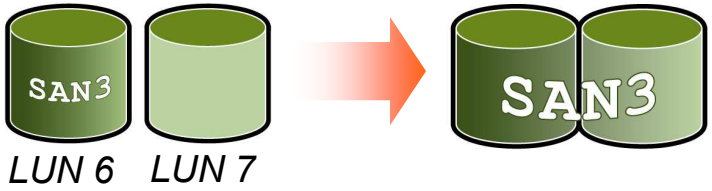
Growing a VMFS

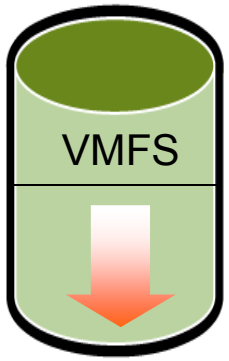
Grow a VMFS to give it more space or possibly to improve performance.

Two ways to grow a VMFS:

- Add an extent to the VMFS – This feature allows you to dynamically add a new extent to a VMFS.
- Grow the datastore – This feature allows you to dynamically expand a VMFS on the volume partition on which it is located.

Add an extent to the existing VMFS.





Grow the datastore on the existing extent.

You can grow but you cannot shrink a VMFS datastore.

Copyright © 2009 VMware, Inc. All rights reserved.

Comparing Methods for Growing a VMFS

	Growing the datastore	Adding extents to the datastore
VM power state	On	On
Newly provisioned LUN	No	Yes
Existing array-expanded LUN	Yes	Yes
Limits	An extent can be grown any number of times, up to 2TB.	A datastore can have up to 32 extents, each up to 2TB.
New partition	No	Yes
VM availability impact	None, if datastore has only one extent.	Introduces dependency on first extent.

Copyright © 2009 VMware, Inc. All rights reserved.

Before Growing a VMFS

In general, before making any changes to your storage allocation:

- Perform a rescan to ensure that your host sees the most current storage.
- Quiesce I/O on all disks involved.
- Note the unique identifier of the volume that you want to grow.

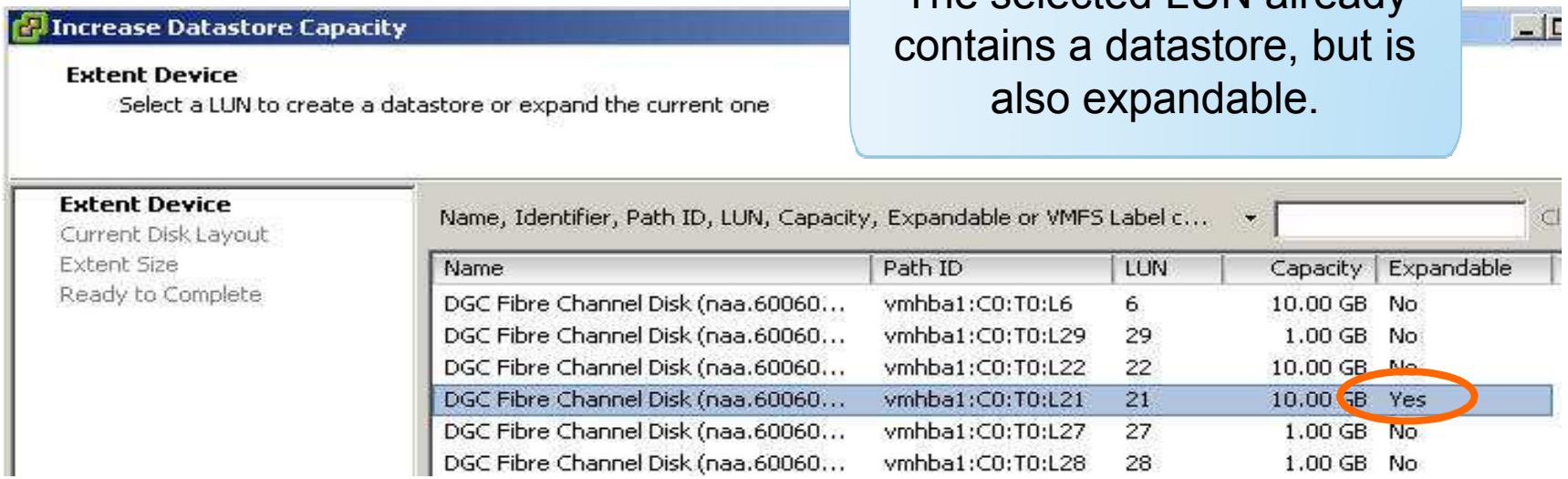
Copyright © 2009 VMware, Inc. All rights reserved.

Growing the VMFS Within the LUN

To grow a VMFS within a LUN, click Properties**.**

Click Increase **to launch the Increase Datastore Capacity wizard.**

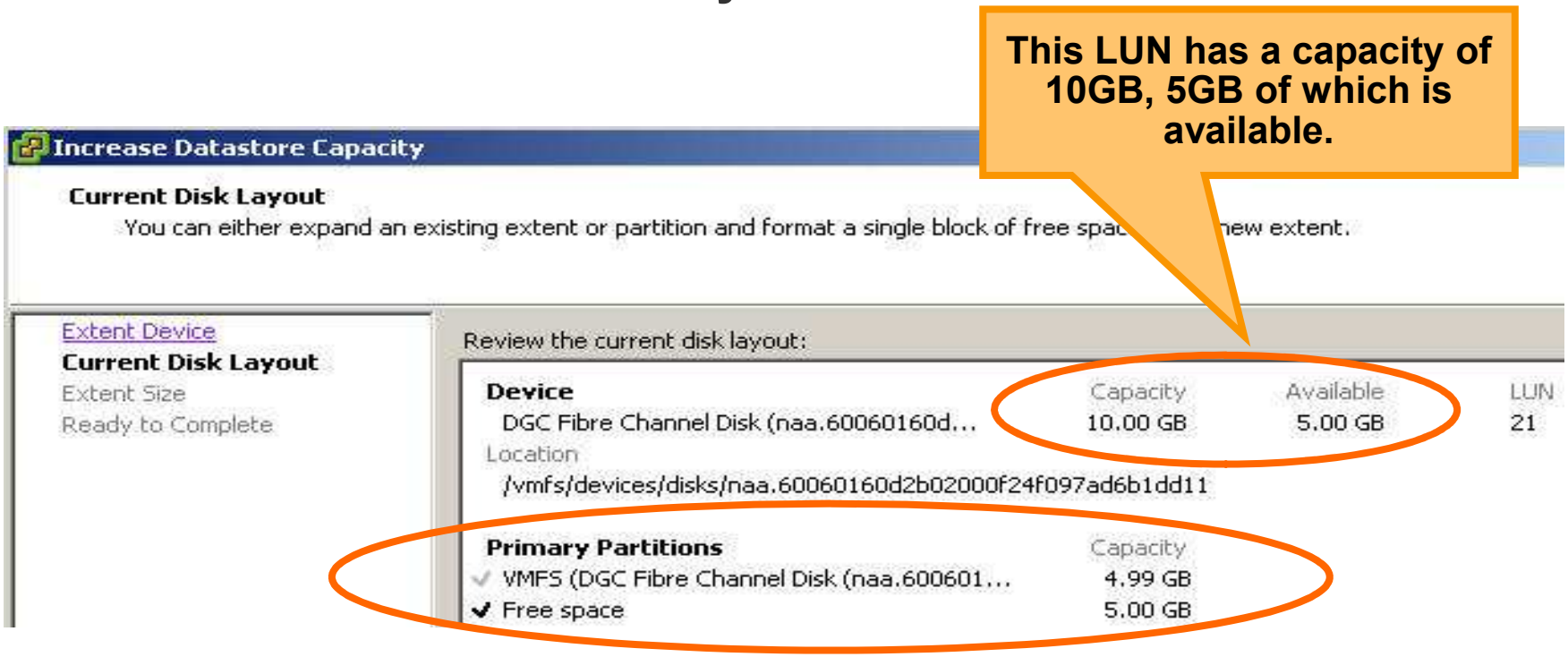
The selected LUN already contains a datastore, but is also expandable.



Copyright © 2009 VMware, Inc. All rights reserved.

Growing the VMFS: View Disk Layout

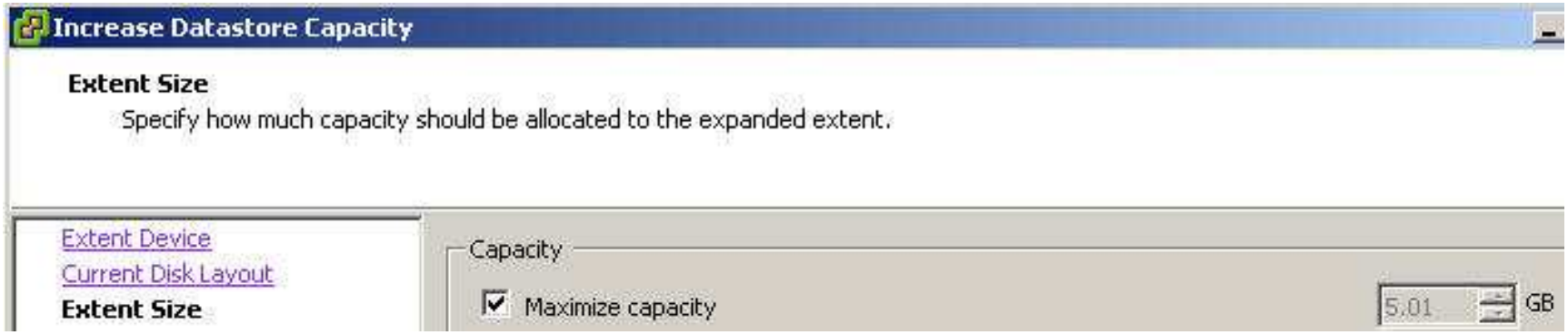
View the current disk layout.



Copyright © 2009 VMware, Inc. All rights reserved.

Growing the VMFS: Specify Capacity

Select maximize capacity to use all remaining free space, or grow the VMFS by a specific size.



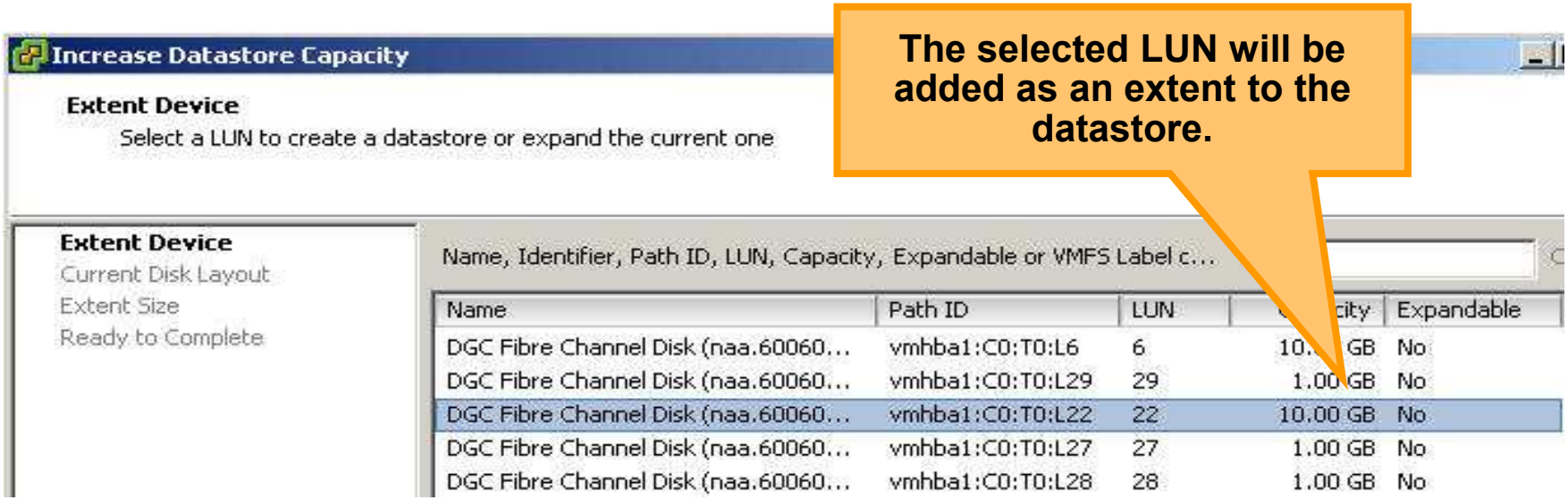
The VMFS Properties dialog box shows the new size.

Copyright © 2009 VMware, Inc. All rights reserved.

Adding an Extent: Select LUN

To add an extent to an existing VMFS, click Properties**.**

Click Increase **to launch the Increase Datastore Capacity wizard.**

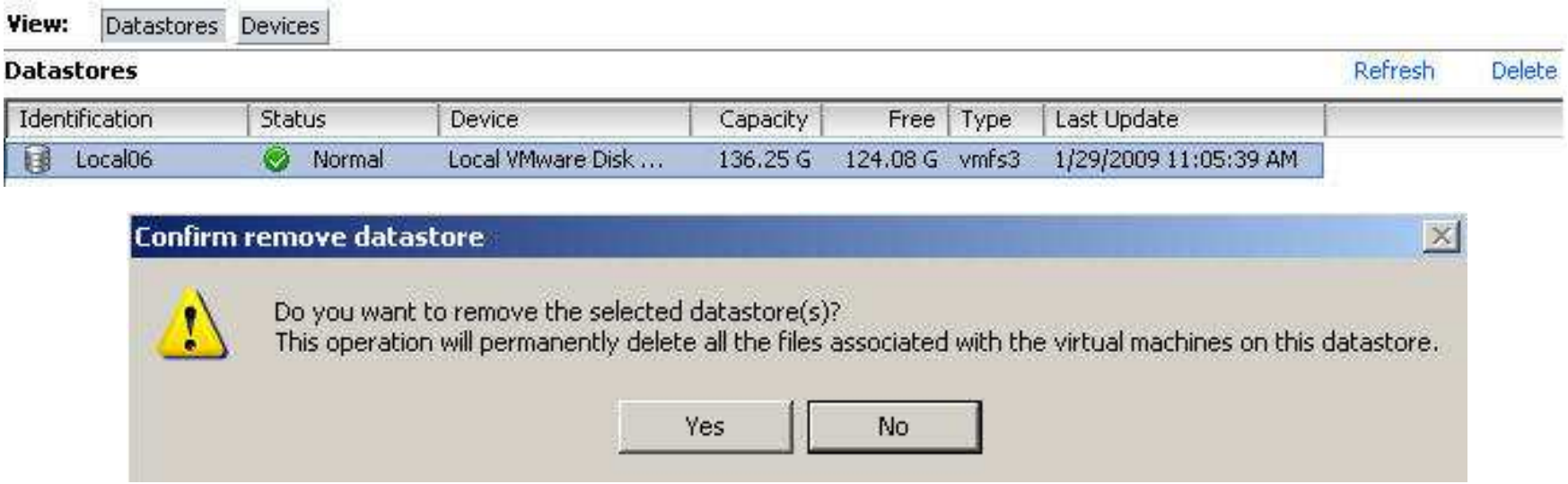


Copyright © 2009 VMware, Inc. All rights reserved.

Deleting a VMFS

Use the Storage **link in the** Configuration **tab to delete the VMFS.**

Deleting a VMFS permanently deletes all the files associated with the virtual machines on the datastore.



Copyright © 2009 VMware, Inc. All rights reserved.

Lab 7

In this lab, you will work with VMFS datastores.

1. Display information about your shared storage.
2. View information about existing VMFS datastores.
3. Change the name of your local datastore.
4. Create a VMFS datastore.
5. Grow an existing VMFS datastore.
6. Add an extent to a VMFS datastore.
7. Remove an extent by removing the entire VMFS datastore.
8. Recreate the VMFS datastore, without the additional extent.

Learn from your instructor which LUNs contain VMFS datastores that should not be removed or reformatted.

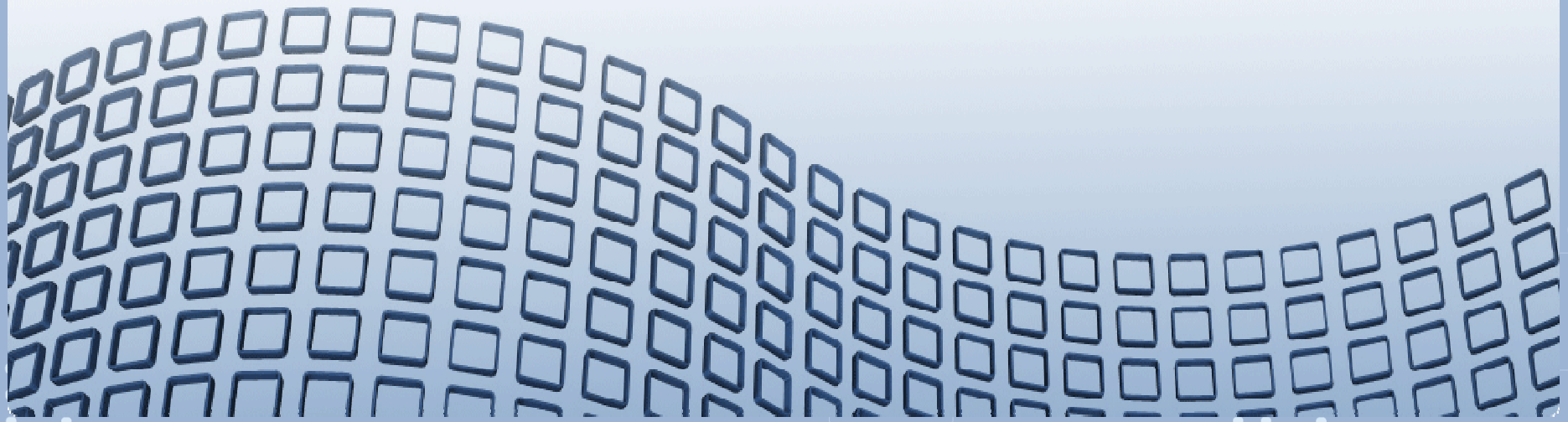
Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Summary

- Create a VMFS datastore on locally attached storage, a Fibre Channel SAN LUN, or an iSCSI LUN.
- One way to grow a VMFS is to increase its size in the existing LUN.
- Another way to grow a VMFS is to add an extent to the VMFS.
- When you delete a VMFS datastore, all data is destroyed on the datastore.

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson 5:
NAS/NFS Datastores



Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Objectives

- Describe NFS components and addressing
- Create an NFS datastore
- View the contents of a datastore
- Unmount an NFS datastore

Copyright © 2009 VMware, Inc. All rights reserved.

Using NAS/NFS with ESX/ESXi

NAS/NFS storage:

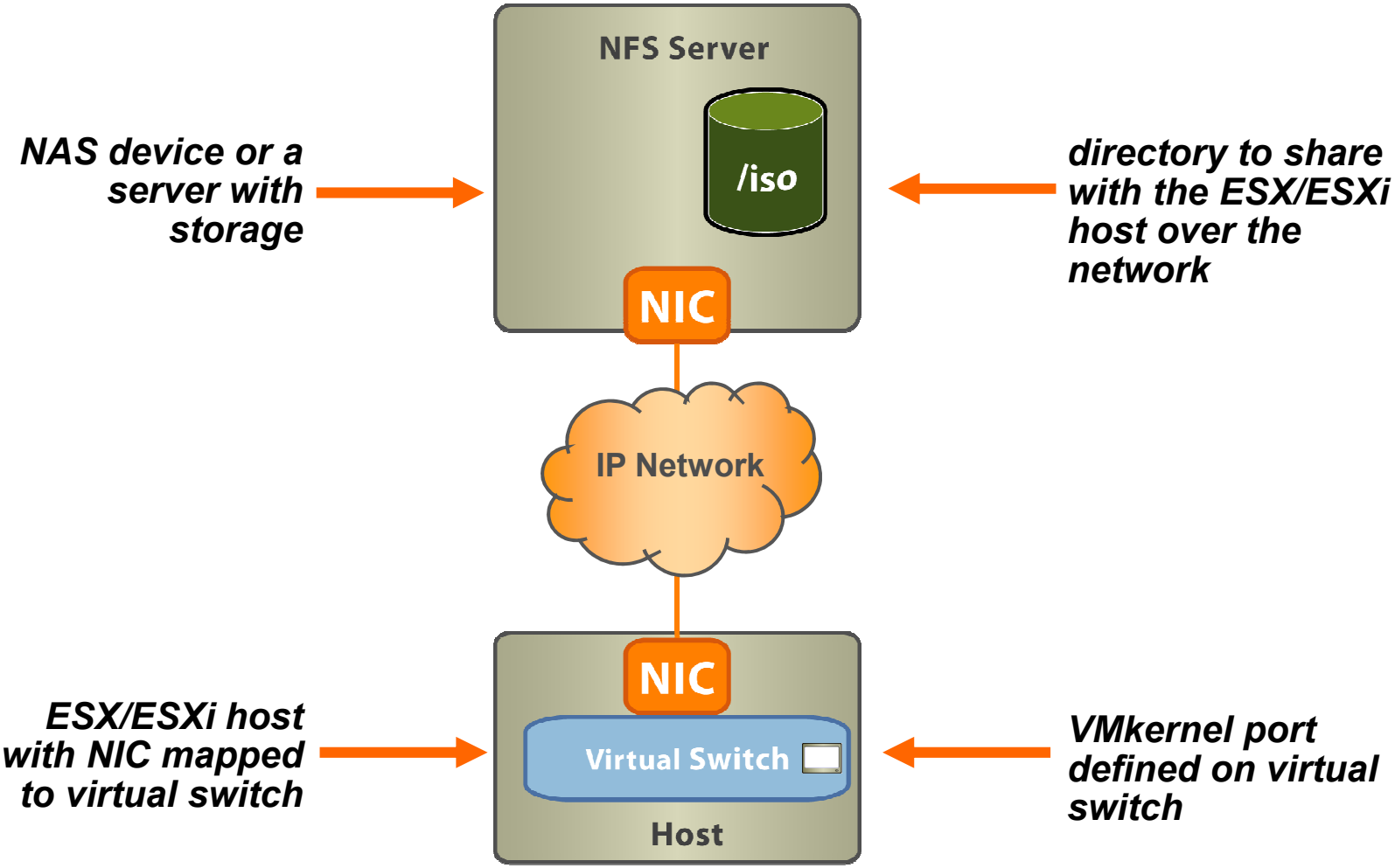
- Is used to hold virtual machines, ISO images, and templates
- Supports vSphere features like VMotion, VMware HA, and DRS

ESX/ESXi supports:

- Up to 64 NFS volumes
- NFS over a 10GbE interface
- NFS in an IPv6 environment

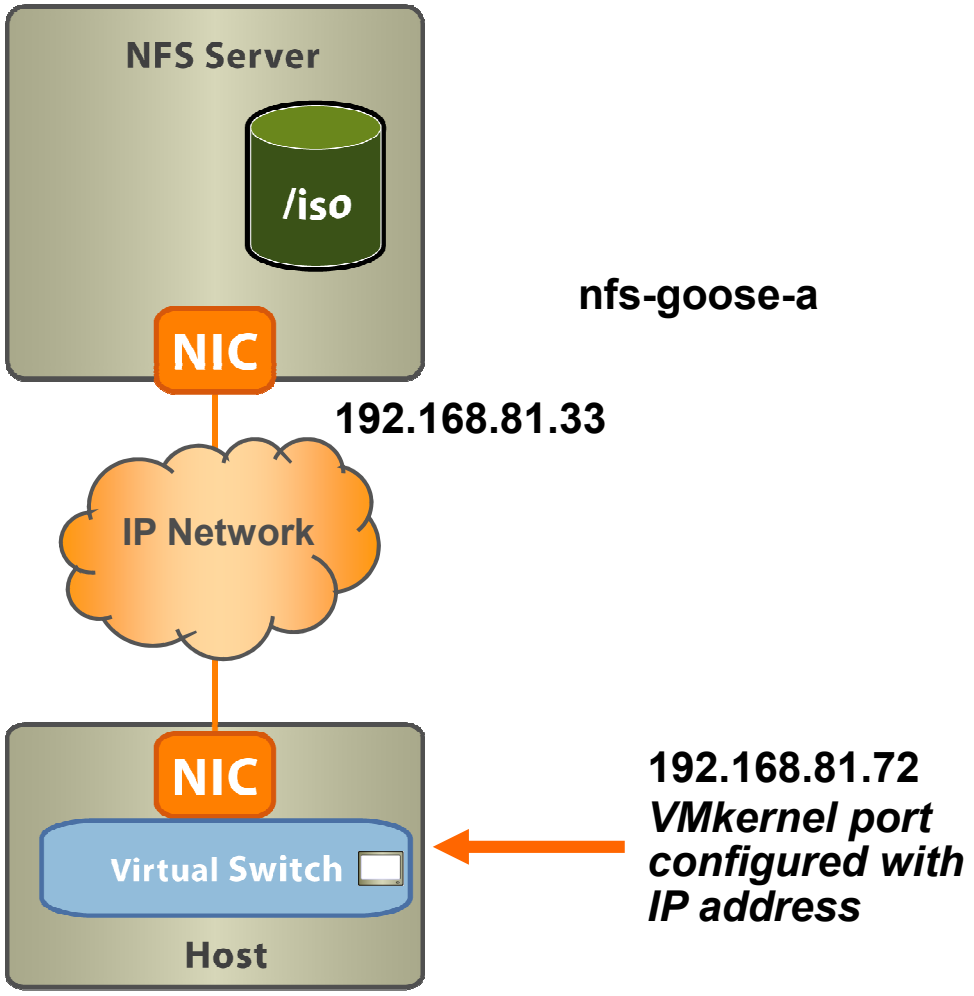
Copyright © 2009 VMware, Inc. All rights reserved.

NFS Components



Copyright © 2009 VMware, Inc. All rights reserved.

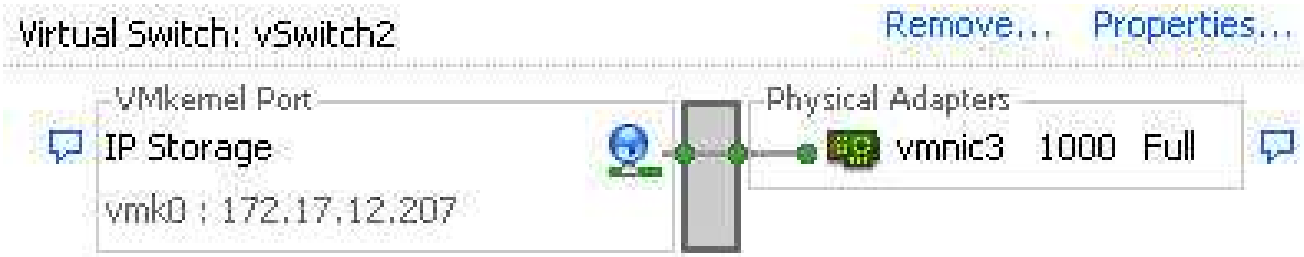
Addressing and Access Control with NFS



Copyright © 2009 VMware, Inc. All rights reserved.

Configuring Networking for NFS Access

Create a VMkernel port on a vSwitch for access to IP storage (for example, iSCSI and NFS).



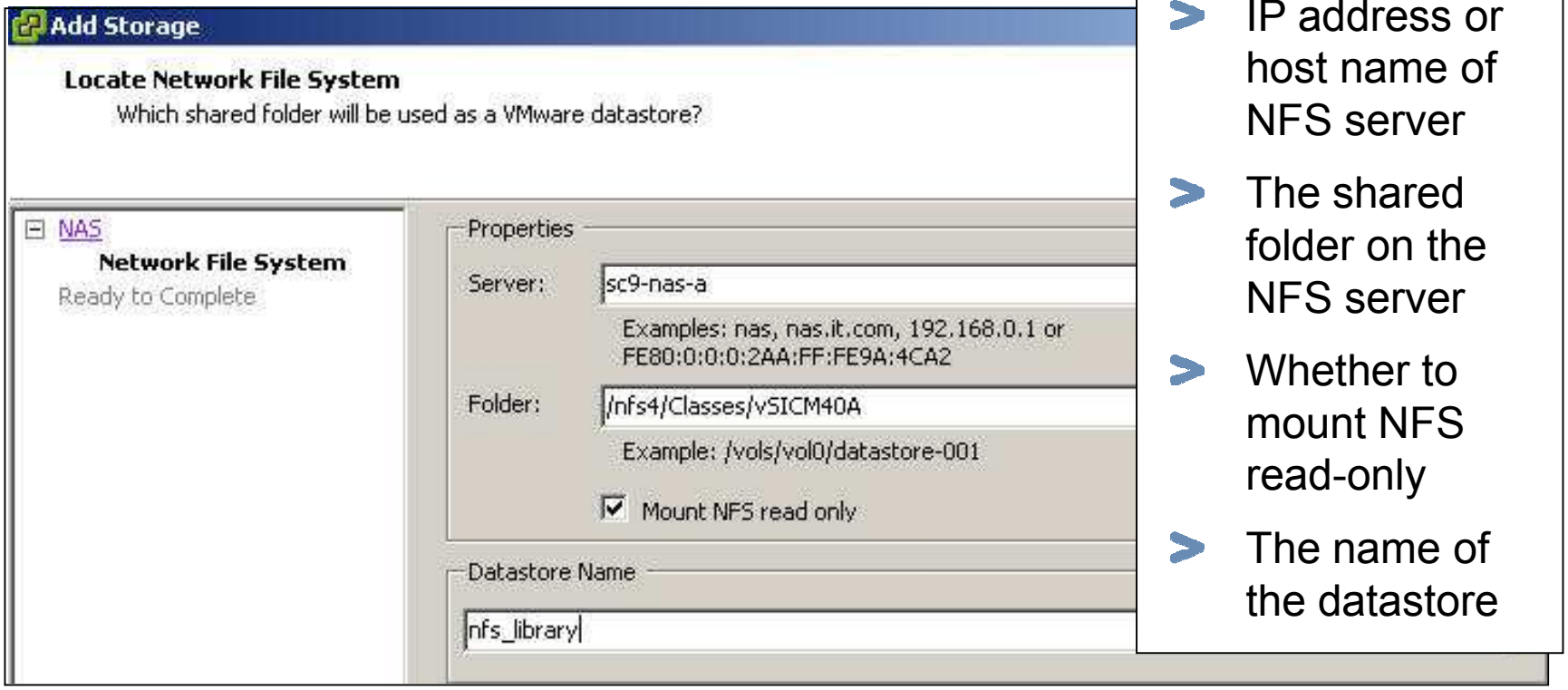
To optimize your vSphere networking setup:

- Separate network services like iSCSI and NFS access.
  - Physical separation is preferred.
  - If not possible, use VLANs.

Copyright © 2009 VMware, Inc. All rights reserved.

Creating an NFS Datastore

In the Add Storage wizard, enter the following information:



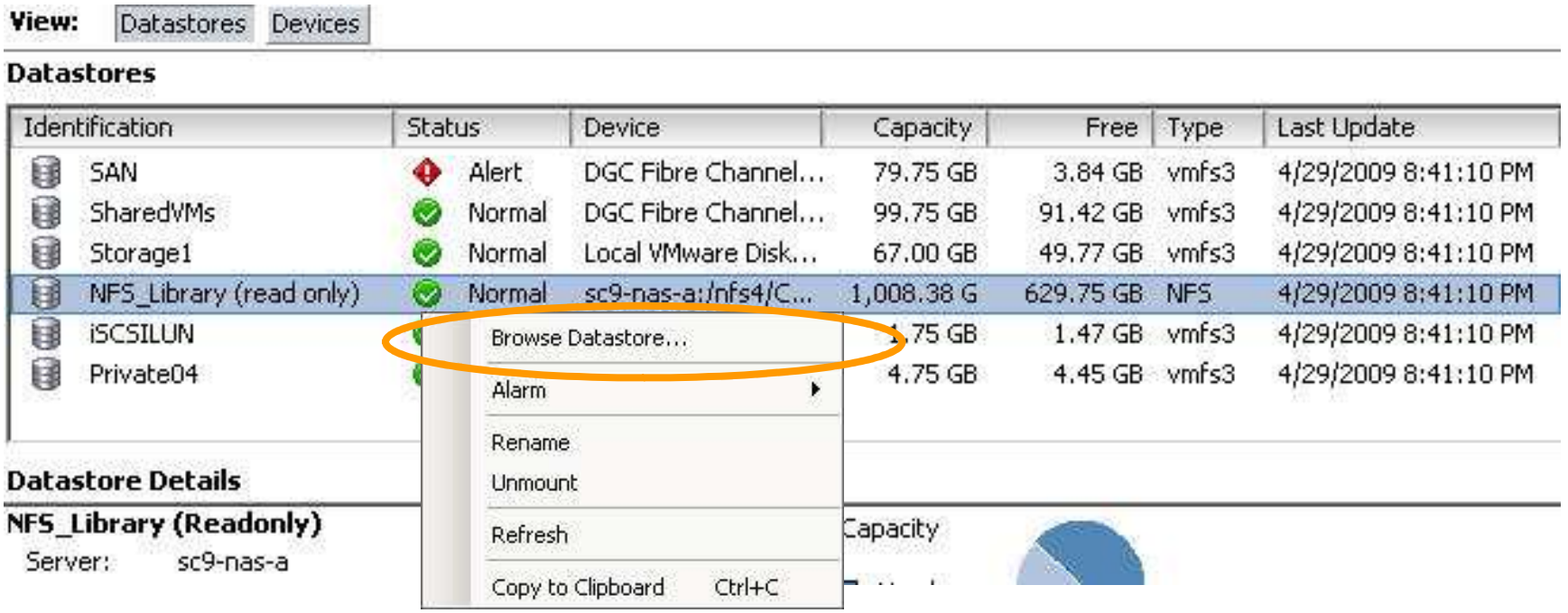
- IP address or host name of NFS server
- The shared folder on the NFS server
- Whether to mount NFS read-only
- The name of the datastore

Copyright © 2009 VMware, Inc. All rights reserved.

Viewing NFS Datastore: Storage Tab

The NFS volume is displayed in the Datastores pane of the Configuration tab.

Browse the NFS datastore to display its contents.



Copyright © 2009 VMware, Inc. All rights reserved.

Viewing NFS Datastore: Storage Views Tab

The Datastores inventory view includes NFS volumes.

The Storage Views tab shows information about all NAS mounts (NFS datastores):

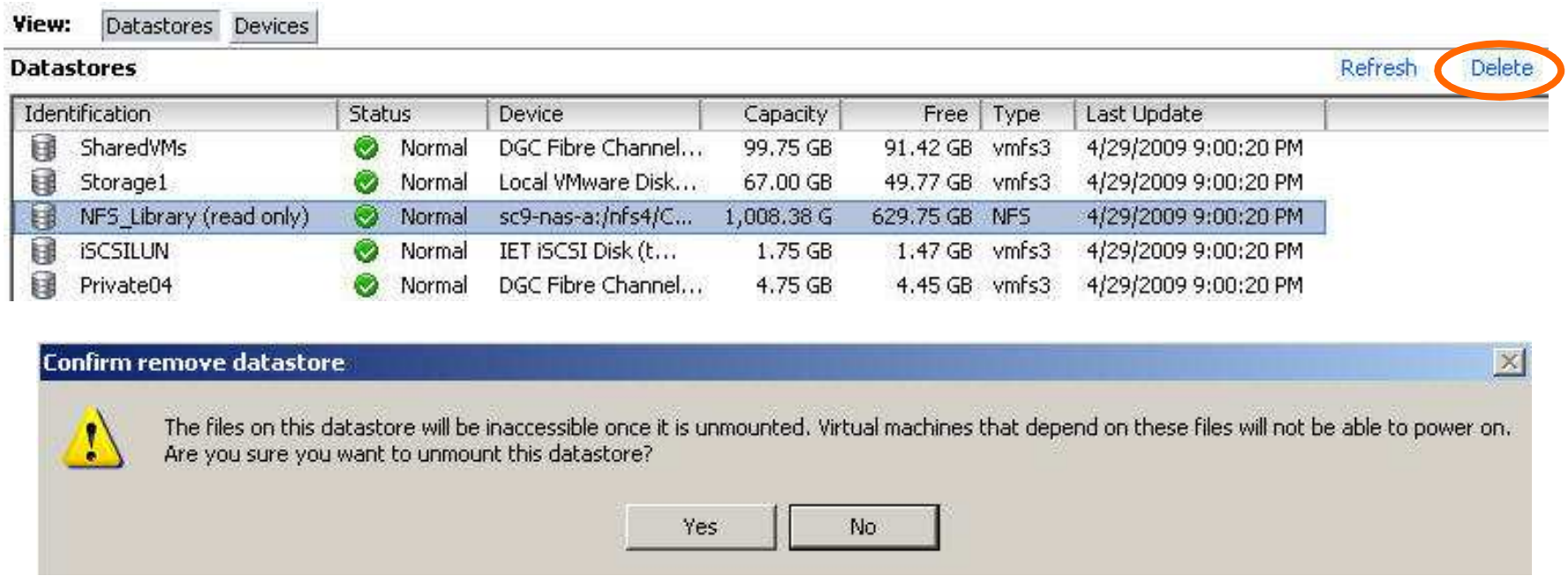
- NFS server, shared folder, datastore type, and datastore name

Copyright © 2009 VMware, Inc. All rights reserved.

Unmounting an NFS Datastore

Use the Storage **link in the** Configuration **tab to unnmount an NFS datastore.**

Unmounting an NFS datastore makes the files in the shared folder inaccessible to the host.



Copyright © 2009 VMware, Inc. All rights reserved.

Lab 8

In this lab, you will configure access to an NFS datastore.

1. Verify that a VMkernel port exists for NFS access.
2. Create an NFS datastore and view its contents.

Copyright © 2009 VMware, Inc. All rights reserved.

Lesson Summary

- When you create an NFS datastore, you must specify the NFS server host name and the shared folder on the NFS server.
- The VMware vSphere Client allows you to browse the contents of a VMFS or NFS datastore.
- When you unmount an NFS datastore, all files in the shared folder are inaccessible to the ESX/ESXi host.

Copyright © 2009 VMware, Inc. All rights reserved.

Key Points

- Whenever possible, use VMFS datastores to hold virtual machines' files.
- NFS datastores make a great repository for ISO images.
- Shared storage is integral to vSphere features like VMware HA, DRS, and VMotion.

Copyright © 2009 VMware, Inc. All rights reserved.