Setup for Failover Clustering and Microsoft Cluster Service

ESX 4.0
ESXi 4.0
vCenter Server 4.0

This document supports the version of each product listed and supports all subsequent versions until the document is replaced by a new edition. To check for more recent editions of this document, see http://www.vmware.com/support/pubs.
You can find the most up-to-date technical documentation on the VMware Web site at:
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Contents

Updated Information  5

About This Book  7

1 Getting Started with MSCS  9
   Clustering Configuration Overview  9
   Hardware and Software Requirements for Clustering  11
   Supported Shared Storage Configurations  12
   vSphere MSCS Setup Limitations  12
   MSCS and Booting from a SAN  13
   Setting up a Continuous Clustered Replication Environment for Microsoft Exchange  13

2 Cluster Virtual Machines on One Physical Host  15
   Create the First Node for Clusters on One Physical Host  15
   Create the Second Node for Clusters on One Physical Host  16
   Add Hard Disks to the First Node for Clusters on One Physical Host  17
   Add Hard Disks to the Second Node for Clusters on One Physical Host  18

3 Cluster Virtual Machines Across Physical Hosts  21
   Create the First Node for Clusters Across Physical Hosts  21
   Create the Second Node for Clusters Across Physical Hosts  22
   Add Hard Disks to the First Node for Clusters Across Physical Hosts  23
   Add Hard Disks to the Second Node for Clusters Across Physical Hosts  24

4 Cluster Physical and Virtual Machines  27
   Create the First Node for a Cluster of Physical and Virtual Machines  27
   Create the Second Node for a Cluster of Physical and Virtual Machines  28
   Add Hard Disks to the Second Node for a Cluster of Physical and Virtual Machines  29
   Install Microsoft Cluster Service  30
   Create Additional Physical-Virtual Pairs  30

5 Upgrade Clustered Virtual Machines  31

6 vSphere MSCS Setup Checklist  33

Index  35
Updated Information

This Setup for Failover Clustering and Microsoft Cluster Service guide is updated with each release of the product or when necessary.

This table provides the update history of the Setup for Failover Clustering and Microsoft Cluster Service guide.

### Table 1.

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000121-03</td>
<td>▪ Minor change in “Setting up a Continuous Clustered Replication Environment for Microsoft Exchange,” on page 13 section.</td>
</tr>
<tr>
<td>000121-02</td>
<td>▪ Added one more point in “vSphere MSCS Setup Limitations,” on page 12 section.</td>
</tr>
</tbody>
</table>
| 000121-01 | ▪ The topic “vSphere MSCS Setup Limitations,” on page 12 now states that clustering with iSCSI, FCoE, and NFS is not supported.  
▪ Minor revisions. |
| 000121-00 | Initial release. |
About This Book


Intended Audience

This book is for system administrators who are familiar with VMware technology and Microsoft Cluster Service.

NOTE This is not a guide to using Microsoft Cluster Service or Failover Clustering. Use your Microsoft documentation for information about installation and configuration of Microsoft Cluster Service or Failover Clustering.

Document Feedback

VMware welcomes your suggestions for improving our documentation. If you have comments, send your feedback to docfeedback@vmware.com.

VMware vSphere Documentation

The vSphere documentation consists of the combined VMware vCenter Server and ESX/ESXi documentation set.

Abbreviations Used in Figures

The figures in this book use the abbreviations listed in Table 2.

Table 2. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC</td>
<td>Fibre Channel</td>
</tr>
<tr>
<td>SAN</td>
<td>Storage area network type datastore shared between managed hosts</td>
</tr>
<tr>
<td>VM#</td>
<td>Virtual machines on a managed host</td>
</tr>
</tbody>
</table>
Table 2. Abbreviations (Continued)

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VNIC</td>
<td>Virtual NIC</td>
</tr>
<tr>
<td>VSCSI</td>
<td>Virtual SCSI adapter</td>
</tr>
</tbody>
</table>

Technical Support and Education Resources

The following technical support resources are available to you. To access the current version of this book and other books, go to http://www.vmware.com/support/pubs.

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VMware® vSphere supports clustering using MSCS across virtual machines. Clustering virtual machines can reduce the hardware costs of traditional high-availability clusters.

**Note** VMware High Availability (HA) supports a clustering solution in conjunction with vCenter Server clusters. The *Availability Guide* describes VMware HA functionality.

This chapter includes the following topics:
- “Clustering Configuration Overview,” on page 9
- “Hardware and Software Requirements for Clustering,” on page 11
- “Supported Shared Storage Configurations,” on page 12
- “vSphere MSCS Setup Limitations,” on page 12
- “MSCS and Booting from a SAN,” on page 13
- “Setting up a Continuous Clustered Replication Environment for Microsoft Exchange,” on page 13

### Clustering Configuration Overview

Several applications use clustering, including stateless applications such as Web servers, and applications with built-in recovery features such as database servers. You can set up MSCS clusters in several configurations, depending on your environment.

A typical clustering setup includes:
- Disks that are shared between nodes. A shared disk is required as a quorum disk. In a cluster of virtual machines across physical hosts, the shared disk must be on a Fibre Channel (FC) SAN.
- A private heartbeat network between nodes.

You can set up the shared disks and private heartbeat using one of several clustering configurations.

### Clustering Virtual Machines on a Single Host

A cluster of virtual machines on a single host (also known as a cluster in a box) consists of two clustered virtual machines on the same ESX/ESXi host connected to the same storage, either local or remote. This configuration protects against failures at the operating system and application level, but it does not protect against hardware failures.

**Figure 1-1** shows a cluster in a box setup.

- Two virtual machines on the same physical machine (ESX/ESXi host) run clustering software.
The virtual machines share a private network connection for the private heartbeat and a public network connection.

Each virtual machine is connected to shared storage, which can be local or on a SAN.

**Figure 1-1. Virtual Machines Clustered on a Single Host**

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Clustering Virtual Machines Across Physical Hosts

A cluster of virtual machines across physical hosts (also known as a cluster across boxes) protects against software failures and hardware failures on the physical machine by placing the cluster nodes on separate ESX/ESXi hosts. This configuration requires shared storage on an FC SAN for the quorum disk.

*Figure 1-2* shows a cluster-across-boxes setup.

- Two virtual machines on two different physical machines (ESX/ESXi hosts) run clustering software.
- The virtual machines share a private network connection for the private heartbeat and a public network connection.
- Each virtual machine is connected to shared storage, which must be on a SAN.

**Figure 1-2. Virtual Machines Clustered Across Hosts**

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This setup provides significant hardware cost savings.

You can expand the cluster-across-boxes model and place multiple virtual machines on multiple physical machines. For example, you can consolidate four clusters of two physical machines each to two physical machines with four virtual machines each.

*Figure 1-3* shows how four two-node clusters can be moved from eight physical machines to two.
Clustering Physical Machines with Virtual Machines

For a simple clustering solution with low hardware requirements, you might choose to have one standby host. Set up your system to have a virtual machine corresponding to each physical machine on the standby host, and create clusters, one each for each physical machine and its corresponding virtual machine. In case of hardware failure in one of the physical machines, the virtual machine on the standby host can take over for that physical host.

Figure 1-4 shows a standby host using three virtual machines on a single physical machine. Each virtual machine is running clustering software.

Hardware and Software Requirements for Clustering

All vSphere MSCS configurations require certain hardware and software components. Table 1-1 lists hardware and software requirements that apply to all vSphere MSCS configurations.
### Table 1-1. Clustering Requirements

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual SCSI adapter</td>
<td>LSI Logic Parallel for Windows 2000 Server</td>
</tr>
<tr>
<td></td>
<td>LSI Logic Parallel for Windows Server 2003</td>
</tr>
<tr>
<td></td>
<td>LSI Logic SAS for Windows Server 2008</td>
</tr>
<tr>
<td>Operating system</td>
<td>Windows Server 2003 SP2, Windows 2000 Server SP4, or Windows Server 2008</td>
</tr>
<tr>
<td>Virtual NIC</td>
<td>Use the default type for all guest operating systems.</td>
</tr>
<tr>
<td>I/O timeout</td>
<td>Set to 60 seconds or more. Modify HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Disk\TimeOutValue. The system might reset this I/O timeout value if you recreate a cluster. You must reset the value in that case.</td>
</tr>
<tr>
<td>Disk format</td>
<td>Select Support clustering features such as Fault Tolerance to create disks in eagerzeroedthick format.</td>
</tr>
<tr>
<td>Disk and networking setup</td>
<td>Add networking before disks. Refer to the VMware knowledge base article at <a href="http://kb.vmware.com/kb/1513">http://kb.vmware.com/kb/1513</a> if you encounter any errors.</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>Use two-node clustering.</td>
</tr>
<tr>
<td>NTP server</td>
<td>Synchronize domain controllers and cluster nodes with a common NTP server, and disable host-based time synchronization when using clustering in the guest.</td>
</tr>
</tbody>
</table>

### Supported Shared Storage Configurations

Different MSCS cluster setups support different types of shared storage configurations. Some setups support more than one type. Select the recommended type of shared storage for best results.

Table 1-2 lists supported setups for each clustering solution.

### Table 1-2. Shared Storage Requirements

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Clusters on One Physical Machine (Cluster in a Box)</th>
<th>Clusters Across Physical Machines (Cluster Across Boxes)</th>
<th>Clusters of Physical and Virtual Machines (Standby Host Clustering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual disks</td>
<td>Yes (recommended)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pass-through RDM (physical compatibility mode)</td>
<td>No</td>
<td>Yes (recommended)</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-pass-through RDM (virtual compatibility mode)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Note**  Clusters across physical machines with non-pass-through RDM is supported only for clustering with Windows 2000 Server or Windows Server 2003. It is not supported for clustering with Windows Server 2008.

### vSphere MSCS Setup Limitations

Before you set up MSCS, review the list of functionality that is not supported for this release, and any requirements and recommendations that apply to your configuration.

The following environments and functionality are not supported for MSCS setups with this release of vSphere:

- Clustering on iSCSI, FCoE, and NFS disks.
- Mixed environments, such as configurations where one cluster node is running a different version of ESX/ESXi than another cluster node.
- Clustered virtual machines as part of VMware clusters (DRS or HA).
- Use of MSCS in conjunction with VMware Fault Tolerance.
- Migration with VMotion of clustered virtual machines.
- N-Port ID Virtualization (NPIV)
  - With native multipathing (NMP), clustering is not supported when the path policy is set to round robin.
  - You must use hardware version 7 with ESX/ESXi 4.0.
  - With native multipathing (NMP), clustering is not supported when the path policy is set to round robin.
    Third-party multipathing plug-ins might support round robin or other load balancing behavior with Microsoft clusters. Support of third-party multipathing plug-ins is provided by the plug-in vendor.

**MSCS and Booting from a SAN**

You can put the boot disk of a virtual machine on a SAN-based VMFS volume.

MSCS is supported in a setup where virtual machines boot from an FC SAN.

Booting from a SAN is complex. Problems that you encounter in physical environments extend to virtual environments. For general information about booting from a SAN, see the *Fibre Channel SAN Configuration Guide*.

Follow these guidelines when you place the boot disk of a virtual machine on a SAN-based VMFS volume:

- Consider the best practices for boot-from-SAN that Microsoft publishes in the following knowledge base article: [http://support.microsoft.com/kb/305547/en-us](http://support.microsoft.com/kb/305547/en-us).
- Use StorPort LSI Logic drivers instead of SCSIport drivers when running Microsoft Cluster Service for Windows Server 2003 or 2008 guest operating systems.
- Test clustered configurations in different failover scenarios before you put them into production environments.

**Setting up a Continuous Clustered Replication Environment for Microsoft Exchange**

You can set up a Continuous Cluster Replication or Database Availability Groups with Exchange 2010 in your vSphere environment.

When working in a vSphere environment:

- Use virtual machines instead of physical machines as the cluster components.
- Use physical compatibility mode RDMs.
  
    If the boot disks of the CCR virtual machines are on a SAN, refer to “**MSCS and Booting from a SAN,”** on page 13.

For more information, refer to Microsoft’s documentation for CCR clusters on the Microsoft Web site.
Cluster Virtual Machines on One Physical Host

You can create a two-node MSCS cluster on a single ESX/ESXi host.

Prerequisites

A cluster of virtual machines on one physical machine requires an ESX/ESXi host with the following:

- For ESX hosts, use one physical network adapter for the service console. Use a separate physical network adapter for clustered virtual machines to connect with external hosts.
- For ESXi, use one physical network adapter for the VMkernel. Use a separate physical network adapter for clustered virtual machines to connect with external hosts.

This chapter includes the following topics:

- “Create the First Node for Clusters on One Physical Host,” on page 15
- “Create the Second Node for Clusters on One Physical Host,” on page 16
- “Add Hard Disks to the First Node for Clusters on One Physical Host,” on page 17
- “Add Hard Disks to the Second Node for Clusters on One Physical Host,” on page 18

Create the First Node for Clusters on One Physical Host

To create the first node, you create and configure a virtual machine with two virtual network adapters and install a guest operating system on the virtual machine.

You configure the virtual network adapters to handle virtual machine traffic for the cluster: a private network connection for the private heartbeat and a public network connection.

Procedure

1. Open the vSphere Client and connect to the ESX/ESXi host or a vCenter Server system.
   
   Use the user name and password of the user who will own the virtual machine.

2. In the vSphere Client inventory, right-click the host and select New Virtual Machine.

3. Proceed through the wizard to create the virtual machine.

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Select Typical.</td>
</tr>
<tr>
<td>Name and Location</td>
<td>Enter a name and select a location.</td>
</tr>
<tr>
<td>Datastore</td>
<td>Select a datastore as the location for the virtual machine configuration file and the virtual machine disk (.vmdk) file.</td>
</tr>
<tr>
<td>Guest Operating System</td>
<td>Select the Windows Server operating system that you intend to install.</td>
</tr>
</tbody>
</table>
**Option** | **Action**
--- | ---
Create Disk | Enter the appropriate value in **Virtual disk size**. Select **Support clustering features such as Fault Tolerance** to create a disk in **eagerzeroedthick** format.

**Ready to Complete** | Select **Edit the virtual machine settings before completion** and click **Continue**. The Virtual Machine Properties dialog box appears.

4. In the Virtual Machine Properties dialog box, select **New NIC (adding)**.
5. Under Network Connection, select a label from the Network Label list.
   The network label refers to the network to be used for virtual machine traffic for the cluster, either public or private.
6. Click **Finish** to complete creating the virtual machine.

   **NOTE** Do not add shared cluster disks at this time.

7. In the Virtual Machine Properties dialog box, click **Add**.
8. From the list of devices, select **Ethernet Adapter** and click **Next**.
9. Select the adapter type and network label.
   - If you selected a private network for the first network adapter, you must select a public network for this network adapter.
   - If you selected a public network for the first network adapter, you must select a private network adapter.
10. Click **Next**, and click **Finish** to complete creating the device.
11. Install a Windows Server operating system on the virtual machine.
   The new node appears in the virtual machine inventory.

**What to do next**
Clone the virtual machine to create the second node.

### Create the Second Node for Clusters on One Physical Host

To create the second node, you clone the first virtual machine that you created using the vSphere Client connected to a vCenter Server system.

**CAUTION** If you clone a virtual machine with an RDM setup, the cloning process converts the RDMs to virtual disks. Unmap all RDMs before cloning, and remap them after cloning is complete.

**Prerequisites**
Before you begin, shut down the guest operating system and power off the virtual machine that you intend to clone.

**Procedure**
1. In the vSphere Client inventory, right-click the virtual machine and select **Clone**.
2. Proceed through the wizard to clone the virtual machine.

<table>
<thead>
<tr>
<th>Page</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name and Location</td>
<td>Enter a name (for example, Node2_Template) and select a location.</td>
</tr>
<tr>
<td>Host/Cluster</td>
<td>Select the host or cluster where you will run the virtual machine.</td>
</tr>
</tbody>
</table>
You have created a virtual machine with two network adapters. The operating system you chose for the first node is installed on the second node.

What to do next
Add a shared quorum disk.

Add Hard Disks to the First Node for Clusters on One Physical Host

In an MSCS cluster, storage disks are shared between nodes. You set up a quorum disk and an optional shared storage disk.

Procedure

1. In the vSphere Client inventory, select the newly created virtual machine and select Edit Settings. The Virtual Machine Properties dialog box appears.
2. Click Add, select Hard Disk, and click Next.
3. Select Create a new virtual disk and click Next.
4. Select the disk size.
5. Under Disk Provisioning, select Support clustering features such as Fault Tolerance. You can also use a mapped SAN LUN set to virtual compatibility mode.
6. Click Next.
7. From the Virtual Device Node drop-down menu, select a new SCSI controller (for example, SCSI (1:0)).

   **NOTE**: You must select a new virtual device node. You cannot use SCSI 0.
8. Click Next, and click Finish. The wizard creates a new hard disk and a new SCSI controller.
9. In the Virtual Machine Properties dialog box, select the new SCSI controller and click Change Type. The Change SCSI Controller Type dialog box appears.
10. Select the appropriate type of controller, depending on your operating system.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Type of Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 2000 Server</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2003</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2008</td>
<td>LSI Logic SAS</td>
</tr>
</tbody>
</table>

You must download the LSI Logic Parallel driver for Windows 2000 Server on the LSI Web site.
11. Click OK.
12. On the Virtual Machine Properties dialog box, set SCSI Bus Sharing to Virtual and click OK.
Figure 2-1 shows the setup: a virtual machine connected to the shared storage on the Fibre Channel (FC) SAN and to local or remote storage for the virtual disk. The virtual machine has two available network connections, one for the private heartbeat and one for public communications.

![Cluster in a Box Setup for One Node](image)

**What to do next**

Add hard disks to the second node.

**Add Hard Disks to the Second Node for Clusters on One Physical Host**

To allow shared access to clustered services and data, point the quorum disk of the second node to the same location as the first node’s quorum disk. Point any shared storage disks to the same location as the first node’s shared storage disks.

**Prerequisites**

Before you begin, obtain the following information:

- Which virtual device node is for the first virtual machine’s shared storage disks (for example, SCSI (1:0)).
- The location of the quorum disk specified for the first node.

**Procedure**

1. In the vSphere Client inventory, select the second virtual machine that you created and select **Edit Settings**.

   The Virtual Machine Properties dialog box appears.

2. Click **Add**, select **Hard Disk**, and click **Next**.

3. Select **Use an existing virtual disk** and click **Next**.

4. Select the same virtual device node you chose for the first virtual machine’s shared storage disks (for example, SCSI (1:0)), and click **Next**.

   **Note** The location of the virtual device node for this virtual machine’s shared storage must match the corresponding virtual device node for the first virtual machine.

5. In Disk File Path, browse to the location of the quorum disk specified for the first node.

**Figure 2-2** shows the complete setup.
Figure 2-2. Cluster in a Box Complete Setup

- **NIC1** connected to:
  - **virtual switch1 (public)**
  - **virtual switch2 (private)**

- **VNIC1** connected to:
  - **virtual machine Node1**
  - **VSCSI1**
  - **SCSI1**
  - **FC**

- **VNIC2** connected to:
  - **virtual machine Node2**
  - **VSCSI2**
  - **SCSI2**

- **physical machine**

- **local or remote storage**

- **remote storage**
Cluster Virtual Machines Across Physical Hosts

You can create a MSCS cluster that consists of two virtual machines on two ESX/ESXi hosts.

Prerequisites
A cluster across physical hosts requires specific hardware and software.

- ESX/ESXi hosts that have the following:
  - Two physical network adapters dedicated to the MSCS cluster and to the public and private networks.
  - One physical network adapter dedicated to the service console (ESX hosts) or the VMkernel (ESXi hosts).
- Fibre Channel (FC) SAN. Shared storage must be on an FC SAN.
- RDM in physical compatibility (pass-through) or virtual compatibility (non-pass-through) mode. VMware recommends physical compatibility mode. The cluster cannot use virtual disks for shared storage.

  Failover clustering with Windows Server 2008 is not supported with virtual compatibility mode (non-pass-through) RDMs.

This chapter includes the following topics:

- “Create the First Node for Clusters Across Physical Hosts,” on page 21
- “Create the Second Node for Clusters Across Physical Hosts,” on page 22
- “Add Hard Disks to the First Node for Clusters Across Physical Hosts,” on page 23
- “Add Hard Disks to the Second Node for Clusters Across Physical Hosts,” on page 24

Create the First Node for Clusters Across Physical Hosts

To create the first node, you create and configure a virtual machine with two virtual network adapters and install a guest operating system on the virtual machine.

You configure the virtual network adapters to handle virtual machine traffic for the cluster: a private network connection for the private heartbeat and a public network connection.

Procedure

1. Open the vSphere Client and connect to the ESX/ESXi host or a vCenter Server system.

   Use the user name and password of the user who will own the virtual machine.

2. In the vSphere Client inventory, right-click the host and select New Virtual Machine.
3 Proceed through the wizard to create the virtual machine.

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Select <strong>Typical</strong>.</td>
</tr>
<tr>
<td>Name and Location</td>
<td>Enter a name and select a location.</td>
</tr>
<tr>
<td>Datastore</td>
<td>Select a datastore as the location for the virtual machine configuration file and the virtual machine disk (.vmdk) file.</td>
</tr>
<tr>
<td>Guest Operating System</td>
<td>Select the Windows Server operating system that you intend to install.</td>
</tr>
<tr>
<td>Create Disk</td>
<td>Enter the appropriate value in Virtual disk size. Select Support clustering features such as Fault Tolerance to create a disk in eagerzeroedthick format.</td>
</tr>
<tr>
<td>Ready to Complete</td>
<td>Select <strong>Edit the virtual machine settings before completion</strong> and click <strong>Continue</strong>. The Virtual Machine Properties dialog box appears.</td>
</tr>
</tbody>
</table>

4 In the Virtual Machine Properties dialog box, select **New NIC (adding)**.

5 Under Network Connection, select a label from the Network Label list.

   The network label refers to the network to be used for virtual machine traffic for the cluster, either public or private.

6 Click **Finish** to complete creating the virtual machine.

   **NOTE**  Do not add shared cluster disks at this time.

7 In the Virtual Machine Properties dialog box, click **Add**.

8 From the list of devices, select **Ethernet Adapter** and click **Next**.

9 Select the adapter type and network label.

   - If you selected a private network for the first network adapter, you must select a public network for this network adapter.
   - If you selected a public network for the first network adapter, you must select a private network adapter.

10 Click **Next**, and click **Finish** to complete creating the device.

11 Install a Windows Server operating system on the virtual machine.

The new node appears in the virtual machine inventory.

**What to do next**

Clone the virtual machine to create the second node.

**Create the Second Node for Clusters Across Physical Hosts**

To create the second node in a cluster of virtual machines across physical hosts, you clone the first virtual machine you created onto a second ESX/ESXi host using the vSphere Client connected to a vCenter Server system.

**CAUTION**  If you clone a virtual machine with an RDM setup, the cloning process converts the RDMs to virtual disks. Unmap all RDMs before cloning, and remap them after cloning is complete.

**Prerequisites**

Before you begin, shut down the guest operating system and power off the virtual machine you intend to clone.
Procedure

1. In the vSphere Client inventory, right-click the virtual machine and select **Clone**.
2. Proceed through the wizard to clone the virtual machine.

<table>
<thead>
<tr>
<th>Page</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name and Location</td>
<td>Enter a name and select a location.</td>
</tr>
<tr>
<td>Host or Cluster</td>
<td>Select the second host for the cluster setup.</td>
</tr>
<tr>
<td>Resource Partition</td>
<td>Select the resource pool for the virtual machine, or select the host if no resource pools exist.</td>
</tr>
<tr>
<td>Datastore</td>
<td>Select a datastore as the location for the virtual machine configuration file and the .vmdk file.</td>
</tr>
<tr>
<td>Customization</td>
<td>Select <strong>Do not customize</strong>.</td>
</tr>
<tr>
<td>Ready to Complete</td>
<td>Click <strong>OK</strong> to create the virtual machine template.</td>
</tr>
</tbody>
</table>

You have created a virtual machine with two network adapters. The operating system you chose for the first node is installed on the second node.

**What to do next**

Add a shared quorum disk.

**Add Hard Disks to the First Node for Clusters Across Physical Hosts**

In an MSCS cluster, storage disks are shared between nodes. You set up a quorum disk and an optional shared storage disk.

**Prerequisites**

Before you add hard disks to the first node, complete the following tasks:

- For each virtual machine, configure the guest operating system’s private and public IP addresses.
- Ask your SAN administrator for the location of unformatted SAN LUNs. The hard disks you create in this task must point to SAN LUNs.

**Note** Use RDMs in physical compatibility mode. The procedure below uses physical compatibility mode.

**Procedure**

1. In the vSphere Client inventory, select the newly created virtual machine and select **Edit Settings**.
   
   The Virtual Machine Properties dialog box appears.
2. Click **Add**, select **Hard Disk**, and click **Next**.
3. Select **Raw Device Mappings** and click **Next**.
4. Select an unformatted LUN and click **Next**.
5. Select a datastore and click **Next**.
   
   This datastore must be on a SAN because you need a single shared RDM file for each shared LUN on the SAN.
6. Select **Physical** as the compatibility mode and click **Next**.
   
   A SCSI controller is created when the virtual hard disk is created.
7. Select a new virtual device node (for example, select **SCSI (1:0)**), and click **Next**.

**Note** This must be a new SCSI controller. You cannot use SCSI 0.
8 Click **Finish** to complete creating the disk.

   The wizard creates a new SCSI controller and a new hard disk.

9 In the Virtual Machine Properties dialog box, select the new SCSI controller and click **Change Type**.

   The Change SCSI Controller Type dialog box appears.

10 Select the appropriate type of controller, depending on your operating system.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Type of Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 2000 Server</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2003</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2008</td>
<td>LSI Logic SAS</td>
</tr>
</tbody>
</table>

   You must download the LSI Logic Parallel driver for Windows 2000 Server on the LSI Web site.

11 Click **OK**.

12 On the Virtual Machine Properties dialog box, set SCSI Bus Sharing to **Physical** and click **OK**.

Figure 3-1 shows the setup: the virtual machine is connected to a public network and a private network with two virtual switches, and is connected to the quorum disk on FC SAN and the virtual machine virtual disk on local or remote storage.

**Figure 3-1.** Cluster Across Boxes with First Node Set Up

What to do next

Add hard disks to the second node.

**Add Hard Disks to the Second Node for Clusters Across Physical Hosts**

To allow shared access to clustered services and data, point the quorum disk of the second node to the same location as the first node’s quorum disk. Point any shared storage disks to the same location as the first node’s shared storage disks.

**Prerequisites**

Before you begin, obtain the following information:

- Which virtual device node is for the first virtual machine’s shared storage disks (for example, SCSI (1:0)).
The location of the quorum disk specified for the first node.

Procedure

1. In the vSphere Client inventory, select the second virtual machine that you created and select **Edit Settings**.
   The Virtual Machine Properties dialog box appears.
2. Click **Add**, select **Hard Disk**, and click **Next**.
3. Select **Use an existing virtual disk** and click **Next**.
4. In Disk File Path, browse to the location of the quorum disk specified for the first node.
5. Select **Physical** as the compatibility mode and click **Next**.
   A SCSI controller is created when the virtual hard disk is created.
6. Select the same virtual device node you chose for the first virtual machine’s shared storage disks (for example, **SCSI (1:0)**), and click **Next**.
   
   **Note** The location of the virtual device node for this virtual machine’s shared storage must match the corresponding virtual device node for the first virtual machine.
7. Click **Finish**.
   The wizard creates a new hard disk and a new SCSI controller.
8. In the Virtual Machine Properties dialog box, select the new SCSI controller and click **Change Type**.
   The Change SCSI Controller Type dialog box appears.
9. Select the appropriate type of controller, depending on your operating system.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Type of Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 2000 Server</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2003</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2008</td>
<td>LSI Logic SAS</td>
</tr>
</tbody>
</table>

   You must download the LSI Logic Parallel driver for Windows 2000 Server on the LSI Web site.
10. Click **OK**.
11. Set SCSI Bus Sharing to **Physical** and click **OK**.

**Figure 3-2** shows the completed setup, including the shared storage on the quorum disk and the shared private network.
Figure 3-2. Cluster Across Boxes Complete Setup

- **NIC1**
  - virtual switch1 (public)
  - VNIC1
    - virtual machine Node1
      - VSCSI1
      - physical machine
      - SCSI1
  - FC
  - local or remote storage

- **NIC2**
  - virtual switch2 (private)
  - VNIC2
    - virtual machine Node1
      - VSCSI2
      - physical machine
      - SCSI2

- **NIC1**
  - virtual switch1 (public)
  - VNIC1
    - virtual machine Node2
      - VSCSI1
      - physical machine
      - SCSI1
  - FC
  - local or remote storage

- **NIC2**
  - virtual switch2 (private)
  - VNIC2
    - virtual machine Node2
      - VSCSI2
      - physical machine
      - SCSI2

Remote storage
Cluster Physical and Virtual Machines

You can create an MSCS cluster in which each physical machine has a corresponding virtual machine. This type of configuration is known as a standby host cluster.

Prerequisites
A standby host cluster has specific hardware and software requirements.

- Use ESX/ESXi hosts that have the following:
  - Two physical network adapters dedicated to the MSCS cluster and to the public and private networks.
  - One physical network adapter dedicated to the service console (ESX hosts) or the VMkernel (ESXi hosts).
- Use RDMs in physical compatibility mode (pass-through RDM). You cannot use virtual disks or RDMs in virtual compatibility mode (non-pass-through RDM) for shared storage.
- Use the STORport Miniport driver for the Fibre Channel (FC) HBA (QLogic or Emulex) in the physical Windows machine.
- Do not run multipathing software in the physical or virtual machines.
- Use only a single physical path from the host to the storage arrays in standby host configurations.

This chapter includes the following topics:

- “Create the First Node for a Cluster of Physical and Virtual Machines,” on page 27
- “Create the Second Node for a Cluster of Physical and Virtual Machines,” on page 28
- “Add Hard Disks to the Second Node for a Cluster of Physical and Virtual Machines,” on page 29
- “Install Microsoft Cluster Service,” on page 30
- “Create Additional Physical-Virtual Pairs,” on page 30

Create the First Node for a Cluster of Physical and Virtual Machines

The first node in a standby host setup is a physical machine.

For information about setting up a physical machine that participates in an MSCS cluster, see the Microsoft Cluster Service documentation.
Procedure

◆ Set up the physical machine using the settings listed in the table.

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Cluster Administrator</td>
<td>Application. Advanced minimum configuration if Windows 2003 is used.</td>
</tr>
<tr>
<td>Network adapters</td>
<td>At least two.</td>
</tr>
<tr>
<td>Storage</td>
<td>Access to the same storage on a SAN as the ESX/ESXi host on which the</td>
</tr>
<tr>
<td></td>
<td>corresponding virtual machine will run.</td>
</tr>
<tr>
<td>Operating system</td>
<td>Installed on each physical machine.</td>
</tr>
</tbody>
</table>

What to do next

Create the second node by setting up a virtual machine for clustering across physical machines.

Create the Second Node for a Cluster of Physical and Virtual Machines

To create the second node, you set up a virtual machine for clustering across physical machines.

You configure the virtual network adapters to handle virtual machine traffic for the cluster: a private network connection for the private heartbeat and a public network connection.

Prerequisites

Before you begin, make sure that the shared storage that is visible from the physical machine that you configured in "Create the First Node for a Cluster of Physical and Virtual Machines," on page 27 is also visible from the virtual machine.

Procedure

1. Open the vSphere Client and connect to the ESX/ESXi host.
   Use the user name and password of the user who will own the virtual machine.
2. In the vSphere Client inventory, right-click the host and select New Virtual Machine.
3. Proceed through the wizard to create the virtual machine.

<table>
<thead>
<tr>
<th>Option</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Select Typical.</td>
</tr>
<tr>
<td>Name and Location</td>
<td>Enter a name and select a location.</td>
</tr>
<tr>
<td>Datstore</td>
<td>Select a datastore as the location for the virtual machine configuration file and the virtual machine disk (.vmdk) file.</td>
</tr>
<tr>
<td>Guest Operating System</td>
<td>Select the Windows Server operating system that you intend to install.</td>
</tr>
<tr>
<td>Create Disk</td>
<td>Enter the appropriate value in Virtual disk size. Select Support clustering features such as Fault Tolerance to create a disk in eagerzeroedthick format.</td>
</tr>
<tr>
<td>Ready to Complete</td>
<td>Select Edit the virtual machine settings before completion and click Continue. The Virtual Machine Properties dialog box appears.</td>
</tr>
</tbody>
</table>

5. Under Network Connection, select a label from the Network Label list.
   The network label refers to the network to be used for virtual machine traffic for the cluster, either public or private.
6. Click Finish to complete creating the virtual machine.
In the Virtual Machine Properties dialog box, click Add.

From the list of devices, select Ethernet Adapter and click Next.

Select the adapter type and network label.
- If you selected a private network for the first network adapter, you must select a public network for this network adapter.
- If you selected a public network for the first network adapter, you must select a private network adapter.

Click Next, and click Finish to complete creating the device.

Install a Windows Server operating system on the virtual machine.
The new node appears in the virtual machine inventory.

What to do next
Add hard disks to the second node.

Add Hard Disks to the Second Node for a Cluster of Physical and Virtual Machines

When you add hard disks to the second node, you set up the disks to point to the quorum disk and shared storage disks, if any, for the first node. The setup allows shared access to clustered services and data.

Procedure

1 In the vSphere Client inventory, select the newly created virtual machine and select Edit Settings.
The Virtual Machine Properties dialog box appears.

2 Click Add, select Hard Disk, and click Next.

3 Select Raw Device Mappings and click Next.

4 Select the LUN that is used by the physical machine.

5 Select the datastore, which is also the location of the boot disk, and click Next.

6 Select Physical as the compatibility mode and click Next.
A SCSI controller is created when the virtual hard disk is created.

7 From the Virtual Device Node drop-down menu, select a new SCSI controller (for example, SCSI (1:0)).

   Note You must select a new virtual device node. You cannot use SCSI 0.

8 Click Next, and click Finish.
The wizard creates a new hard disk and a new SCSI controller.

9 In the Virtual Machine Properties dialog box, select the new SCSI controller and click Change Type.
The Change SCSI Controller Type dialog box appears.
Select the appropriate type of controller, depending on your operating system.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Type of Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 2000 Server</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2003</td>
<td>LSI Logic Parallel</td>
</tr>
<tr>
<td>Windows Server 2008</td>
<td>LSI Logic SAS</td>
</tr>
</tbody>
</table>

You must download the LSI Logic Parallel driver for Windows 2000 Server on the LSI Web site.

11 Click **OK**.

12 On the Virtual Machine Properties dialog box, set SCSI Bus Sharing to **Physical** and click **OK**.

**What to do next**

Install Microsoft Cluster Service.

**Install Microsoft Cluster Service**

For Windows Server 2003 operating systems only, after you set up the first and second nodes, you must configure Microsoft Cluster Service.

See Microsoft’s documentation for creating and configuring server clusters on the Microsoft Web site.

In some complex storage solutions, such as an FC switched fabric, a particular storage unit might have a different identity (target ID or raw disk ID) on each computer in the cluster. Although this is a valid storage configuration, it causes a problem when you want to add a node to the cluster.

The following procedure allows you to avoid target identity problems when using clustering with Windows 2003.

**Procedure**

1. Within the Microsoft Cluster Administrator utility, on the Select Computer page, click **Advanced** to disable the storage validation heuristics.

2. Select the **Advanced** (minimum) configuration option, and click **OK**.

Microsoft Cluster Service should operate normally in the virtual machine after it is installed.

**What to do next**

Create additional physical-virtual pairs, if necessary.

**Create Additional Physical-Virtual Pairs**

If you have additional physical machines, you can create additional clusters for each.

**Procedure**

1. On the ESX/ESXi host, set up an additional virtual machine for the physical machine.

2. Cluster the physical machine with the new virtual machine.
You can upgrade clustered virtual machines following the procedures in the Upgrade Guide. Perform upgrades in the order listed for each upgrade scenario.

**Note** During the upgrade process, you do not need to change legacy configuration parameters that are not listed in this guide.

### Upgrade ESX 3.x to ESX 4.0

Upgrade ESX 3.x hosts to ESX 4.0 using the procedure Upgrading ESX 4.0 in the Upgrade Guide, ESX 4.0, ESXi 4.0, and vCenter Server 4.0.

### Upgrade ESX 2.5.2 to ESX 4.0

You must follow these steps for the upgrade to complete successfully.

1. Upgrade ESX 2.5.2 hosts to ESX Server 3 using the procedure, Upgrading VMware ESX Server in the Installation and Upgrade Guide, VMware Virtual Infrastructure.

2. Update clusters on ESX Server 3 hosts using the procedure, Updating Clusters in Setup for Microsoft Cluster Service, ESX Server 3.0 and VirtualCenter 2.0.

3. Upgrade ESX 3.x hosts to ESX 4.0 using the procedure Upgrading ESX 4.0 in the Upgrade Guide, ESX 4.0, ESXi 4.0, and vCenter Server 4.0.
When you set up MSCS on ESX/ESXi, refer to the checklists to configure your environment according to the requirements. You can also use the checklists to verify that your setup meets the requirements if you need technical support.

Requirements for Clustered Disks

Each type of clustered disk has its own requirements, depending on whether it is in a single-host cluster or multihost cluster. Table 6-1 lists the requirements.

Table 6-1. Requirements for Clustered Disks

<table>
<thead>
<tr>
<th>Component</th>
<th>Single-Host Clustering</th>
<th>Multihost Clustering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clustered virtual disk (.vmdk)</td>
<td>SCSI bus sharing mode must be set to virtual.</td>
<td>Not supported.</td>
</tr>
<tr>
<td>Clustered disks, virtual compatibility mode (non-pass-</td>
<td>Device type must be set to virtual compatibility mode.</td>
<td>Device type must be set to virtual compatibility mode for</td>
</tr>
<tr>
<td>through RDM)</td>
<td>SCSI bus sharing mode must be set to virtual mode.</td>
<td>cluster across boxes, but not for</td>
</tr>
<tr>
<td></td>
<td>A single, shared RDM mapping file for each clustered disk is</td>
<td>standby host clustering or cluster across boxes on Windows</td>
</tr>
<tr>
<td></td>
<td>required.</td>
<td>2008.</td>
</tr>
<tr>
<td>Clustered disks, physical</td>
<td>Not supported.</td>
<td>Device type must be set to Physical</td>
</tr>
<tr>
<td>compatibility mode (pass-through RDM)</td>
<td></td>
<td>compatibility mode during hard disk creation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SCSI bus sharing mode must be set to physical (the default).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A single, shared RDM mapping file for each clustered disk is</td>
</tr>
<tr>
<td></td>
<td></td>
<td>required.</td>
</tr>
<tr>
<td>All types</td>
<td>All clustered nodes must use the same target ID (on the virtual</td>
<td>Device type must be set to Physical</td>
</tr>
<tr>
<td></td>
<td>SCSI adapter) for the same clustered disk.</td>
<td>compatibility mode during hard disk creation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SCSI bus sharing mode must be set to physical (the default).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A single, shared RDM mapping file for each clustered disk is</td>
</tr>
<tr>
<td></td>
<td></td>
<td>required.</td>
</tr>
</tbody>
</table>

Other Requirements and Recommendations

Table 6-2 lists the components in your environment that have requirements for options or settings.
Table 6-2. Other Clustering Requirements and Recommendations

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk</td>
<td>If you place the boot disk on a virtual disk, select <strong>Support Clustering Features such as Fault Tolerance</strong> during disk provisioning. The only disks that you should not create with the <strong>eagerzeroedthick</strong> option are RDM files (both physical and virtual compatibility mode).</td>
</tr>
<tr>
<td>Windows</td>
<td>Use Windows Server 2003 SP2 (32 bit), Windows Server 2003 (64 bit) SP2, Windows 2000 Server SP4, or Windows Server 2008. Only two cluster nodes. Disk I/O timeout is 60 seconds or more (HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Disk\TimeOutValue). <strong>Note</strong>: If you recreate the cluster, this value might be reset to its default, so you must change it again. The cluster service must restart automatically on failure (first, second, and subsequent times).</td>
</tr>
<tr>
<td>ESX configuration</td>
<td>Do not overcommit memory. Set the <strong>Memory Reservation</strong> (minimum memory) option to the same as the amount of memory assigned to the virtual machine. If you must overcommit memory, the swap file must be local, not on the SAN.</td>
</tr>
<tr>
<td>Multipathing</td>
<td>Running third-party multipathing software is not supported.</td>
</tr>
</tbody>
</table>

Required Information for Technical Support

**Table 6-3** lists the files and settings to collect if you require technical support. Technical support uses these files and settings to analyze clustering issues.

**Note**: Verify that your setup complies with the checklists in **Table 6-1** and **Table 6-2** before you contact technical support.

Table 6-3. Information Required by Technical Support

<table>
<thead>
<tr>
<th>File or Information</th>
<th>Description or Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>vm-support tarball</td>
<td>Contains the vmkernel log, virtual machine configuration files and logs, and so on.</td>
</tr>
<tr>
<td>Application and system event logs of all virtual machines with the problem</td>
<td></td>
</tr>
<tr>
<td>Cluster log of all virtual machines with the problem</td>
<td>%ClusterLog%, which is usually set to %SystemRoot%\cluster\cluster.log.</td>
</tr>
<tr>
<td>Disk I/O timeout</td>
<td>HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Disk\TimeOutValue</td>
</tr>
<tr>
<td>vSphere Client display names and Windows NETBIOS names of the virtual machines experiencing the problem</td>
<td></td>
</tr>
<tr>
<td>Date and time that the problem occurred</td>
<td></td>
</tr>
<tr>
<td>SAN configuration of the ESX system</td>
<td>Details about LUNs, paths, and adapters.</td>
</tr>
<tr>
<td>(Optional) Memory dump of the virtual machine</td>
<td>Required if a guest virtual machine fails (a blue screen appears with an error message).</td>
</tr>
</tbody>
</table>
Index

A
abbreviations 7

B
boot from SAN 13

C
clustering
   hardware requirements 11
   limitations 12
   multiple host 10
   overview 9
   physical and virtual machines 11, 27
   types of applications 9
   virtual machines across hosts 10, 21
   virtual machines on one host 9, 15
   compatibility mode
      physical 12, 21, 23, 24, 27
      virtual 12, 21, 27
   continuous clustered replication (CCR) 13

D
disks
   adding to nodes 17, 18, 23
   format 11
   quorum 17, 23, 29
   shared 17, 23, 29

E
eagerzeroedthick 11, 15, 21
ESX/ESXi 15, 21, 27
Ethernet adapter 15, 21

F
Fault Tolerance (FT) 12
feedback 7
Fibre Channel (FC) SAN 9, 13, 17, 21
first node, creating 15, 21, 27
format
   disks 11, 15, 21
   eagerzeroedthick 11, 15, 21
   thick 11

G
guest operating system requirements 11

H
hardware requirements 11
hardware version 7 12
high availability (HA) 9

I
iSCSI 12
iSCSI SAN 13

L
LSI Logic Parallel 11, 17, 23, 24, 29
LSI Logic SAS 11, 17, 23, 24, 29

M
Microsoft Cluster Service (MSCS)
   boot from SAN 13
   installing 30
Microsoft Exchange and CCR, See continuous
   clustered replication (CCR)
   multipathing 27
   multiple host clustering 10

N
N-Port ID Virtualization (NPIV) 12
native multipathing (NMP) 12
NFS 12
NIC, virtual 11
NTP server 11

P
physical compatibility mode 12, 21, 23, 24, 27
physical-virtual pairs, creating 30

Q
quorum disk 17, 23, 29

R
RDM
   non-pass-through 12, 27
   pass-through 12, 27
   requirements
      checklist 33
      clustering 11
   guest operating system 11
   hardware 11
SAN, boot from 13
SCSI adapter, virtual 11
SCSI bus sharing
  physical 23, 24, 29
  virtual 17
second node, creating 16, 22, 28
service console 15, 21, 27
shared storage
  disks 17, 23, 29
  supported configurations 12
single host clustering 9
standby host 11, 27, 28
storage
  quorum disk 17, 23, 29
  shared 12, 17, 23, 29
support 7

technical support checklist 33
thick format, disks 11

upgrading virtual machines 31

virtual compatibility mode 21, 27
virtual machines, upgrading 31
VMkernel 15
vmkfstools 16, 22
VMotion 12