Compellent Storage Center

How To Setup a Microsoft Windows Server 2003 Failover Cluster

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This purpose of this document is to provide additional guidance around the process of setting up and configuring a Windows Server 2003 Failover Cluster using Microsoft Clustering Services with Compellent Storage Center.

These guidelines should be evaluated thoroughly as every environment configuration is different, and should not be construed as final recommendations in the configuration of your Compellent Storage Center or Microsoft Clustering environments.


Customer Support

Compellent provides live support 1-866-EZSTORE (866.397.8673), 24 hours a day, 7 days a week, 365 days a year. For additional support, email Compellent at support@compellent.com. Compellent responds to emails during normal business hours.

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Document Revision

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<th>Date</th>
<th>Revision</th>
<th>Description</th>
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<tr>
<td>1/10/2008</td>
<td>A</td>
<td>Draft</td>
</tr>
<tr>
<td>10/13/2008</td>
<td>1</td>
<td>Initial Release</td>
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Introduction to Clustering

Overview

Windows Server Clustering provides the capability to tie multiple servers together to offer high availability for business-critical applications and services. Clustering is designed to maintain data integrity and provide failover support. Windows Clustering can scale up to eight nodes in a single Windows Server 2003 cluster.

History

In 1995, Microsoft released its initial attempt at clustering called “Wolfpack”. Wolfpack was developed as an additional add-in for Windows NT 4.0 Enterprise Edition. Since then, Microsoft Cluster Server (MSCS) has evolved through several OS releases and is available in the Enterprise Edition of Windows Server 2003 and Windows Server 2003 R2.

Platforms

In order to use Windows Clustering, you must be running one of the following platforms:

- Windows Server 2000 Advanced Server
- Windows Server 2003 Enterprise Edition
- Windows Server 2003 R2 Enterprise Edition
- Windows Storage Server 2003 R2 Enterprise Edition

Active/Active Clusters

In active/active clusters, all nodes are active. In the event of a failover, the remaining active node takes on the additional processing operations, which causes a reduction in the overall performance of the cluster. Active/passive cluster configurations are generally recommended over active/active configurations because they often increase performance, availability, and scalability. Microsoft Exchange 2003 and SQL Server 2000 support a configuration that falls into the realm of what would be considered as an active/active cluster configuration. These particular configurations will not be discussed as they are beyond the intended scope of this document.

Active/Passive Clusters

In active/passive clustering, the cluster includes active nodes and passive nodes. The passive nodes are only used if an active node fails. Active/Passive clusters are commonly known as failover clusters. For example, file and print environments use the active/passive cluster model since two nodes cannot own the same disk resource at one time.
Quorums

The following information on quorums was taken from the Microsoft document “Server Clusters: Quorum Options”.

Each cluster has a special resource known as the quorum resource. A quorum resource can be any resource that does the following:

- Provides a means for arbitration leading to membership and cluster state decisions.
- Provides physical storage to store configuration information.

A quorum log is simply a configuration database for the server cluster. It holds cluster configuration information such as which servers are part of the cluster, what resources are installed in the cluster, and what state those resources are in (for example, online or offline). The quorum log is located by default in \MSCS\quolog.log.

The quorum is important because it provides consistency. Since the basic idea of a cluster is multiple physical servers acting as a single virtual server, it is critical that each of the physical servers have a consistent view of how the cluster is configured. The quorum acts as the definitive repository for all configuration information relating to the cluster. In the event that the Cluster Service is unable to read the quorum log, it will not start, as it is not able to guarantee that the cluster will be in a consistent state, which is one of the primary requirements for a cluster.

In addition, the quorum is used as the tie-breaker to avoid “split-brain” scenarios. A split-brain scenario happens when all of the network communication links between two or more cluster nodes fail. In these cases, the cluster may be split into two or more partitions that cannot communicate with each other. The quorum is used to guarantee that any cluster resource is only brought online on only one node. It does this by allowing the partition that “owns” the quorum to continue, while the other partitions are evicted from the cluster.

Standard Quorum

Standard quorums should be sufficient for the majority of situations that users will encounter. This is the type of quorum that we will be use in this document. Typical situations include:

- **Highly available data in a single location** – most customers that require their data to be highly available only need this on a per site basis. If they have multiple sites, each site has its own cluster. Typical applications that use this type of cluster include Microsoft SQL Server™, Exchange Server, file shares, printer queues, and network services (e.g. DHCP & WINS).

- **Stateful applications** – applications or NT services that require only a single instance at any time and require some sort of state to be stored, typically use standard quorums, as they already have some sort of shared storage for maintaining the state.
Majority Set Quorum

While majority node set quorums are an exciting new feature of Windows Server 2003 clusters, they do have very strict requirements to ensure they work correctly, and therefore should only be considered by people who fully understand the issues involved in using MNS based clusters. The following are the key situations that the product team thought of when creating MNS quorums:

- **Geographically Dispersed Clusters** – this involves a single MSCS cluster that has members in multiple geographic sites. While geographic clusters are possible using a standard quorum (for example, there is a separate geographic cluster Hardware Compatibility List (HCL)), a number of issues arise in terms of presenting the quorum as a single, logical shared drive between all sites. Majority Node Set quorums solve these issues by allowing the quorum to be stored on the local hard disk.

- **Clusters with No Shared Disks** – there are some specialized configurations that need tightly consistent cluster features without having shared disks. For example:
  
  - Clusters that host applications that can failover, but where there is some other, application-specific way to keep data consistent between nodes (e.g. database log shipping for keeping database state up-to-date; file replication for relatively static data, etc.).
  
  - Clusters that host applications that have no persistent data, but need to cooperate in a tightly coupled way to provide consistent volatile state.

**iSCSI Clusters**

iSCSI Clusters are supported in Windows Server 2003 Service Pack 1 and higher. iSCSI clusters are beyond the scope of this document, but a few links are provided for more information.

iSCSI Cluster Support: Frequently Asked Questions

How to set the Cluster service dependency in a pure iSCSI clustering environment in Windows 2000 and in Windows Server 2003
http://support.microsoft.com/default.aspx?scid=KB;EN-US;883397

**Using MPIO with Windows Clusters**

Using MPIO with clustering is supported in a failover-only MPIO configuration. The default configuration for volumes using MPIO is to provide round-robin functionality to the volume’s paths. The MPIO configuration for the volume must be changed from round-robin to failover-only. This is due to how the HBA driver assigns Node WWNs, and the SCSI reservation being made on the initiator Node WWN. If the HBA driver does not assign the same Node WWN to all ports in the server, you must configure the MPIO driver for failover-only mode.

Set the Compellent MPIO driver to failover mode. Currently, the only way to change the routing policy is by modifying the registry as follows:
Under this node there will be an entry for each device “owned” by Compellent’s DSM. In other words, there should be an entry under here for every Compellent volume mapped to the server.

To change the policy you would click on each entry. In the right-hand pane you should see a key called “DsmLoadBalancePolicy”. By default this should be set to 2, which is Round Robin. You can double-click on the node and change the value to 1 (failover-only). MPIO needs to reread these values before they go into effect, which will require a server reboot.

Public Interface

The public interface contains the IP address of the server as it would be accessed over the network. It should contain the specific subnet mask, default gateway, and DNS server addresses for accessing the network.

Private Interface

The private interface is reserved for cluster communications and is commonly referred to as the “heartbeat”. In a two node cluster, a crossover cable is used to directly connect the first node to the second node. In a larger cluster configuration, a separate subnet or private network should be dedicated as a switch or hub will have to be used for these cluster communications. Because little is required for communication, a 10mbps half-duplex connection is all that is required.

It is common to use the 10.x.x.x network for the private interface. Here is an example of how you would configure the TCP/IP settings of the private interface.

A few other configuration pointers:
• Do not specify a default gateway or DNS servers. It is not necessary.

• On the DNS Settings tab, be sure to uncheck “Register this connection’s addresses in DNS”.

• On the WINS Settings tab, uncheck “Enable LMHOSTS lookup” and select “Disable NetBIOS over TCP/IP”.

• Configure your network interface for a speed and duplex setting of 10/Half.

• Label your network interfaces respectively, “Private” and “Public”.

Prerequisites

The following are required to successfully configure Windows Clustering Services:

• Windows Server, Enterprise Edition that is a domain member
• Compellent Storage Center
• Properly zoned Fibre connectivity
• Two Ethernet ports (1 for public and 1 for private connectivity)
• One static IP address for public network connectivity
• Local Administrator (or like) credentials
• User account configured as local administrator to be used as a Cluster Service Account

Server Configuration

Identify the server that will be the first node in the new cluster. This will be referred to as Node 1 in this document.

It is required that this server is a member of a domain. To form a cluster, cluster nodes must be member servers.

Quorum Setup

Start by creating a 1GB volume on the Compellent Storage Center and mapping it only to Node 1. Once this is complete, rescan the disks on Node 1 using Disk Management. Initialize the LUN, create the partition and format with NTFS. Standard practice is to assign the drive letter Q: to the quorum volume.
Shared Storage Registry Key

When setting up a cluster using the Compellent Storage Center, the registry must be modified so the system can correctly identify the shared storage resources. This must be performed on all nodes that will be a member of this cluster.

Windows Server 2003 original release version

If you are running the original release version of Windows Server 2003, follow these steps:

1. Click **Start**, click **Run**, type **regedit**, and then click **OK**.

2. Locate and then right-click the following registry subkey:
   
   **HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ClusSvc\Parameters**

3. On the **Edit** menu, point to **New**, and then click **DWORD Value**.

4. Type **ManageDisksOnSystemBuses** for the name of the DWORD, and then press **ENTER**.

5. Right-click **ManageDisksOnSystemBuses**, and then click **Modify**.
6. In the **Edit DWORD Value** dialog box, click **Decimal**, type **1** in the **Value data** box, and then click **OK**.

When you try to configure or modify the cluster service on a Windows Server 2003 original release version-based computer, the cluster service may stop responding. This problem occurs because the following registry subkey is deleted:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ClusSvc\Parameters\ManageDisksOnSystemBuses

**Important** When you configure or modify the Cluster service, the cluster Setup program may re-create the ClusSvc registry subkey. The cluster Setup program may delete the ManageDisksOnSystemBuses registry entry. Therefore, the cluster Setup program may form the cluster by using a local quorum resource.

If the ManageDisksOnSystemBuses registry entry is deleted, you must manually add the ManageDisksOnSystemBuses entry to the ClusSvc registry subkey by using the steps in this article.

**Windows Server 2003 with Service Pack 1**

If you are running Windows Server 2003 with Service Pack 1 (SP1), follow these steps:

1. Click **Start**, click **Run**, type **regedit**, and then click **OK**.

2. Locate and then right-click the following registry subkey:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ClusDisk\Parameters

    **Note** If the Parameters registry subkey does not exist, right-click **ClusDisk**, point to **New**, click **Key**, type **Parameters** as the subkey name, and then press ENTER.

3. On the **Edit** menu, point to **New**, and then click **DWORD Value**.

4. Type **ManageDisksOnSystemBuses** as the entry name, and then press ENTER.

5. Right-click **ManageDisksOnSystemBuses**, and then click **Modify**.

6. In the **Edit DWORD Value** dialog box, click **Decimal**, type **1** in the **Value data** box, and then click **OK**.

**NOTE:** The registry changes required vary based on the platform. You can find step-by-step instructions on how to implement this change by following Microsoft Knowledge Base Article #886569 at [http://support.microsoft.com/kb/886569](http://support.microsoft.com/kb/886569).
Creating the New Cluster

Cluster Administrator

Cluster Administrator is loaded by default with the Enterprise Edition of Windows Server 2003 and is located under Start, Programs, Administrative Tools.

We will use this tool to create a new cluster, add additional nodes, and administrator the new cluster going forward.

Server Cluster Wizard

We will use the New Server Cluster Wizard to walk us through the creation of the cluster.

1. Start Cluster Administrator by going to Start, Programs, Administrative Tools, Cluster Administrator.

2. From the “Open Connection to Cluster” dialog, select the action for “Create new cluster”, then click OK.

4. By default, the domain that the server is a member of is placed in the Domain textbox. In the Cluster Name, put the name of the cluster is it will be referred to in the domain. This name must be unique. Click Next.

5. Enter the name of the computer that will be the first node of the cluster. The local computer name is automatically entered into the textbox. Do not click Next.

6. After entering the name of the computer that will be the first node in the cluster, click Advanced. Make sure that Typical (full) Configuration is selected. Click OK, then Click Next.

7. The configuration will be analyzed verifying that everything is setup correctly so far.

   At this point, you should see the green bar and a status of Tasks completed. Review any warnings that occurred during the analyzing configuration phase.

   If you encountered errors, noted with
a red bar instead of a green bar, you’ll have to review those and resolve the issues before continuing.

A common error that occurs is if the Shared Storage Bus registry key is not in place. You’ll typically see this during the analyzing configuration phase and an error stating “Could not locate a sharable quorum resource…” similar to the image on the right.

8. Enter the IP address that will be used to access the cluster. This is not the same IP address that is used on the Public interface.

9. Enter the username and password of the cluster service account that you will use. This account will be given local administrator rights on all nodes of the cluster.
10. Review the proposed cluster configuration. You can review the configuration log at this point, as well as validate the volume that the cluster wizard has chosen for the quorum.

Make sure that the quorum has been selected correctly by clicking on the Quorum button.

The dialog will allow you to select the correct drive if it has not already been selected.

11. One final cluster validation will take place while it configures the cluster services, types, and resources.
12. You have successfully completed the new server cluster wizard. Click Finish.

You have a new cluster configured with a single node as shown in the Cluster Administrator below.

Figure 3. Cluster Administrator with single-node cluster
Adding Additional Nodes

Quorum Configuration on Secondary Nodes

Before adding additional nodes to the cluster, the next node (Node 2) should have the same quorum volume from Node 1 mapped up to Node 2.

Once the quorum volume has been properly mapped up to Node 2, on Node 2 using Disk Management, rescan the disks.

You’ll see the quorum volume, but you’ll notice that it appears to be an uninitialized and unreadable state. There is no additional work that needs to be done with the quorum.

Add Nodes Wizard

To add additional nodes, use the Add Nodes Wizard from the Cluster Administrator. Inside Cluster Administrator while it’s connected to the new cluster, select File, New, Node. This will start the Add Nodes Wizard.
1. From the Welcome page of the Add Nodes Wizard, click Next.

2. Type in the name of the computer that you want to add as a new node to the cluster, then click Add.

3. The configuration will be analyzed verifying that everything is setup correctly so far.

   At this point, you should see the green bar and a status of Tasks completed. Review any warnings that occurred during the analyzing configuration phase.

   If you encountered errors, noted with a red bar instead of a green bar, you’ll have to review those and resolve the issues before continuing.
4. Enter the password that is used for the cluster service account shown. This account was chosen when the cluster was initially setup and the first node was added.

![Add Nodes Wizard](image)

5. Review the proposed cluster configuration. You can review the configuration log at this point.

![Add Nodes Wizard](image)

6. One final cluster validation will take place while it configures the cluster services, types, and resources and adds the new node to the cluster.
7. You have successfully completed the Add Nodes Wizard.

![Add Nodes Wizard](image)

Figure 5. Cluster Administrator now shows two nodes configured for this cluster
Cluster Groups

Adding a Cluster Group

Cluster Groups are used to group or associate multiple cluster resources together. When a failover of a particular group occurs, all resources assigned to a particular group are failed over to another node.

NOTE: In order to initiate successful failover of a cluster group to another node, it must contain a Network Name, IP Address, and Physical Disk resource.

By default a “Cluster Group” is created when a new cluster is created. This cluster group contains the resources for the cluster IP address, the cluster name, and the quorum.

![Figure 6. Default Cluster Group showing cluster name, IP, and quorum resources](image)

1. To create a new cluster group, start Cluster Administrator, click on File, New, Group.
2. Type in a name and description for the new cluster group and then click Next.

3. If you want, you can choose which nodes are the preferred owners for the group. You can also choose to not select a preferred owner. Click Finish.

4. The cluster group has been created successfully.

Figure 7. A new cluster group is ready to be brought online
Cluster resources can be anything from the physical disk to services and applications whose availability will be managed by the cluster. Some examples of cluster resources are physical disks, file shares, IP addresses, cluster names, and DHCP.

**Adding a Physical Disk Resource**

A physical disk resource is required for each volume that the cluster service is going to manage. For this scenario, this physical disk will be used for our users file storage on this cluster. We have already mapped the volume to the server, partitioned, and formatted it for use. We assigned it a driver letter of D:. In addition, the first time you setup the physical disk resource for a particular drive, you should be mapping the volume to the active node of the cluster and only the active node at this time. Map the volume to each node individually as it is added to the cluster.

1. To create a new cluster resource, start Cluster Administrator, click on File, New, Resource.
2. Select Physical Disk as the resource type and give the physical disk resource a meaningful name. You can then select the Cluster Group it should belong to, and click Next.

3. Specify the possible owners. You typically want all nodes to be a possible owner for a physical disk resource. Click Next.

4. Specify any necessary dependencies for the physical disk. In this case, there are not even any dependencies available.
5. Select the disk from the dropdown that will be the actual physical disk resource.

6. The new physical disk resource can be brought online now by right-clicking on it, and then clicking Bring Online.

   This physical disk is now managed by the cluster.

7. Complete the process by mapping the new data volume up to any other nodes in the cluster, and then in Disk Management rescan the disks. The disk will be discovered but will be in an unavailable/unwritable state since another node will have ownership of the physical disk cluster resource.

   **NOTE:** The disk will be discovered, but will be in an unavailable or unwritable state since another node will have ownership of the physical disk cluster resource.

**Adding a File Share Resource**

File Share cluster resources are used to setup file shares so they can be failed over from one node to another. For this scenario, we’ll create a file share on our new volume and setup the file share cluster resource in Cluster Administrator.
1. To create a new cluster resource, start Cluster Administrator, click on File, New, Resource.

2. Select File Share as the resource type and give the file share resource a meaningful name. You can then select the Cluster Group it should belong to, and click Next.

3. Specify the possible owners. You typically want all nodes to be a possible owner for a physical disk resource. Click Next.

4. Specify any resource dependencies for the file share resource. In this case, the file share is dependent upon the physical disk being online, so we select the physical disk and click Add. Once dependencies are set, click Next.
5. Specify the share name and path. You can also specify the permissions as well as advanced options and caching preferences. Once set, click Finish.

6. The cluster resource has been created successfully.
Administrative Tasks

Here are a few useful administrative tasks that may be required over the course of managing your Microsoft Cluster.

Testing Cluster Group Failover

Short of pulling the power on one of your nodes to test the failover capabilities, you can simulate this process within Cluster Administrator.

In Cluster Administrator, select the cluster group you want to fail over, right-click on the cluster group, and choose Move Group. This will take the cluster group and all of its associated resources and move them to the other node in the cluster.

You can also use this method for splitting resource groups between nodes. You can easily any cluster group between nodes using the Move Group method.

![Figure 10. Move Group can be used to move cluster groups between nodes](image)

Evicting a Cluster Node

At some point you may wish to remove a node permanently from a cluster. Evicting a node is a permanent operation.

**NOTE:** This procedure should only be executed with guidance from Microsoft Premier Support. This procedure is a permanent operation.

To evict a node from the cluster follow this procedure. Before beginning, make sure that the node you want to evict does not currently own any of the cluster resources.
1. In Cluster Administrator, right-click the node you wish to evict. Click Stop Cluster Services.

2. Once the cluster services have successfully stopped, right-click on the node you wish to evict again, then click Evict Node.

3. Confirm that you want to evict the node by clicking Yes.

4. If the node was successfully evicted, then it will disappear from Cluster Administrator.

**Evicting the Last Node in a Cluster**

If you want to completely disband a Windows Server 2003 cluster, in Cluster Administrator, right-click the last node you wish to evict. Click Evict Node. Confirm that you wish to evict the node by clicking Yes. This process takes several minutes and removes the last node and destroys the cluster configuration permanently.

**NOTE:** This procedure should only be executed with guidance from Microsoft Premier Support. This procedure is a permanent operation.
Additional Resources

These additional links might be useful in setting up, configuring, and managing your cluster for other applications.

Planning and Preparing for Cluster Installation

Server Cluster Best Practices

Support for GPT Volumes in Windows Clustering
http://support.microsoft.com/kb/919117

Checklist: Planning and Creating a Server Cluster

Cluster Disk & Drive Connection Problems
http://technet2.microsoft.com/windowsserver/en/library/3974d0c5-1c3f-4dce-921c-2859a8abd8ae1033.mspx?mfr=true

Cluster Resource Command Reference

Clustering in a SAN Environment
http://www.microsoft.com/windowsserversystem/storage/clustering.mspx

Microsoft Cluster Configuration Validation Wizard

Virtual Server Host Clustering Step-by-Step Guide for Virtual Server 2005 R2

SQL Server 2005 Failover Clustering White Paper

Deploying Exchange Server 2003 in a Cluster