

Novell Cluster Services

1.6

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OVERVIEW AND INSTALLATION



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Introduction to Novell Cluster Services

Novell® Cluster Services™ is a server clustering system that ensures high availability and manageability of critical network resources including data (volumes), applications, server licenses, and services. It is a multinode, eDirectory™ enabled clustering product for NetWare® 6 that supports failover, failback, and migration (load balancing) of individually managed cluster resources.

Documentation Conventions

In this documentation, a greater-than symbol (>) is used to separate actions within a step and items in a cross-reference path.

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1

Overview

Novell® Cluster Services™ is a server clustering system that ensures high availability and manageability of critical network resources including data (volumes), applications, server licenses, and services. It is a multinode clustering product for NetWare® that is enabled for eDirectory™ and supports failover, failback, and migration (load balancing) of individually managed cluster resources.

Licenses for two cluster nodes is included with NetWare 6. Licenses for additional cluster nodes may be purchased separately.

Product Features

Novell Cluster Services includes several important features to help you ensure and manage the availability of your network resources. These include:

- ◆ Support for shared SCSI or fiber channel storage area networks.
- ◆ Multinode all-active cluster (up to 32 nodes). Any NetWare server in the cluster can restart resources (applications, services, IP addresses, and volumes) from a failed server in the cluster.
- ◆ Single point of administration through a browser-based NetWare Remote Manager™ or a Java-based ConsoleOne™ cluster configuration and monitoring GUI. The browser-based NetWare Remote Manager lets you remotely manage your cluster.
- ◆ The ability to tailor a cluster to the specific applications and hardware infrastructure that fit your organization.
- ◆ Dynamic assignment and reassignment of server storage on an as-needed basis.
- ◆ The ability to automatically notify administrators through e-mail of cluster events and cluster state changes.

Product Benefits

Novell Cluster Services allows you to configure up to 32 NetWare servers into a high-availability cluster, where resources can be dynamically switched or moved to any server in the cluster. Resources can be configured to automatically switch or be moved in the event of a server failure, or can be moved manually to troubleshoot hardware or balance the workload.

Novell Cluster Services provides high availability from commodity components. Lower costs are obtained through the consolidation of applications and operations onto a cluster. The ability to manage a cluster from a single point of control and to adjust resources to meet changing workload requirements (thus, manually “load balance” the cluster) are also important benefits of Novell Cluster Services.

An equally important benefit of implementing Novell Cluster Services is that you can reduce unplanned service outages and reduce planned outages for software and hardware maintenance and upgrades.

Reasons you would want to implement Novell Cluster Services include:

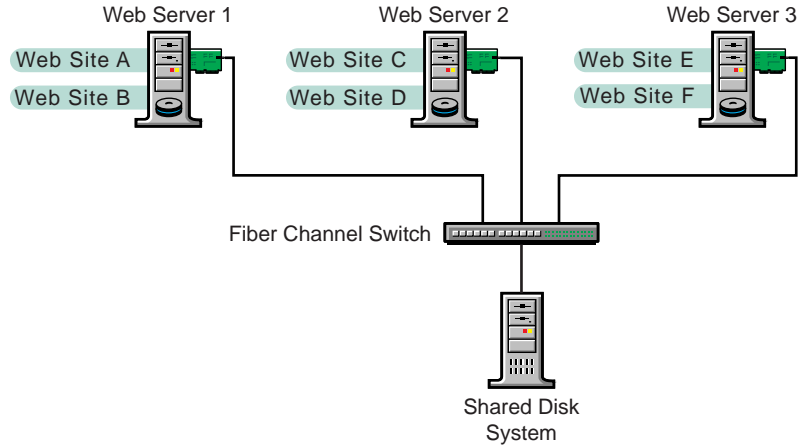
- ◆ Increased availability
- ◆ Improved performance
- ◆ Low cost of operation
- ◆ Scalability
- ◆ Disaster recovery
- ◆ Data protection
- ◆ Shared resources

Shared disk fault tolerance can be obtained by implementing RAID Level 5 on the shared disk subsystem.

An example of the benefits Novell Cluster Services provides can be better understood through the following scenario.

Suppose you have configured a three-server cluster, with a Web server installed on each of the three servers in the cluster. Each of the servers in the cluster hosts two Web sites. All the data, graphics, and e-mail messages for each Web site is stored on a shared disk subsystem connected to each of the servers in the cluster. The following figure depicts how this setup might look.

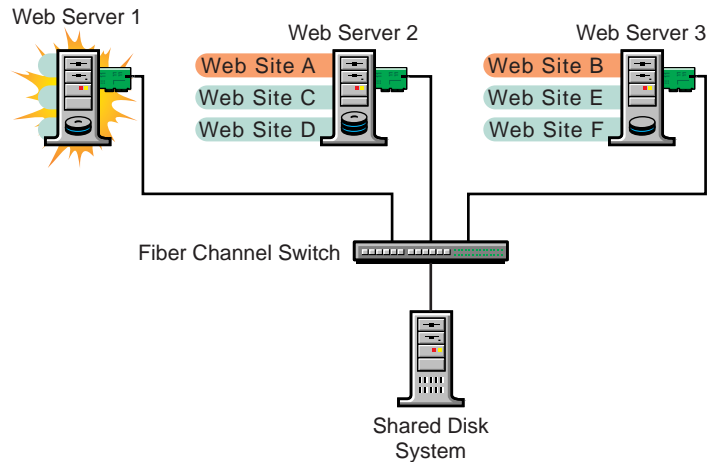
Figure 1 Three-Server Cluster



During normal cluster operation, each server is in constant communication with the other servers in the cluster and performs periodic polling of all registered resources to detect failure.

Suppose Web Server 1 experiences hardware or software problems and the users depending on Web Server 1 for Internet access, e-mail, and information lose their connections. The following figure shows how resources are moved when Web Server 1 fails.

Figure 2 Three-Server Cluster after One Server Fails



Web Site A moves to Web Server 2 and Web Site B moves to Web Server 3. IP addresses and applicable licenses also move to Web Server 2 and Web Server 3.

When you configured the cluster, you decided where the Web sites hosted on each Web server would go should a failure occur. In the previous example, you configured Web Site A to move to Web Server 2 and Web Site B to move to Web Server 3. This way, the workload once handled by Web Server 1 is evenly distributed.

When Web Server 1 failed, Novell Cluster Services software

- ◆ Detected a failure.
- ◆ Remounted the shared data volumes (that were formerly mounted on Web server 1) on Web Server 2 and Web Server 3 as specified.
- ◆ Restarted applications (that were running on Web Server 1) on Web Server 2 and Web Server 3 as specified.
- ◆ Transferred IP addresses to Web Server 2 and Web Server 3 as specified.

In this example, the failover process happened quickly and users regained access to the Internet, Web site information, and e-mail within seconds, and in most cases, without having to log in again.

Now suppose the problems with Web Server 1 are resolved, and Web Server 1 is returned to a normal operating state. Web Site A and Web Site B will automatically failback, or be moved back to Web Server 1, and Web Server operation will return back to the way it was before Web Server 1 failed.

Novell Cluster Services also provides resource migration capabilities. You can move applications, Web sites, etc. to other servers in your cluster without waiting for a server to fail.

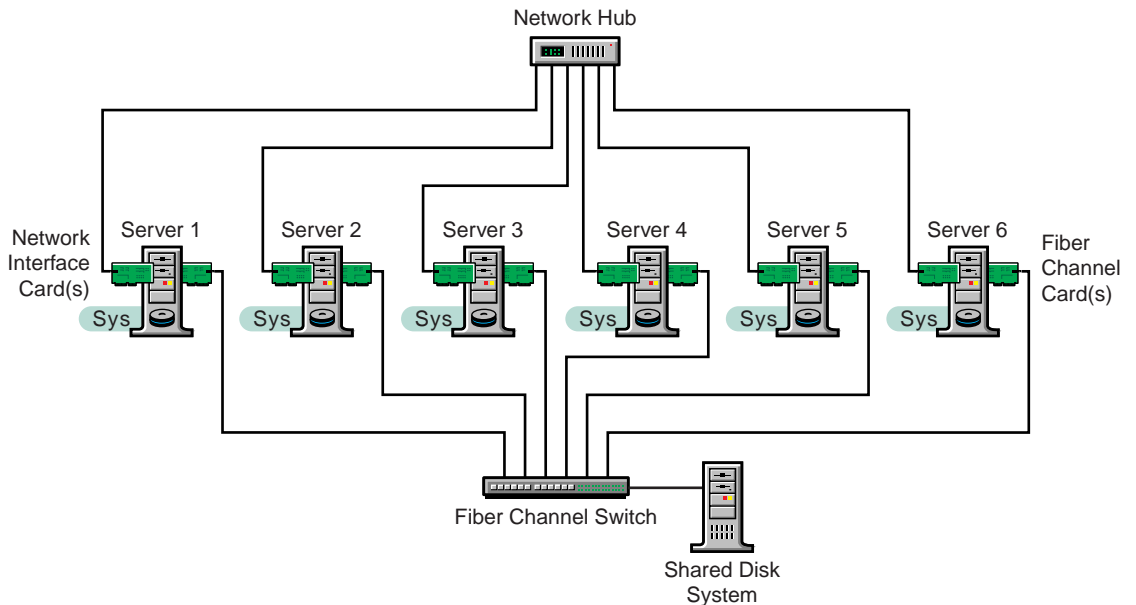
For example, you could have manually moved Web Site A or Web Site B from Web Server 1 to either of the other servers in the cluster. You might want to do this to upgrade or perform scheduled maintenance on Web Server 1, or just to increase performance or accessibility of the Web sites.

Cluster Configuration

Typical cluster configurations normally include a shared disk subsystem connected to all servers in the cluster. The shared disk subsystem can be connected via high-speed fiber channel cards, cables, and switches, or be configured to use shared SCSI. If a server fails, another designated server in the cluster automatically mounts the shared disk volumes previously mounted on the failed server. This gives network users continuous access to the volumes on the shared disk subsystem.

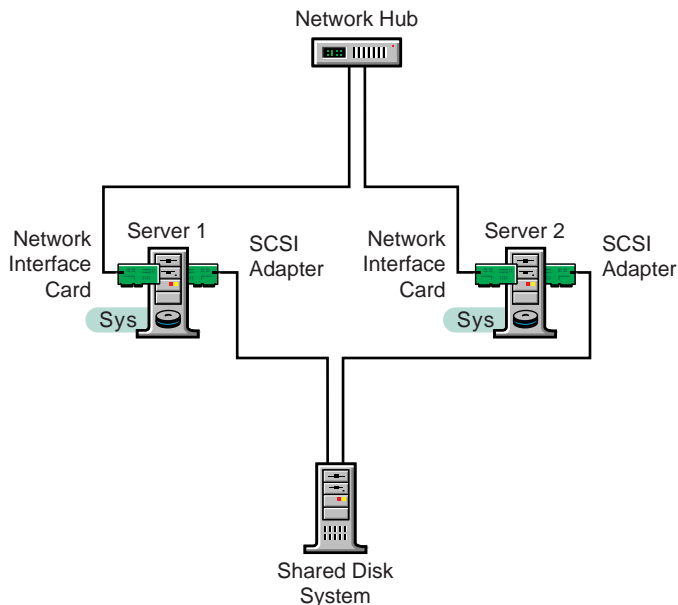
Typical resources might include data (volumes), applications, server licenses, and services. The following figure shows how a typical fiber channel cluster configuration might look.

Figure 3 Typical Fiber Channel Cluster Configuration



Although fiber channel is the recommended configuration, you can configure your cluster to use shared SCSI. The following figure shows how a typical shared SCSI cluster configuration might look.

Figure 4 Typical Shared SCSI Cluster Configuration



Cluster Components

The following components make up a Novell Cluster Services cluster:

- ♦ From 2 to 32 NetWare servers configured to use IP, each containing at least one local disk device (used for a local SYS: volume).
- ♦ Novell Cluster Services software running on each NetWare server in the cluster.
- ♦ A shared disk subsystem connected to all servers in the cluster (optional, but recommended for most configurations).
- ♦ High-speed fiber channel cards, cables, and switch or SCSI cards and cables used to connect the servers to the shared disk subsystem.

2 Installation and Setup

Hardware Requirements

The following list specifies hardware requirements for installing Novell® Cluster Services™. These requirements represent the minimum hardware configuration. Additional hardware might be necessary depending on how you intend to use Novell Cluster Services.

- A minimum of two NetWare® servers
- At least 256 MB of memory on all servers in the cluster (512 MB recommended for failing multiple applications to the same server)
- At least one local disk device (not shared) for volume SYS: on each server

Software Requirements

You must have NetWare 6 running on each cluster server. Ensure the following requirements are met:

- All servers in the cluster configured with the IP protocol and on the same IP subnet
- An additional IP address for the cluster and each cluster resource and cluster-enabled volume
- All servers in the cluster in the same eDirectory™ tree

Shared Disk System Requirements

A shared disk system (Storage Area Network or SAN) is required for each cluster if you want data to be highly available. If a shared disk subsystem is used, ensure the following:

- At least 15 MB of free disk space on the shared disk system for creating a special cluster partition

The Novell Cluster Services installation automatically allocates one cylinder on one drive of the shared disk system for the special cluster partition. Depending on the location of the cylinder, the actual amount of space used by the cluster partition may be less than 15 MB.

- The shared disk system is properly set up and functional according to the manufacturer's instructions

Prior to installation, verify that all the drives in your shared disk system are recognized by NetWare by running the LIST DEVICES command on each server you intend to add to your cluster. If any of the drives in the shared disk system do not show up in the list, consult your NetWare documentation or the shared disk system documentation for troubleshooting information.

- The disks contained in the shared disk system are configured in a mirroring or RAID 5 configuration to add fault tolerance to the shared disk system

WARNING: If the disks in the shared disk system are not configured to use mirroring or RAID 5, a single disk error can cause a volume failure. Novell Cluster Services software will not protect against such faults.

Rules for Operating a Novell Cluster Services SAN

When you create a Novell Cluster Services system that utilizes shared storage space (a Storage Area Network or SAN), it is important to remember that all servers attached to the shared device, whether in the cluster or not, have access to all of the volumes on the shared storage space unless you specifically prevent such access. Novell Cluster Services arbitrates access to shared volumes for all cluster nodes, but cannot protect shared volumes from being corrupted by noncluster servers.

When working with shared storage, do not attach a noncluster server to the same shared storage device as a cluster unless you have isolated the storage so that the noncluster server has access only to its own volumes. Failure to do so will result in data corruption or volume loss.

Installing or Upgrading Novell Cluster Services

It is necessary to run the Novell Cluster Services installation program when you

- ◆ Create a new cluster
- ◆ Add new nodes to an existing cluster
- ◆ Upgrade Novell Cluster Services software in an existing cluster

If you are running the Novell Cluster Services installation program to create a new cluster, the program automatically

- ◆ Creates a new Cluster object in eDirectory
- ◆ Installs Novell Cluster Services software on the servers you specify to be part of your cluster

After running the Novell Cluster Services installation the first time to create a new cluster, you will need to run the Novell Cluster Services installation again each time you want to add new servers to your cluster or upgrade Novell Cluster Services software on an existing cluster.

Novell Cluster Services Licensing

Novell Cluster Services requires a Cluster Server License for each server that is part of the cluster. The Cluster Server License allows a server to join a cluster. Cluster Server License objects are created in the same eDirectory context as the Cluster object.

Cluster Server Licenses for a two-node cluster are already provided with NetWare 6 and are automatically added during the Novell Cluster Services installation. You only need additional Cluster Server Licenses if you have a three-node or larger cluster. Additional Cluster Server Licenses can be obtained from Novell or from your Novell Authorized ResellerSM.

Prepare Cluster Servers for an Upgrade

If you are upgrading Novell Cluster Services from a previous version and your cluster has shared storage, you must prepare your cluster servers before upgrading them to NetWare 6 and before upgrading Novell Cluster Services. This preparation is necessary to ensure existing shared-volume trustee assignments can be used after the upgrade.

To prepare cluster servers for an upgrade, from a NetWare client run NWDEPLOY.EXE from the root of the *NetWare 6 Operating System* CD to launch the NetWare Deployment Manager, and then complete the following steps:

- 1** In the NetWare Deployment Manager, open the Network Preparation Folder and click Prepare a Novell Cluster for Upgrade.

Continue through the screens until you get to the screen that prompts you to select an existing cluster to prepare for upgrade.

- 2** Specify the cluster name, eDirectory tree, and context for the cluster you are preparing for upgrade.
- 3** Choose whether you want the servers you are going to upgrade to go down after completing the preparation for upgrading cluster servers. Then click Next to run the program for preparing cluster servers for upgrade.

Bringing down all cluster servers before an upgrade ensures NSS volumes on shared storage (your SAN) are deactivated prior to upgrading to NetWare 6.

If you choose to not bring down all cluster servers after completing the preparation for upgrading cluster servers, you must do it manually before upgrading cluster servers to NetWare 6.

Once you have completed the process for preparing cluster servers for upgrade and upgrading those servers to NetWare 6, continue with the instructions in “Run the Installation Program” on page 19.

Run the Installation Program

To install Novell Cluster Services, insert the *NetWare 6 Operating System* CD in a NetWare client workstation and allow the NetWare Deployment Manager to automatically launch. You can also run NWDEPLOY.EXE from the root of the CD to launch the NetWare Deployment Manager. After starting the NetWare Deployment Manager, complete the following steps:

- 1** In the NetWare Deployment Manager, open the Post-Installation Tasks folder and click Install or Upgrade a Novell Cluster.

Continue through the installation screens until you get to the screen that prompts you to create a new cluster, add new nodes to an existing cluster, or upgrade software in an existing cluster.

- 2** Click Create a New Cluster, Add New Nodes to Existing Cluster, or Upgrade Software in Existing Cluster, and then click Next.

The Skip File Copy check box is checked by default and prevents Novell Cluster Services files from being copied during the installation. The NetWare 6 installation program automatically copies all Novell Cluster Services files to every NetWare 6 server. If you want to refresh Novell Cluster Services files on cluster servers you should uncheck the Skip File Copy check box. Even though Novell Cluster Services files already exist on each NetWare 6 server, you still need to run the Novell Cluster Services installation program to configure and set up cluster nodes.

Leaving the Skip File Copy check box unchecked will cause existing Novell Cluster Services files to be copied over, but will not otherwise affect the installation.

- 3** Do one of the following:

- ◆ (If creating) Enter the name for the new Cluster object you are creating and specify the Directory tree and context where you want it created. Then click Next and continue with Step 4 on page 20.

NOTE: Do not use periods in cluster names. NetWare and NetWare clients interpret a period as a delimiter.

- ◆ (If adding new nodes) Specify the eDirectory tree, context, and name of the cluster you will add servers to. If you don't know a cluster name or its context, browse and select one. Then click Next and continue with Step 4 on page 20.
- ◆ (If upgrading software) Specify the Directory tree, context, and name of the cluster where software will be upgraded. Then click Next and go to Step 7 on page 20.

- 4 Enter the name of the server you want to add to the cluster, or browse and select one from the list, and then click Add to Cluster. Repeat this step for every server you want to add to the cluster. Then click Next.

You can also remove servers you just added to the cluster by selecting them from the NetWare Servers in Cluster list and clicking Remove.

When you add a server to a cluster, Novell Cluster Services automatically detects the server's IP address. If the server you are adding has more than one IP address, you will be prompted to select the IP address you want Novell Cluster Services to use.

- 5 Enter a unique IP address for the cluster.

The cluster IP address is separate from the server IP address and is required for certain external network management programs to get cluster status alerts. The cluster IP address provides a single point of cluster access for NetWare Remote Manager. A Master IP Address resource is created automatically during the Cluster Services installation that makes this possible.

The cluster IP address will be bound to the master node and will remain with the master node regardless of which server is the master node.

- 6 (Conditional) If you are creating a new cluster, specify whether your cluster has a shared disk system and, if so, select the drive where you want the small cluster partition created. Then click Next.

Novell Cluster Services requires a small cluster partition on the shared disk system. You are also given the option of mirroring the partition for greater fault tolerance.

IMPORTANT: You must have at least 10 MB of free space that is not part of an NSS partition on one of the shared disk drives to create the cluster partition. If no free space is available, the shared disk drives can't be used by Novell Cluster Services.

If you previously installed Novell Cluster Services and created a cluster with the same name, the installation program will detect that a cluster partition has already been created and this screen will not appear.

- 7 Choose whether or not you want the servers you are upgrading or adding to your cluster to start Novell Cluster Services software after the installation. Then click Next.

If you choose to not start Novell Cluster Services software on each server that you upgrade or add to your cluster, you will need to manually start it after the installation or you will need to reboot cluster servers to automatically start it.

You can manually start Novell Cluster Services by running LDNCS at the server console on each cluster server.

If you are installing or upgrading a two-node cluster or not adding additional nodes to a two-node cluster, continue with Step 9 on page 21.

- 8** (Conditional) Specify the location of the Cluster Server License files or browse and select a path, then click Add.

Since licenses for a two-node cluster are included with NetWare 6, this screen only appears if you are installing or upgrading a three-node or larger cluster.

If you are installing a three-node or larger cluster, you can obtain additional Cluster Server Licenses from Novell or from your Novell Authorized Reseller.

You are given the option of installing without licenses. If you choose to install without licenses and you have a cluster with more than two nodes, you will need to manually install the licenses at a later date using iManage. Novell Cluster Services will not function without the proper licenses in place.

- 9** Continue through the final installation screen.
 - ◆ If you are creating a new cluster, the installation program will create a new Cluster object in eDirectory and install Novell Cluster Services software on the servers you specified to be part of your cluster.
 - ◆ If you are adding new nodes to an existing cluster, the installation program will install Novell Cluster Services software on the servers you are adding to your cluster.
 - ◆ If you are upgrading Novell Cluster Services software on an existing cluster, the installation program will upgrade cluster software on all servers in the cluster.

Setting Up Novell Cluster Services

If you created a new cluster, you now need to create and configure cluster resources. You might also need to create shared disk partitions if they do not already exist and, if necessary, configure all shared disk system pools and volumes to work with Novell Cluster Services. You might also need to cluster enable the shared disk system pools and volumes.

While ConsoleOne is the recommended tool for creating shared disk partitions, NSS pools, and volumes, NetWare Remote Manager can also be used. NetWare Remote Manager currently does not provide all the features for managing network storage that are available in ConsoleOne.

Create Shared Disk Partitions

Before creating disk partitions on shared storage (storage area network or SAN), Novell Cluster Services must be installed. You should carefully plan how you want to configure your shared storage prior to installing Novell Cluster Services.

Using ConsoleOne

- 1** Start ConsoleOne and authenticate to the eDirectory tree where the Cluster object resides.

ConsoleOne runs faster on a client than a server. From a NetWare client, go to the `SYS:PUBLIC\MGMT\CONSOLEONE\1.2\BIN` directory on a server in the cluster and run `CONSOLEONE.EXE`.

We recommend running ConsoleOne from the server that is your primary NetWare connection.

- 2** In the left pane, right-click the Cluster object or the Server object of a server in the cluster and then click Properties.
- 3** On the Media tab, click Devices and then select the Device where you want to create the shared partition. Ensure the Sharable for Clustering check box is checked for the device.

If a device is marked as sharable, all partitions on that device will automatically be sharable.

Device names are not changeable and might be labeled something like 0x2 or 0x1.

If Cluster Services was previously installed and shared disk partitions were already created, the Partitions List field will include this information.

- 4 On the Media tab, click Partitions >New, and then select the device where you want to create the partition (the same device you selected in the previous step).
- 5 Specify the size of the partition and click OK to create it.

Continue with “Create NSS Pools” on page 24.

On this screen you should also ensure NSS is selected as the partition type (this is the default) and ensure the Hot Fix™ and Mirror check boxes are checked and that Create New Mirror Group is selected.

In NetWare Remote Manager, the same process for creating a shared disk partition is also used to create an NSS pool and volume. NetWare Remote Manager currently does not allow you to create multiple volumes on a pool. If you want to create multiple volumes on a pool, use ConsoleOne.

Using NetWare Remote Manager

- 1 In NetWare Remote Manager, in the left column under the Manage Server section, select Volumes.

This is same screen that appears when you start NetWare Remote Manager.

- 2 Under Partition Management, click Disk Partitions.

A screen appears that displays a list of devices that are currently accessible to servers in the cluster. For each device, the list displays the partitions, NSS pools, volumes, and free space on that device.

- 3 Find the device that corresponds to your shared storage system and click Create on the free space where you want to create the partition.
- 4 Under Novell Storage Services, click Create a New Pool and Volume.
- 5 Specify the pool size and name, the volume name, and volume attributes.

Since only one pool exists in each partition, the pool size you specify will be the size of the partition that gets created. The volume that is created will be allowed to grow to the pool size.

The Prepare Volume for Use by Novell Clustering Services check box is currently not functional and does not need to be checked.

- 6 Click CREATE to create the partition, NSS pool, and volume.

Create NSS Pools

The new Storage Pools feature in NSS gives you more flexibility in planning and configuring your storage to work with Novell Cluster Services. More than one cluster-enabled volume can now be part of a single cluster resource, and volumes can dynamically grow as needed to take advantage of free disk space.

Only one NSS pool can be created on a partition. Storage pools must be created prior to creating and cluster-enabling volumes. To learn more about NSS pools, see “Creating a Storage Pool” in the *Novell Storage Services Administration Guide*.

Using ConsoleOne

- 1** In ConsoleOne, on the property page of the Server object, click the Media Tab and select NSS pools.
- 2** Click New, specify the name and type of pool you want to create, and then click Next.

ZLSS is the default pool (LSS) type and should be the type used with Novell Cluster Services.

- 3** Select the partition you just created and then click Next > Finish to create the pool.

The Activate on Creation check box is checked by default. This will cause the pool to be activated as soon as it is created. If you uncheck the check box, you will have to manually activate the pool later before it can be used.

Depending on your network configuration and the size of your eDirectory tree, it could take a while for the pool information to be updated in eDirectory. You can ensure the pool information is updated immediately in eDirectory by selecting the pool from the pools list under the Media tab and then clicking Update NDS.

Repeat the above steps for each additional pool you want to create on shared storage.

Continue with “Create Cluster Volumes” on page 25.

Using NetWare Remote Manager

The same procedure for creating shared disk partitions using NetWare Remote Manager is used to create NSS pools. To create an NSS pool on shared storage using NetWare Remote Manager go to Step 1 on page 23.

Create Cluster Volumes

If you plan on using a shared disk system in your cluster and need to create new NetWare pools or volumes after installing Novell Cluster Services, the server used to create the volumes should already have NSS installed and running. NSS is the default file system for NetWare 6.

Using ConsoleOne

- 1 In ConsoleOne, on the property page of the Server object, click the Media tab and select NSS Logical Volumes.
- 2 Click New, enter the name of the volume you want to create, and then click Next.

Each shared volume in the cluster must have a unique name.

- 3 Select the pool where you want the volume to reside and either enter a quota for the volume or check the check box to allow the volume to grow to the pool size. Then click Next.

The quota is the maximum possible size of the volume. If you have more than one volume per pool, you should enter a quota for each volume rather than allowing multiple volumes to grow to the pool size.

- 4 Review and change volume attributes as necessary, and then click Finish to create the volume.

You might want to check the Flush Files Immediately check box. This will help ensure the integrity of volume data. Checking the Flush Files Immediately check box will improve file system reliability but will hamper performance. You should consider this option only if necessary.

Depending on your network configuration and the size of your eDirectory tree, it could take a while for the volume information to be updated in eDirectory. You can ensure the volume information is updated immediately in eDirectory by selecting the volume from the volumes list under the Media tab and then clicking the Update NDS button

- 5 Repeat the above steps for each cluster volume you want to create.

Depending on your configuration, the new volumes will either mount automatically when resources that require them start or will have to be mounted manually on individual servers after they are up.

IMPORTANT: If you have a volume that is not being managed by Novell Cluster Services, the volume will need to be mounted before you can access it. The MOUNT ALL command in AUTOEXEC.NCF will no longer mount all NSS volumes

by default. In the AUTOEXEC.NCF file of the server where the volume is to be mounted, add separate MOUNT commands followed by the volume name for each of the noncluster volumes you want to mount.

Using NetWare Remote Manager

The same procedure for creating shared disk partitions using NetWare Remote Manager is used to create cluster volumes. To create a cluster volume on shared storage using NetWare Remote Manager go to Step 1 on page 23.

Cluster Enable Pools and Volumes

If you have a shared disk system that is part of your cluster and you want the pools and volumes on the shared disk system to be highly available to NetWare clients, you will need to cluster enable those pools and volumes. Cluster enabling a pool or volume allows it to be moved or mounted on different servers in the cluster in a manner that supports transparent client reconnect.

With this release of Cluster Services, cluster-enabled volumes no longer appear as cluster resources. NSS pools are resources, and load and unload scripts apply to pools and are automatically generated for them. Each cluster-enabled NSS pool requires its own IP address. This means that each cluster-enabled volume does not have an associated load and unload script or an assigned IP address.

The first volume you cluster enable in the pool automatically cluster enables the pool where the volume resides. Once a pool has been cluster enabled, you will need to cluster enable the other volumes in the pool if you want them to be mounted on another server during a failover.

When a server fails, any cluster-enabled pools being accessed by that server will fail over to other servers in the cluster. Because the cluster-enabled pool fails over, all volumes in the pool will also fail over, but only the volumes that have been cluster enabled will be mounted. Any volumes in the pool that have not been cluster enabled will have to be mounted manually. For this reason, volumes that aren't cluster enabled should be in separate pools that are not cluster enabled.

If you want each cluster-enabled volume to be its own cluster resource, each volume must have its own pool.

Some server applications don't require NetWare client access to volumes, so cluster enabling pools and volumes might not be necessary. Pools should be deactivated and volumes should be dismounted before being cluster enabled.

Using ConsoleOne

- 1** Browse and select the Cluster object.
- 2** Click File > New > Cluster > Cluster Volume.
- 3** Browse and select a volume on the shared disk system to cluster enable.
- 4** Enter an IP address for the volume.

This is only required for the first volume to be cluster enabled in the pool. This IP address will be assigned to the pool where the volume resides.

Checking the Online Resource after Create check box will cause the volume to automatically mount once it is created.

- 5** (Optional) Change the default name of the virtual Server object.

When you cluster enable a pool, a virtual Server object is automatically created and given the name of the Cluster object plus the cluster-enabled pool. For example, if the cluster name is cluster1 and the cluster-enabled pool name is pool1, then the default virtual server name will be cluster1_pool1_server.

If you are cluster enabling a volume in a pool that has already been cluster enabled, the virtual Server object has already been created, and you can't change the virtual Server object name.

- 6** (Optional) Change the default name of the cluster-enabled Volume object.

When you cluster enable a volume, a new object is automatically created and given the name of the Cluster object and the volume name. For example, if the cluster name is cluster1 and the volume name is vol1, then the default cluster-enabled Volume object name will be cluster1_vol1.

- 7** Ensure the Define Additional Properties check box is checked, click Create and then continue with "Set Start, Failover, and Failback Modes" on page 33.

Using NetWare Remote Manager

- 1** In NetWare Remote Manager, in the left column under the Clustering section, select Cluster Config.
- 2** At the bottom of the screen under Create New Objects, click New Cluster Volume.
- 3** Select the volume you created in the previous section and click Select.
- 4** Enter the IP address you want to assign to the cluster-enabled volume.

All other fields on this screen should be automatically updated. You can change or edit the information in the fields as desired. See Step 5 on page 27 and Step 6 on page 27 for more information.

This is only required for the first volume to be cluster enabled in the pool. This IP address will be assigned to the pool where the volume resides.

Checking the Auto-Online check box will cause the resource to automatically start once it is created.

- 5 Click the Save button to create the volume resource and then continue with “Set Start, Failover, and Failback Modes” on page 33.

When the volume resource is brought online, the pool will automatically be activated. You don’t need to activate the pool at the server console.

Create Cluster Resource Templates

Templates simplify the process of creating similar or identical cluster resources. For example, templates are helpful when you want to create multiple instances of the same resource on different servers. You can create templates for any server application or resource you want to add to your cluster.

Novell Cluster Services currently provides templates for DHCP, GroupWise[®], and NetWare Enterprise Web Server, as well as a generic IP SERVICE template. The generic IP SERVICE template can be used when configuring certain server applications to run on your cluster. You can edit and customize any of the templates for your specific needs.

Using ConsoleOne

- 1 Browse and select the Cluster object where you want to create a cluster resource template.
- 2 From the menu bar, click File > New > Cluster > Cluster Resource.
- 3 Enter a name for the new cluster resource template.
- 4 Check the Create Resource Template check box.

This option lets you create a cluster resource template instead of a cluster resource.

- 5 Check the Define Additional Properties check box, and then continue with “Configure Load Scripts” on page 30.

To finish creating a cluster resource template, you need to configure load and unload scripts, set failover and failback modes and, if necessary, change the node assignments for the resource template.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 At the bottom of the screen above Create New Objects, click New Cluster Resource.
- 3 Enter a name for the new cluster resource template.
- 4 Check the Create Resource and the Define Additional Properties check boxes and then click Apply.
- 5 Continue with “Configure Load Scripts” on page 30.

Create Cluster Resources

Cluster resources must be created for every resource or application you run on servers in your cluster. Cluster resources can include Web sites, e-mail servers, databases, and any other server-based applications or services you want to make available to users at all times.

Using ConsoleOne

- 1 Browse and select the Cluster object you want to create resources for.
- 2 Click File > New > Cluster > Cluster Resource.
- 3 Enter a name for the new cluster resource.
IMPORTANT: Do not use periods in cluster resource names. NetWare and NetWare clients interpret a period as a delimiter.
- 4 If a template exists for the resource you are creating, enter the template name in the Inherit From Template field, or browse and select it from the list. If a template does not exist, check the Define Additional Properties check box.
- 5 (Conditional) Check the Online Resource after Create check box if you want the resource to automatically start on the master node as soon as it is created and configured.
- 6 Click Create.
- 7 (Conditional) If you are not using a template for the resources, continue with “Configure Load Scripts” on page 30.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 At the bottom of the screen under Create New Objects, click New Cluster Resource.
- 3 Enter a name for the new cluster resource.
- 4 If a template exists for the resource you are creating, select it from the list and then click Apply. If a template does not exist, check the Define Additional Properties check box and then click Apply.

The default selection for this field is No Template.

- 5 (Conditional) If you are not using a template for the resource, continue with “Configure Load Scripts” on page 30.

If you are not using a template, you must complete the process for creating the cluster resource by configuring load and unload scripts, setting failover and failback modes and, if necessary, changing the node assignments for the resource.

If you are using a template for this resource, additional resource configuration is performed automatically by the template.

More information on configuring GroupWise, NDPS[®], NetWare Enterprise Web Server and many other applications is available at Novell's documentation Web site (<http://www.novell.com/documentation/lg/ncs6p/index.html>).

Configure Load Scripts

A load script is required for each resource, service, or disk pool in your cluster. The load script specifies the commands to start the resource or service on a server, or to mount the volume on a server.

You can use any commands in the load script that would be used in a .NCF file run from the server console. If you don't know which commands to add to your load script, consult the documentation for the application or resource.

Load scripts are automatically created for disk pools when you cluster enable them. Because of this, it might not be necessary to configure or change the load script for a pool.

Using ConsoleOne

- 1 Select the Load Script tab on the resource property page.
- 2 Edit or add the necessary commands to the script to load the resource on the server.

Some commands may require command line input. You can add << to a command to indicate command line input. For example, a script command might read

```
LOAD SLPDA <<Y
```

This means that when SLPDA is loaded, it will receive a Y at the command line, presumably to a question that needs a Yes answer. If more inputs are required, they can be continued on subsequent lines, as follows:

```
LOAD SLPDA <<Y
```

```
<<Y
```

```
<<N
```

The string can be up to 32 characters.

- 3 Specify a timeout value.

The default is 600 seconds, or 10 minutes. The timeout value determines how much time the script is given to complete. If the script does not complete within the specified time, the resource becomes comatose.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 From the list of Resources, select the desired resource or resource template.
- 3 On the Resource Information screen, click Loading.
- 4 Edit or add the necessary commands to the script to load the resource on the server.

For more details on load script commands see the instructions above on configuring load scripts using ConsoleOne.

- 5 Specify the Load Timeout and click Apply to save the script.

This is the same as the timeout value described in the above instructions on configuring load scripts using ConsoleOne.

Configure Unload Scripts

Depending on your cluster application or resource, you can add an unload script to specify how the application or resource should terminate. An unload script is not required by all resources or applications, but it can ensure that during a failback or manual migration, a resource unloads before it loads on another node. Consult your application vendor or documentation to determine if you should add commands to unload the resource.

Unload scripts are automatically created for disk pools when you cluster enable them. Because of this it might not be necessary to configure or change the load script for a pool.

Using ConsoleOne

- 1 Select the Unload Script tab on the resource property page.
- 2 Edit or add the necessary commands to the script to unload the intended resource on the server.

You can use any commands used in a .NCF file run from the server console. If you don't know which commands to add, consult the documentation for the application or resource you want to unload.

- 3 Specify a timeout value and click Apply to save the script.

The default is 600 seconds, or 10 minutes. The timeout value determines how much time the script is given to complete. If the script does not complete within the specified time, the resource becomes comatose.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 From the list of Resources, select the desired resource.
- 3 On the Resource Information screen, click Unloading.
- 4 Edit or add the necessary commands to the script to unload the intended resource on the server.
- 5 Specify the Load Wait Time and click Apply to save the script.

Set Start, Failover, and Failback Modes

You can configure the start, failover, and failback of cluster resources to happen manually or automatically. With the resource Start Mode set to **AUTO**, the resource automatically starts on a server when the cluster is first brought up. If the resource Start Mode is set to **MANUAL**, you can manually start the resource on a server when you want, instead of having it automatically start when servers in the cluster are brought up.

With the resource Failover Mode set to **AUTO**, the resource automatically starts on the next server in the Assigned Nodes list in the event of a hardware or software failure. If the resource Failover Mode is set to **MANUAL**, you can intervene after a failure occurs and before the resource is moved to another node.

With the resource Failback Mode set to **DISABLE**, the resource does not fail back to its most preferred node when the most preferred node rejoins the cluster. If the resource Failback Mode is set to **AUTO**, the resource automatically fails back to its most preferred node when the most preferred node rejoins the cluster. Set the resource Failback Mode to **MANUAL** to prevent the resource from moving back to its preferred node when that node is brought back online, until you are ready to allow it to happen.

The preferred node is the first server in the list of the assigned nodes for the resource.

Using ConsoleOne

- 1** In ConsoleOne, right click the resource object and select Properties, then select the Policies tab on the property page.
- 2** (Conditional) Check the Ignore Quorum check box if you don't want the cluster-wide timeout period and node number limit enforced.

The quorum default values were set when you installed Novell Cluster Services. You can change the quorum default values by accessing the properties page for the Cluster object.

Checking this box will ensure the resource is launched immediately on any server in the Assigned Nodes list as soon as any server in the list is brought online.

- 3** Choose the Start, Failover, and Failback modes for this resource.

The default for both Start and Failover modes is **AUTO**, and the default for Failback mode is **DISABLE**.

- 4 Check the Master Only check box to ensure the resource runs only on the master node in the cluster.

If the master node in the cluster fails, the resource will fail over to whichever node becomes the master.

- 5 Click Apply to save changes.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.

- 2 From the list of Resources, select the desired resource.

- 3 On the Resource Information screen, click Policies.

- 4 Check or uncheck the Ignore Quorum check box as desired.

See the instructions above on setting resource Start, Failover, and Failback modes using ConsoleOne for more details.

- 5 Select the Start, Failover, and Failback modes for this resource.

- 6 Check or uncheck the Master Only check box.

If the Master Only box is checked, the resource will run only on the server designated as the Master node in the cluster.

- 7 Click Apply.

Assign Nodes to a Resource

When you create a resource on a cluster or cluster enable a volume or pool, the nodes in the cluster are automatically assigned to the resource or the volume or pool. The order of assignment is the order the nodes appear in the resource list. You can assign or unassign nodes to the resource or the volume or pool, or change the failover order.

Using ConsoleOne

- 1 Select the Nodes tab on the resource property page.

- 2 From the list of unassigned nodes, select the server you want the resource assigned to and click the Right-arrow button to move the selected server to the Assigned Nodes list.

Repeat this step for all servers you want assigned to the resource. You can also use the Left-arrow button to unassign servers from the resource.

- 3 Click the Up- and Down-arrow buttons to change the failover order of the servers assigned to the resource or volume.
- 4 Click Apply to save node assignment changes.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 From the list of Resources, select the desired resource.
- 3 On the Resource Information screen, click Nodes.
- 4 Select or type in the nodes that you want assigned to this resource.
- 5 Click Apply to save node assignment changes.

Configuration Settings

Depending on your needs and cluster setup, some additional configuration may be required for you to effectively use Novell Cluster Services. This additional configuration might consist of changing the values on some of the properties for the Cluster object and the Cluster Node objects.

Edit Quorum Membership and Timeout Properties

You can edit Quorum Membership and Timeout properties using either ConsoleOne or NetWare Remote Manager.

Using ConsoleOne

- 1 Right-click the Cluster object.
- 2 Click Properties.
- 3 Select the Quorum tab on the Cluster Object Property page.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 Select the Cluster object name.
- 3 Click Quorum.

Membership

The Quorum Membership is the number of nodes that must be running in the cluster before resources will start to load. When you first bring up servers in your cluster, Novell Cluster Services reads the number specified in the Membership field and waits until that number of servers is up and running in the cluster before it starts loading resources.

Set the Membership value to a number greater than 1 so that all resources don't automatically load on the first server that is brought up in the cluster. For example, if you set the Membership value to 4, there must be four servers up in the cluster before any resource will load and start.

Timeout

Timeout specifies the amount of time to wait for the number of servers defined in the Membership field to be up and running. If the timeout period elapses before the quorum membership reaches its specified number, resources will automatically start loading on the servers that are currently up and running in the cluster. For example, if you specify a Membership value of 4 and a timeout value equal to 30 seconds, and after 30 seconds only two servers are up and running in the cluster, resources will begin to load on the two servers that are up and running in the cluster.

Cluster Protocol Properties

You can use the Cluster Protocol property pages to view or edit the transmit frequency and tolerance settings for all nodes in the cluster, including the master node. The master node is generally the first node brought online in the cluster, but if that node fails, any of the other nodes in the cluster can become the master.

Using ConsoleOne

- 1 Right-click the Cluster object.
- 2 Click Properties.
- 3 On the Cluster Object property page, select the Protocol tab.

This tab has two pages: Settings and Internals. The Internals page lets you view the script used to configure the cluster protocol settings, but not change it. Use the Settings page to make changes to cluster protocol properties.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 Select the Cluster object name.
- 3 Click Protocol.

Heartbeat

Heartbeat specifies the amount of time between transmits for all nodes in the cluster except the master. For example, if you set this value to 1, nonmaster nodes in the cluster send a signal that they are alive to the master node every second.

Tolerance

Tolerance specifies the amount of time the master node gives all other nodes in the cluster to signal that they are alive. For example, setting this value to 4 means that if the master node does not receive an “I’m alive” signal from a node in the cluster within four seconds, that node is removed from the cluster.

Master Watchdog

Master Watchdog specifies the amount of time between transmits for the master node in the cluster. For example, if you set this value to 1, the master node in the cluster transmits an “I’m alive” signal to all the other nodes in the cluster every second.

Slave Watchdog

Slave Watchdog specifies the amount of time the master node has to signal that it is alive. For example, setting this value to 5 means that if the nonmaster nodes in the cluster do not receive an “I’m alive” signal from the master within five seconds, the master node is removed from the cluster and one of the other nodes becomes the master node.

Max Retransmits

This option is not currently used with Novell Cluster Services but will be used for future versions.

Cluster IP Address and Port Properties

The Cluster IP address is assigned when you install Novell Cluster Services. The Cluster IP address normally does not need to be changed, but can be if needed.

The default cluster port number is 7023, and is automatically assigned when the cluster is created. The cluster port number does not need to be changed unless a conflict is created by another resource using the same port number. If there is a port number conflict, change the Port number to any other value that doesn't cause a conflict.

Using ConsoleOne

- 1 Right-click the cluster object.
- 2 Click Properties.
- 3 On the Cluster Object property page, select the Management tab.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 Select the Cluster object name.
- 3 Click IP Address.

Resource Priority

The Resource Priority allows you to control the order in which multiple resources start on a given node when the cluster is brought up or during a failover or failback. For example, if a node fails and two resources fail over to another node, the resource priority determines which resource loads first.

This is useful for ensuring that the most critical resources load first and are available to users before less critical resources.

Using ConsoleOne

- 1 Right-click the cluster object.
- 2 Click Properties.
- 3 On the Cluster Object property page, select the Resource Priority tab.

- 4 To change the priority for a resource, select the resource in the list and then click the Increase or Decrease button to move the resource up or down in the list.

This lets you change the load order of the resource relative to other cluster resources on the same node.

You can also select a resource and then click the Selected button to reset the resource back to its default load order.

- 5 Click the Apply button to save changes made to resource priorities.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 Select the Cluster object name.
- 3 Click Resource Priorities.
- 4 To change the priority for a resource, assign it a number between 0 and 65535.

65535 is the maximum value and 0 is the minimum value. Setting a resource priority to 65535 ensures the resource loads before other resources with lower priority settings. Setting the resource priority to 0 ensures the resource loads last after all other resources have loaded. The default resource priority setting is 0.

If you assign multiple resources the same priority, the start order of those resources is random.

- 5 Click the Apply button to save changes made to resource priorities.

Cluster E-Mail Notification

Novell Cluster Services can automatically send out e-mail messages for certain cluster events like cluster and resource state changes or nodes joining or leaving the cluster.

You can enable or disable e-mail notification for the cluster and specify up to eight administrator e-mail addresses for cluster notification.

Using ConsoleOne

- 1 Right-click the cluster object
- 2 Click Properties.

- 3** On the Cluster Object property page, select the Notification tab.
- 4** Check or uncheck the Enable Cluster Notification Events check box to enable or disable e-mail notification.
- 5** If you enable e-mail notification, add the desired e-mail address in the field provided and click the button next to the field to add the address to the list. Repeat this process for each address you want on the notification list.
- 6** If you enable e-mail notification, specify the type of cluster events you want administrators to receive messages for.

To only receive notification of critical events like a node failure or a resource going comatose, check the Receive Only Critical Events check box .

To receive notification of all cluster state changes including critical events, resource state changes, and nodes joining and leaving the cluster, check the Verbose Messages check box.

To receive notification of all cluster state changes in XML format, check the XML Messages option. XML format messages can be interpreted and formatted with a parser that lets you customize the message information for your specific needs.

- 7** Click the Apply button to save changes made.

Using NetWare Remote Manager

- 1** On the left column under the Clustering section, click Cluster Config.
- 2** Select the Cluster object name and click Email Reporting.
- 3** Add the desired email addresses in the fields provided.
- 4** Specify the type of cluster events you want administrators to receive messages for.

Specify a 1 or a 0 to disable email notification.

Specify a 2 (Critical) to only receive notification of critical events like a node failure or a resource going comatose.

Specify a 4 (Verbose) to receive notification of all cluster state changes including critical events, resource state changes, and nodes joining and leaving the cluster.

Specify an 8 to receive notification of all cluster state changes in XML format. XML format messages can be interpreted and formatted with a

parser that lets you customize the message information for your specific needs.

- 5 Click the Apply button to save your changes.

Cluster Node Properties

You can view or edit the cluster node number or IP address of the selected node or view the context for the NetWare Server object.

Using ConsoleOne

- 1 Select the Cluster object and right-click the desired cluster node on the right side of the ConsoleOne display screen.
- 2 Click Properties.
- 3 On the Cluster Node property page, select the Node tab.

Using NetWare Remote Manager

- 1 On the left column under the Clustering section, click Cluster Config.
- 2 Select the Cluster node name.
- 3 Click IP Address or Node Number.

(Node) Number+IP Address

Number+IP Address specifies the cluster node number and IP address for the selected node. If the cluster node number or IP address changes for the selected node, the new information is not automatically updated in eDirectory. Edit the information and click Apply to update the information in eDirectory.

NCP Server

The NCP Server field is used to view the context for the NetWare Server object. This field cannot be edited.

Migrating Resources

You can migrate resources to different servers in your cluster without waiting for a failure to occur. You might want to migrate resources to lessen the load on a specific server, to free up a server so it can be brought down for scheduled maintenance, or to increase the performance of the resource or application by putting it on a faster machine.

Migrating resources allows you to balance the load and evenly distribute applications among the servers in your cluster.

Using ConsoleOne

- 1** Browse and select the Cluster object that contains the resource you want to migrate.

Resources must be in a running state to be migrated.

- 2** Ensure the right half of ConsoleOne displays the Cluster View State by selecting View > Cluster State from the menu at the top of the screen.

- 3** In the Cluster Resource List, select the resource you want to migrate.

The Cluster Resource Manager screen appears, displaying the server the selected resource is currently running on and a list of possible servers to which you can migrate resources.

- 4** Select a server from the list and click Migrate to move the resource to the selected server.

Using NetWare Remote Manager

- 1** On the left column under the Clustering section, click Cluster Management.
- 2** Select the cluster resource you want to migrate.
- 3** Select a server from the list and then click Migrate to move the resource to the selected server.

If you select a resource and click Offline, the resource will be unloaded from the server. It will not load on any other servers in the cluster and will remain unloaded until you load it again. This option is useful for editing resources because resources can't be edited while loaded or running on a server.

Identifying Cluster and Resource States

Both the Cluster State view in ConsoleOne and the Cluster Management link in NetWare Remote Manager give you important information about the status of servers and resources in your cluster.

Cluster servers and resources display in different colors, depending on their operating state. When servers and resources are green, they are in a normal operating condition. When a server that has been part of the cluster is red with a break in the icon, it has failed. When a resource is red, it is waiting for administrator intervention. When a server is gray with no break in the icon, that server is not currently a member of the cluster, or its state is unknown. When a resource is blank or has no colored icon, it is unassigned, offline, changing state, or in the process of loading or unloading.

The yellow ball in the middle of the server icon designates the master server in the cluster. The master server is initially the first server in the cluster, but another server can become the master if the first server fails.

The Epoch number indicates the number of times the cluster state has changed. The cluster state will change every time a server joins or leaves the cluster.

Clicking on the Event Log tab in ConsoleOne gives you a detailed history of your cluster. Every time the cluster state changes, a new event is added to the Event Log. You can sort the events in the log by clicking on the column headings of the table. You can reverse the sort order by pressing the Shift key while clicking on a column heading. The Event Log is stored on the special cluster partition that was created during the Novell Cluster Services installation, which ensures it is always available. You can also save the Event Log to a file.

Clicking on the HTML Report tab in ConsoleOne in the Cluster State view screen launches a more detailed report of the state of your cluster. You can view this report or save it to an HTML file for printing or viewing with a browser.

The following table identifies the different resource states and gives descriptions and possible actions for each state. The possible actions describe steps for using ConsoleOne to complete each action. You can also use the NetWare Remote Manager to perform the same actions. In NetWare Remote Manager, in the left column under the Clustering section, click Cluster Management and then select the desired resource.

Resource State	Description	Possible Actions
Alert	Either the Start, Failover, or Failback mode for the resource has been set to Manual. The resource is waiting to start, fail over, or fail back on the specified server.	Click the Alert status indicator and depending on the resource state, you will be prompted to Start, Failover, or Failback the resource.
Comatose	The resource is not running properly and requires administrator intervention.	Click the Comatose status indicator and offline the resource. Once resource problems have been resolved, the resource can be put back online (returned to the running state).
Loading	The resource is in the process of loading on a server.	None.
NDS_Sync	The properties of the resource have changed and the changes are still being synchronized in eDirectory.	None.
Offline	Offline status indicates the resource is shut down or is in a dormant or inactive state.	Click the Offline status indicator and if desired, click the online button to load the resource on the best node possible, given the current state of the cluster and the resource's preferred nodes list.
Quorum Wait	The resource is waiting for quorum to be established so it can begin loading.	None.

Resource State	Description	Possible Actions
Running	The resource is in a normal running state.	Click the Running status indicator and choose to either migrate the resource to a different server in your cluster, or unload (offline) the resource.
Unassigned	There isn't an assigned node up that the resource can be loaded on.	Click the Unassigned status indicator and if desired, Offline the resource. Offlining the resource will prevent it from running on any of its preferred nodes should any of them join the cluster.
Unloading	The resource is in the process of unloading from the server it was running on.	None.

Additional Cluster Operating Instructions

The following instructions provide additional information for operating Novell Cluster Services.

Installing NetWare on a Server That Will Be Added to an Existing Cluster

- 1 Install fiber-channel hardware.

NetWare will automatically detect and load the proper drivers when it installs.

- 2 Install NetWare, including the latest Service Pack, on the new server.
- 3 Reboot the server.
- 4 Install Novell Cluster Services on the new server.
- 5 (Conditional) If you have changed the failover order, add the new server to the failover list.

By default, Novell Cluster Services will include all nodes on the failover list, including newly added nodes.

Readding a Node to a Cluster That Was Previously in the Cluster

- 1 If necessary, install NetWare, including the latest service pack on the server using the same node name and IP address.
- 2 If the Cluster object for the server is still present, use ConsoleOne to delete the object.

You can do this by going to the Cluster container, selecting the node in the right frame, and pressing Delete.

- 3 Run the Novell Cluster Services installation.

The node will assume its former identity.

Cluster-enabled Volume Connection Required for Some Utilities

Because Novell Cluster Services uses NDS to find objects and resolve names, you must first establish a client connection to a cluster-enabled volume for it to be visible to certain utilities.

Do this by browsing to and selecting the eDirectory Volume object using Windows Explorer.

Some Applications Do Not Fail Over

Although all NetWare 6 applications will run on a cluster node, not all applications are capable of being configured as a cluster application and failed over to a new node.

Novell Cluster Services Console Commands

Novell Cluster Services provides several server console commands to help you perform certain cluster related tasks. The following table lists the cluster-related server console commands and gives a brief description of each command. To execute a cluster console command type **CLUSTER** followed by the command. For example, if you want to display cluster statistics, type **CLUSTER STATS DISPLAY** at the server console. You can also type **HELP CLUSTER** at the console prompt to get information on the commands and their functions.

Cluster Console Command	Description
ALERT {resource}{YES/NO}	The resource start, failover, or failback mode is set to manual and the resource is waiting to start on a node, or fail over or fail back to another node. Specify the resource name in the command and use the YES or NO switch to specify whether or not you want the resource to fail over, fail back, or start.
CVSBIND {ADD, DEL}{resource}{IP address}	Enables applications that rely on the bindery or bindery emulation to access a virtual server on the cluster. Specify the resource name for the cluster application and the IP address for the virtual server. Use the ADD or DEL switch to enable or disable bindery access to the virtual server.
DHCP {context}	Specifies the eDirectory context where DHCP configuration information is stored. This command is useful if you have problems getting DHCP to function properly on a cluster.
DOWN	Removes all cluster nodes from the cluster. Has the same effect as executing the CLUSTER LEAVE command on every server in the cluster.
JOIN	Adds the node where the command is executed to the cluster and makes the node visible to other servers in the cluster. Cluster Services software must already be installed on a node for it to join the cluster.
LEAVE	Removes the node where the command is executed from the cluster. The node will not be visible to other servers in the cluster.
MIGRATE {resource}{node name}	Migrates the specified resource from the node where it is currently running to the node you specify in the command. The node you migrate the resource to must be running in the cluster and also be in the resource's assigned nodes list.

Cluster Console Command	Description
OFFLINE {resource}	Unloads the specified resource from the node where it is currently running.
ONLINE {resource}{node name}	Starts the specified resource on the most preferred node that is currently active. You can start the resource on a different node by specifying that node in the command.
POOLS	Lists the NSS pools on the shared disk system that are accessible by Novell Cluster Services.
RESOURCES	Lists all resources that currently exist in the cluster. The resources do not have to be online or running.
RESTART {seconds}	Restarts Cluster Services software on all servers in the cluster.
STATS {Display, Clear}	Reports the node number, node name, and heartbeat information. You must switch to the log console screen to see cluster statistics.
STATUS {resource}	Reports the status of the specified resource. This includes the number of times the resource has been migrated or failed over to another server, the resource state, and the node where the resource is currently running.
VIEW	Displays the node name, cluster epoch number, master node name, and a list of nodes that are currently members of the cluster.