Novell Cluster Services™ NetWare to Linux Conversion Guide
Open Enterprise Server 2015 SP1

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About This Guide

This guide describes how to convert Novell Cluster Services cluster nodes and resources from NetWare 6.5 Support Pack (SP) 8 (with the latest patches) to Novell Cluster Services 2.2 on Open Enterprise Server (OES) clusters.

This guide includes the following sections:

- Chapter 1, “Planning the Cluster Conversion,” on page 9
- Chapter 2, “Planning the Conversion of Cluster Resources,” on page 17
- Chapter 3, “Planning the Conversion of Load and Unload Scripts,” on page 21
- Chapter 4, “Converting NetWare Clusters to OES Clusters,” on page 33
- Chapter 5, “Novell AFP,” on page 41
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- Chapter 14, “Novell Storage Services Pools,” on page 95
- Appendix A, “Comparing Novell Cluster Services for Linux and NetWare,” on page 97
- Appendix B, “Comparing Resources Support for Linux and NetWare,” on page 103

Audience

This guide is intended for Novell Cluster Services administrators and other administrators that are responsible for clustered services and data. It is assumed that readers of this guide have a basic understanding of Novell Cluster Services and of the services and file systems that are being clustered.

Feedback

We want to hear your comments and suggestions about this manual and the other documentation included with this product. Please use the User Comments feature at the bottom of each page of the online documentation.

Documentation Updates

For the most recent version of the Novell Cluster Services NetWare to Linux Conversion Guide, visit the OES documentation website (http://www.novell.com/documentation/oes2015/).
Additional Documentation

For information about managing Novell Cluster Services clusters and resources, see the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

For information about managing a NetWare cluster, see the “Clustering NetWare Services” list on the NetWare 6.5 SP8 Clustering (High Availability) documentation website (http://www.novell.com/documentation/nw65/cluster-services.html#clust-config-resources).
Planning the Cluster Conversion

Upgrading a NetWare 6.5 SP8 cluster to Open Enterprise Server (OES) 2015 SP1 is a multi-phase process referred to as a rolling cluster conversion. This approach lets you keep your cluster up and running and lets your users continue to access cluster resources while the conversion is in progress. During a rolling cluster conversion, one server is converted to OES while the other servers in the cluster continue running NetWare. Then another server can be converted to OES, and then another, until all servers in the cluster have been converted. During the conversion, you can also add OES servers to the cluster, and remove NetWare servers from the cluster.

Before you begin a conversion, ensure that your system meets the requirements and caveats described in this section. In addition, your OES nodes and network environment must meet the cluster requirements as described in "Planning for Novell Cluster Services" in the *OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide*.

- Section 1.1, “Supported Conversion Paths,” on page 10
- Section 1.2, “Supported Mixed-Mode Clusters,” on page 10
- Section 1.3, “SBD Devices Must Be Marked as Shareable for Clustering,” on page 10
- Section 1.4, “Master-Election Algorithm,” on page 11
- Section 1.5, “Syntax Translation Issues for Load and Unload Scripts,” on page 11
- Section 1.6, “Adding a New NetWare Node to a Mixed-Mode Cluster,” on page 12
- Section 1.7, “Converting Multiple NetWare Cluster Nodes to OES,” on page 12
- Section 1.8, “Converting Nodes that Contain the eDirectory Master Replica or Certificate Authority,” on page 12
- Section 1.9, “Failing Over Service Cluster Resources in Mixed-Mode Clusters,” on page 12
- Section 1.10, “Failing Over Data Cluster Resources in Mixed-Mode Clusters,” on page 13
- Section 1.11, “Using Resources in Mixed-Mode Clusters,” on page 13
- Section 1.12, “Managing File Systems in Mixed-Mode Clusters,” on page 13
- Section 1.13, “Using Novell iManager in Mixed-Mode Clusters,” on page 14
- Section 1.14, “Using Novell Remote Manager to Manage the Cluster Is Not Supported in Mixed-Mode Clusters,” on page 14
- Section 1.15, “Using ConsoleOne to Manage the Cluster Is Not Supported in Mixed-Mode Clusters,” on page 14
- Section 1.16, “Using the Monitoring Function Is Not Supported in Mixed-Mode Clusters,” on page 15
1.1 Supported Conversion Paths

The NetWare to Linux conversion is supported from NetWare 6.5 SP8 (with the latest patches applied) to OES 2015 SP1 on the SUSE Linux Enterprise Server (SLES) 11 SP4 operating system. The following conversion paths are supported from NetWare to OES:

<table>
<thead>
<tr>
<th>From this NetWare platform</th>
<th>Interim platform upgrade for all nodes</th>
<th>Before conversion to this platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>NetWare 6.5 SP8</td>
<td>Latest patches applied</td>
<td>OES 2015 SP1 on SLES 11 SP4</td>
</tr>
<tr>
<td>NetWare 6.5 SP7 or earlier</td>
<td>NetWare 6.5 SP8 with the latest patches applied</td>
<td>OES 2015 SP1 on SLES 11 SP4</td>
</tr>
</tbody>
</table>

Before converting NetWare clusters to the latest OES release, you must apply all of the latest service packs and patches. See “Upgrading NetWare Clusters” in the NW6.5 SP8: Novell Cluster Services 1.8.5 Administration Guide.

If you have a NetWare 6.5 SP7 or earlier cluster, you must upgrade all nodes to NetWare 6.5 SP8 (with the latest service packs and patches) before you convert any nodes to OES or add OES nodes to the cluster. See “Upgrading NetWare Clusters” in the NW6.5 SP8: Novell Cluster Services 1.8.5 Administration Guide.

1.2 Supported Mixed-Mode Clusters

During the conversion, the intermediate cluster is referred to as a mixed-mode cluster. It contains NetWare nodes and Linux nodes. This is a temporary configuration that is supported for the purpose of converting the cluster from NetWare 6.5 SP8 (with the latest support packs and patches) to OES. It is not supported as a long-term operational state of the cluster.

1.3 SBD Devices Must Be Marked as Shareable for Clustering

Novell Cluster Services for Linux requires that the devices used for the SBD partition be explicitly marked as Shareable for Clustering. When converting a NetWare cluster, ensure that the SBD device, or both devices for a mirrored SBD, are marked as Shareable for Clustering before you add the first Linux node to the cluster.

1. Log in to the master NetWare node as the root user, then open a terminal console.
2. At the console prompt, enter
   
```
nssmu
```
3. In the NSSMU main menu, select Devices, then press Enter.
4. Select the SBD device.
5. If Shareable for Clustering is set to No, press F6 to share the device.
   
Wait for the page to refresh. If the change is successful, Shareable for Clustering is set to Yes.
6. If the SBD is mirrored, repeat Step 4 and Step 5 for the device that is used as the SBD mirror.
1.4 Master-Election Algorithm

Novell Cluster Services for OES 11 SP1 and later introduces some intelligence in the master election process when the master leaves a cluster (voluntarily or involuntarily). The new algorithm substantially reduces the time needed for master election in some cases.

During an upgrade, a master-election dispute can rarely occur in a larger mixed-mode cluster (4 or more nodes) that consists of mixed NetWare 6.5 SP8 and OES nodes. If multiple nodes, including the master, concurrently leave the cluster, the different master-election algorithms might result in a dispute where equal-sized groups of old nodes and new nodes each elects its own master. SBD resolves the dispute by fencing one of the masters.

The fencing does not result in data loss. You can reboot the nodes that are poison-pilled, and they will re-join the cluster.

If you have a larger cluster (4 or more nodes), you can avoid the master-election dispute/fencing problem by upgrading the NetWare nodes with higher IP addresses first, in descending order from highest to lowest. This helps ensure that in master node election disputes between a NetWare node and an OES node, the OES node has the higher IP address and becomes the master.

For example, assume that you have a four-node NetWare 6.5 SP8 cluster with IP address assignments as follows:

Node1, IP: 192.168.99.10
Node2, IP: 192.168.99.11

You should first upgrade Node4 because it has the highest IP address. Upgrade Node3 second, then Node2, and finally Node1.

1.5 Syntax Translation Issues for Load and Unload Scripts

Executing a script that is valid for the NetWare platform is not necessarily recognized on the OES platform. When you cluster migrate a resource from a NetWare node to an OES node, the resource’s load script and unload script need to be translated in-memory while the cluster is in mixed mode. It is also translated in-memory when the cluster is finally converted from NetWare to Linux. This translation is done by the Cluster Translation Library script (/opt/novell/ncs/bin/clstrlib.py). For information about the script translations, see Chapter 3, “Planning the Conversion of Load and Unload Scripts,” on page 21.

**IMPORTANT:** If the commands in cluster resource’s load or unload scripts are not part of the normal translation library, the cluster resource can end up in a comatose state.

Novell Cluster Services allows you to customize the translation syntax that is used for load and unload scripts in mixed-mode clusters by defining them in the /var/opt/novell/ncs/customized_translation_syntax file that you create. The clstrlib.py script reads the additional translation syntax from the syntax file. See Section 3.7, “Customizing the Translation Syntax for Converting Load and Unload Scripts,” on page 28.
1.6 Adding a New NetWare Node to a Mixed-Mode Cluster

You cannot add a new NetWare node to your cluster if OES nodes are active in the cluster. To add NetWare cluster nodes after converting part of your cluster to OES, you must first remove the OES nodes from the cluster by using the `cluster leave` command.

1.7 Converting Multiple NetWare Cluster Nodes to OES

To concurrently convert multiple NetWare cluster servers to OES, we strongly recommend that you use the old NetWare node IP addresses for your Linux cluster servers. You should record the NetWare node IP addresses before converting them to Linux.

If you must assign new node IP addresses to the OES nodes, we recommend that you convert only one node at a time.

If new cluster node IP addresses are required and the old server hardware is being retired, you can shut down the NetWare nodes that are to be removed, add the new OES cluster nodes, then remove the NetWare nodes’ cluster-related objects as described in Step 5 of Section 4.1, “Converting NetWare Cluster Nodes to OES (Rolling Cluster Conversion),” on page 33.

**IMPORTANT:** Failure to follow these recommendations might result in NetWare server abends and OES server restarts.

1.8 Converting Nodes that Contain the eDirectory Master Replica or Certificate Authority

If the Novell eDirectory master replica resides on a clustered NetWare node, convert that node last in the rolling cluster conversion to OES. This also applies to a NetWare node that is running the Novell Certificate Server Certificate Authority.

For OES 2015 SP1, the replacement Linux nodes will use NetIQ eDirectory 8.8 SP8 and NetIQ Certificate Server 3.3.8. These are the same Novell products that you have used for years, but they are now maintained by NetIQ, a sister company of Novell in the Attachmate Group.

1.9 Failing Over Service Cluster Resources in Mixed-Mode Clusters

For service cluster resources, the intention is to have a one-time cluster migration of the service from NetWare to OES. After you cluster migrate the resource to an OES node, the relocated resource should be cluster migrated only between nodes running the OES platform.
1.10 Failing Over Data Cluster Resources in Mixed-Mode Clusters

Pool cluster resources that were created on NetWare cluster nodes and migrated or failed over to OES cluster nodes can be migrated or failed back to NetWare cluster nodes.

Cluster resources that are created on OES cluster nodes cannot be migrated or failed over to NetWare cluster nodes. If you need to create a new pool as part of a documented conversion procedure, create the pool on a NetWare node, then cluster migrate it to an OES node. For more information, see Section 1.12, “Managing File Systems in Mixed-Mode Clusters,” on page 13.

If you cluster migrate an NSS pool from a NetWare cluster server to an OES cluster server, it could take several minutes for volume trustee assignments to synchronize between the NSS volumes and the NCP Server on Linux. Users might have limited access to the migrated volumes until after the trustee database is built on Linux.

1.11 Using Resources in Mixed-Mode Clusters

In cases where a Linux converted script exceeds the imposed NetWare script size limit of 924 bytes, it is best to avoid bringing the resource online on OES nodes until the final cluster convert command has been run. See Section 3.2, “Comparing Script Length Limits for NetWare and Linux,” on page 22.

For example, the Linux script for GroupWise exceeds the length limit for NetWare scripts. Therefore, we recommend that you do not online GroupWise resources while running in mixed-mode clusters.

1.12 Managing File Systems in Mixed-Mode Clusters

In a mixed cluster of NetWare and OES nodes, Linux POSIX file systems as cluster resources cannot be created until the entire cluster had been successfully converted to OES Linux POSIX file systems as cluster resources cannot be migrated or failed over to NetWare cluster nodes.

Only NSS pool cluster resources that are created on a NetWare cluster node can be failed over between Linux and NetWare nodes of a mixed-mode cluster.

NetWare-to-Linux failover of NSS pool cluster resources requires that the Linux node be configured for NSS.

No storage management functions should be executed in a mixed-mode cluster unless you are performing documented steps for the conversion. That is, do not create, delete, expand, or modify the properties for partitions, pools, or volumes for shared resources in the cluster unless the conversion instructions specifically guide you to do so.

**WARNING:** Attempting to reconfigure shared storage in a mixed cluster can cause data loss.

If you need to configure (or reconfigure) existing shared NSS pools and volumes in a mixed-mode cluster, you must temporarily bring down all Linux cluster nodes prior to making changes, then make the configuration changes on a NetWare node. Ensure that the resources are working properly on NetWare before having the Linux cluster nodes rejoin the cluster.
1.13 Using Novell iManager in Mixed-Mode Clusters

Use Novell iManager 2.7.5 or later for all cluster administration in the mixed-mode cluster. Using the Clusters plug-in to iManager is required to manage the cluster after the first OES node is added to the cluster.

The display of node IDs from the NetWare master node might be incomplete if you use other tools like ConsoleOne and Novell Remote Manager in a mixed-mode cluster. However, you can use `cat /admin/Novell/Cluster/NodeConfig.xml` on any cluster node to get the node IDs.

```
 avalon:/Desktop # cat /admin/Novell/Cluster/NodeConfig.xml
 <?xml version="1.0" standalone="yes"?>
  <nsReply>
   <nodes>
     <node>
       <name>avalon</name>
       <nodeNumber>0</nodeNumber>
       <ipAddress>10.10.10.37</ipAddress>
     </node>
   </nodes>
  </nsReply>
```

1.14 Using Novell Remote Manager to Manage the Cluster Is Not Supported in Mixed-Mode Clusters

Do not use Novell Remote Manager when managing mixed-mode clusters. Novell Remote Manager is not supported for cluster management on OES.

Because different time formats are used in the NCS Event log for NetWare and Linux, Novell Remote Manager might have difficulty displaying the time of logged events. To avoid this problem in a mixed-mode cluster, use iManager to access the NCS Event log.

To reduce any confusion you might have when using Novell Remote Manager, you can unload module `pcluster.nlm` and delete its references in `ldncs` and `uldncs`. This removes the Cluster tab in Novell Remote Manager.

1.15 Using ConsoleOne to Manage the Cluster Is Not Supported in Mixed-Mode Clusters

Do not use ConsoleOne when managing mixed-mode clusters. ConsoleOne is not supported for cluster management on OES.
1.16 Using the Monitoring Function Is Not Supported in Mixed-Mode Clusters

In mixed-mode clusters, the Monitor function in Novell Cluster Services for Linux is not available. You cannot enable the Monitor function or modify the Monitor script for cluster resources on the Linux nodes until all nodes in the cluster are running OES, and the conversion is finalized. In the finalization process, the monitor scripts are automatically created for each of the converted cluster resources.

After the conversion is finalized, you can enable monitoring and view or modify the monitor script for a resource by using the Clusters plug-in to iManager. See “Enabling Monitoring and Configuring the Monitor Script” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.
Planning the Conversion of Cluster Resources

In addition to changing the operating system, the software and file systems for various clustered services must be considered in your conversion from NetWare 6.5 SP8 to Open Enterprise Server (OES) 2015 SP1. This section provides an overview of the NetWare services and their counterparts in OES. Before you begin a conversion, ensure that your system meets the general requirements and caveats described in this section.

Converting cluster resources for OES services from NetWare to Linux might require more than a simple cluster migration from a NetWare node to a Linux node. For example, the service might require that you use Migration Tool to convert the service from NetWare to Linux. Some services require post-conversion configuration to finalize the conversion. A few OES services on NetWare are not available on OES, so you must use the standard Linux service instead.

See Table 2-1 for information about converting cluster resources for NetWare 6.5 SP8 services:

<table>
<thead>
<tr>
<th>Service on NetWare 6.5 SP8</th>
<th>Cluster Migrate the Resource</th>
<th>Converting the Service to OES 2015 or Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apache Web Server</td>
<td>Yes</td>
<td>See Chapter 6, “Apache HTTP Server,” on page 43.</td>
</tr>
<tr>
<td>CIFS (Windows File Services)</td>
<td>Yes</td>
<td>See Chapter 8, “Novell CIFS,” on page 63.</td>
</tr>
<tr>
<td>DFS VLDB (Distributed File Services volume location database)</td>
<td>Yes</td>
<td>See Chapter 9, “Novell Distributed File Services VLDB,” on page 65.</td>
</tr>
<tr>
<td>eDirectory</td>
<td>Not clustered, but requires special handling</td>
<td>See Section 1.8, “Converting Nodes that Contain the eDirectory Master Replica or Certificate Authority,” on page 12.</td>
</tr>
<tr>
<td>Service on NetWare 6.5 SP8</td>
<td>Cluster Migrate the Resource</td>
<td>Converting the Service to OES 2015 or Later</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Certificate Server</td>
<td>Not clustered, but requires special handling</td>
<td>Novell Certificate Server provides the Certificate Authority and Server Certificate services. For OES 11 SP2, the product has been rebranded as NetIQ Certificate Server. The Certificate Authority (CA) service is not cluster-enabled for NetWare or OES. There are no cluster-specific tasks for the CA itself. The Server Certificate service issues Server Certificate objects that might need to reside on each node in a cluster, depending on the service that is clustered. NetWare and Linux generate certificates differently, so the NetWare server's certificate is not reused for the OES server. See Chapter 7, “eDirectory Server Certificates,” on page 59.</td>
</tr>
<tr>
<td>exteNd Application Server and MySQL</td>
<td>Not applicable</td>
<td>The exteNd Application Server was discontinued as an install option for NetWare 6.5 SP3. It is not available for Linux. See also MySQL in this table.</td>
</tr>
<tr>
<td>FTP</td>
<td>No</td>
<td>Use the Pure-FTPd service for Linux. See “Novell FTP (Pure-FTPd) and OES 2015” in the OES 2015 SP1: Planning and Implementation Guide.</td>
</tr>
<tr>
<td>iFolder</td>
<td>No, but you can migrate the settings and data</td>
<td>Novell iFolder 2.1x is not available on OES Linux. You must use Novell iFolder 3.x. After you add a Novell iFolder 3.x server to the NetWare cluster and before you finalize the cluster conversion, use iFolder migration procedures to migrate the iFolder 2.1x server configuration and user data from the source NetWare node to the target Linux node. See “Migrating iFolder Services” in the Novell iFolder 3.9.2 Administration Guide.</td>
</tr>
<tr>
<td>iPrint</td>
<td>Yes</td>
<td>See Chapter 12, “Novell iPrint,” on page 71.</td>
</tr>
<tr>
<td>MySQL</td>
<td>No</td>
<td>Use the open source MySQL 5.5.x software that is offered under the GPL. A MySQL cluster template is available that uses a shared LVM volume group to store the database. See Chapter 13, “MySQL,” on page 77.</td>
</tr>
<tr>
<td>NFS</td>
<td>No</td>
<td>Use the standard NFS service for Linux.</td>
</tr>
<tr>
<td>NSS pools and volumes</td>
<td>Yes</td>
<td>See Chapter 14, “Novell Storage Services Pools,” on page 95.</td>
</tr>
<tr>
<td>Tomcat</td>
<td>No</td>
<td>Use the standard Tomcat 6.x service for Linux.</td>
</tr>
</tbody>
</table>
Planning the Conversion of Load and Unload Scripts

You can use a rolling cluster conversion to convert a Novell Cluster Services cluster from NetWare 6.5 SP8 to Open Enterprise Server (OES) 2015 SP1. This section describes how to prepare for and perform the conversion, and how to manage the temporarily mixed cluster during the conversion.

- Section 3.1, “Translation of Cluster Resource Scripts for Mixed NetWare and Linux Clusters,” on page 21
- Section 3.2, “Comparing Script Length Limits for NetWare and Linux,” on page 22
- Section 3.3, “Comparing Script Commands for NetWare and Linux,” on page 23
- Section 3.4, “Comparing Master IP Address Scripts,” on page 23
- Section 3.5, “Comparing NSS Pool Resource Scripts,” on page 24
- Section 3.7, “Customizing the Translation Syntax for Converting Load and Unload Scripts,” on page 28
- Section 3.8, “Adding Monitor Scripts on Linux,” on page 29

3.1 Translation of Cluster Resource Scripts for Mixed NetWare and Linux Clusters

Novell Cluster Services includes specialized script translation functionality, called the Cluster Translation Library script (/opt/novell/ncs/bin/clstrlib.py), to help NetWare and Linux servers coexist in the same cluster. It provides an automatic translation of the Master IP Address resource and cluster-enabled NSS pool resource load and unload scripts from NetWare to Linux. This functionality is also beneficial as you migrate NetWare cluster servers to Linux.

The Cluster Translation Library reads the NetWare load and unload scripts from eDirectory, converts them, and writes them as Linux load and unload scripts. The Linux load and unload script files are then searched for NetWare-specific command strings, and the command strings are then either deleted or replaced with Linux-specific command strings. Separate Linux-specific commands are also added, and the order of certain lines in the scripts is also changed to function with Linux.

During the rolling conversion, a resource's Linux load and unload scripts is stored in cache on the Linux cluster node where the resource is mounted. The NetWare script for the resource continues to be stored in eDirectory until the conversion is finalized. The cluster resource name is used in the load and unload script file names. On Linux, scripts are stored in the /var/opt/novell/ncs/ directory.

**IMPORTANT:** After the final conversion, you can use the Properties > Scripts page in the Clusters plug-in in iManager whenever you make manual changes to the load and unload scripts. The changes are automatically saved to the files.
The normal translations performed by the Cluster Translation Library are described in the following sections:

- Section 3.3, “Comparing Script Commands for NetWare and Linux,” on page 23
- Section 3.4, “Comparing Master IP Address Scripts,” on page 23
- Section 3.5, “Comparing NSS Pool Resource Scripts,” on page 24

**IMPORTANT:** If the commands in cluster resource’s load or unload scripts are not part of the translation library, the cluster resource can end up in a comatose state.

Novell Cluster Services allows you to customize the translation syntax that we used for load and unload scripts in mixed-platform situations by defining new syntax translations to be used in addition to the normal translations. See Section 3.7, “Customizing the Translation Syntax for Converting Load and Unload Scripts,” on page 28.

### 3.2 Comparing Script Length Limits for NetWare and Linux

Scripts have different size limits on NetWare and OES. In a mixed-mode cluster, the scripts for NetWare resources that are cluster migrated to OES nodes are restricted to the NetWare script-size limits until the final `cluster convert` command is issued.

The maximum supported lengths for cluster scripts’ content are as follows:

<table>
<thead>
<tr>
<th>Script</th>
<th>NetWare 6.5 Resources on NetWare Nodes</th>
<th>NetWare 6.5 Resources on OES 11 or Later Nodes</th>
<th>After the Final Conversion to OES 11 or Later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load script</td>
<td>924 bytes</td>
<td>924 bytes</td>
<td>3200 bytes</td>
</tr>
<tr>
<td>Unload script</td>
<td>924 bytes</td>
<td>924 bytes</td>
<td>3200 bytes</td>
</tr>
<tr>
<td>Monitor script</td>
<td>Not supported</td>
<td>Not supported</td>
<td>3200 bytes</td>
</tr>
</tbody>
</table>

In cases where a Linux converted script exceeds the imposed NetWare script size limit, it is best to avoid bringing the resource online on OES nodes until the final cluster `convert` command has been run.

**IMPORTANT:** Because the Linux script for GroupWise exceeds the length limit for NetWare scripts, we recommend that you do not online GroupWise resources while running in mixed-mode clusters.
3.3 Comparing Script Commands for NetWare and Linux

Table 3-1 identifies some of the NetWare cluster load and unload script commands that the Cluster Translation Library script searches for and the Linux commands that it replaces them with (unless the commands are deleted).

Table 3-1
Cluster Script Command Comparison

<table>
<thead>
<tr>
<th>Action</th>
<th>NetWare Cluster Command</th>
<th>Linux Cluster Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace</td>
<td>IGNORE_ERROR add secondary ipaddress</td>
<td>ignore_error add_secondary_ipaddress</td>
</tr>
<tr>
<td>Replace</td>
<td>IGNORE_ERROR del secondary ipaddress</td>
<td>ignore_error del_secondary_ipaddress</td>
</tr>
<tr>
<td>Replace</td>
<td>del secondary ipaddress</td>
<td>ignore_error del_secondary_ipaddress</td>
</tr>
<tr>
<td>Replace</td>
<td>add secondary ipaddress</td>
<td>exit_on_error add_secondary_ipaddress</td>
</tr>
<tr>
<td>Delete</td>
<td>IGNORE_ERROR NUDP</td>
<td>(deletes the entire line)</td>
</tr>
<tr>
<td>Delete</td>
<td>IGNORE_ERROR HTTP</td>
<td>(deletes the entire line)</td>
</tr>
<tr>
<td>Replace</td>
<td>nss /poolactivate=</td>
<td>nss /poolact=</td>
</tr>
<tr>
<td>Replace</td>
<td>nss /pooldeactivate=</td>
<td>nss /pooldeact=</td>
</tr>
<tr>
<td>Replace</td>
<td>mount volume_name VOLID=number</td>
<td>exit_on_error ncpcon mount volume_name=number</td>
</tr>
<tr>
<td>Replace</td>
<td>NUDP ADD clusterservername ipaddress</td>
<td>exit_on_error ncpcon bind --ncpservername=ncpservername --ipaddress=ipaddress</td>
</tr>
<tr>
<td>Replace</td>
<td>NUDP DEL clusterservername ipaddress</td>
<td>ignore_error ncpcon unbind --ncpservername=ncpservername --ipaddress=ipaddress</td>
</tr>
<tr>
<td>Delete</td>
<td>CLUSTER CVSBIND</td>
<td>(deletes the entire line)</td>
</tr>
<tr>
<td>Delete</td>
<td>CIFS</td>
<td>(deletes the entire line)</td>
</tr>
</tbody>
</table>

3.4 Comparing Master IP Address Scripts

IMPORTANT: You can modify the Master IP Address of the cluster only after the cluster conversion is finalized. See “Moving a Cluster or Changing IP Addresses of Cluster Nodes and Resources” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

- Section 3.4.1, “Master IP Address Resource Load Script,” on page 24
- Section 3.4.2, “Master IP Address Resource Unload Script,” on page 24
3.4.1 Master IP Address Resource Load Script

This section provides examples of the master IP address resource load scripts on NetWare and Linux.

- “NetWare” on page 24
- “Linux” on page 24

NetWare

```plaintext
IGNORE_ERROR set allow ip address duplicates = on
IGNORE_ERROR CLUSTER CVSBIND ADD BCCP_Cluster 10.1.1.175
IGNORE_ERROR NUDP ADD BCCP_Cluster 10.1.1.175
IGNORE_ERROR add secondary ipaddress 10.1.1.175
IGNORE_ERROR HTTPBIND 10.1.1.175 /KEYFILE:"SSL CertificateIP"
IGNORE_ERROR set allow ip address duplicates = off
```

Linux

```plaintext
#!/bin/bash
./opt/novell/ncs/lib/ncsfuncs
ignore_error add_secondary_ipaddress 10.1.1.175 -np
exit 0
```

3.4.2 Master IP Address Resource Unload Script

This section provides examples of the master IP address resource unload scripts on NetWare and Linux.

- “NetWare” on page 24
- “Linux” on page 24

NetWare

```plaintext
IGNORE_ERROR HTTPUNBIND 10.1.1.175
IGNORE_ERROR del secondary ipaddress 10.1.1.175
IGNORE_ERROR NUDP DEL BCCP_Cluster 10.1.1.175
IGNORE_ERROR CLUSTER CVSBIND DEL BCCP_Cluster 10.1.1.175
```

Linux

```plaintext
#!/bin/bash
./opt/novell/ncs/lib/ncsfuncs
ignore_error del_secondary_ipaddress 10.1.1.175
exit 0
```

3.5 Comparing NSS Pool Resource Scripts

- Section 3.5.1, “NSS Pool Resource Load Script,” on page 25
- Section 3.5.2, “NSS Pool Resource Unload Script,” on page 25
3.5.1 NSS Pool Resource Load Script

This section provides examples of the NSS pool resource load scripts on NetWare and Linux.

- "NetWare" on page 25
- "Linux" on page 25

NetWare

nss /poolactivate=HOMES_POOL
mount HOMES VOLID=254
CLUSTER CVSBIND ADD BCC_CLUSTER_HOMES_SERVER 10.1.1.180
NUDP ADD BCC_CLUSTER_HOMES_SERVER 10.1.1.180
add secondary ipaddress 10.1.1.180
CIFS ADD .CN=BCC_CLUSTER_HOMES_SERVER.OU=servers.O=lab.T=TEST_TREE.

Linux

#!/bin/bash
. /opt/novell/ncs/lib/ncsfuncs
exit_on_error nss /poolact=HOMES_POOL
exit_on_error ncpcon mount HOMES=254
exit_on_error add_secondary_ipaddress 10.1.1.180

exit_on_error ncpcon bind --ncpservername=BCC_CLUSTER_HOMES_SERVER
--ipaddress=10.1.1.180
exit 0

3.5.2 NSS Pool Resource Unload Script

This section provides examples of the NSS pool resource unload scripts on NetWare and Linux.

- "NetWare" on page 25
- "Linux" on page 25

NetWare

del secondary ipaddress 10.1.1.180
CLUSTER CVSBIND DEL BCC_CLUSTER_HOMES_SERVER 10.1.1.180
NUDP DEL BCC_CLUSTER_HOMES_SERVER 10.1.1.180
nss /pooldeactivate=HOMES_POOL /overridetype=question
CIFS DEL .CN=BCC_CLUSTER_HOMES_SERVER.OU=servers.O=lab.T=TEST_TREE.

Linux

#!/bin/bash
. /opt/novell/ncs/lib/ncsfuncs

ignore_error ncpcon unbind --ncpservername=BCC_CLUSTER_HOMES_SERVER
--ipaddress=10.1.1.180

ignore_error del_secondary_ipaddress 10.1.1.180
ignore_error nss /pooldeact=HOMES_POOL
exit 0
3.6 Comparing File Access Protocol Commands in NSS Pool Resource Scripts


3.6.1 File Access Protocol Commands for Load Scripts

This section provides examples of the file access protocol commands for NSS pool cluster resource load scripts on NetWare and Linux.

- “NetWare” on page 26
- “Linux” on page 26

### NetWare

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Script Command for Load Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCP</td>
<td>NUDP ADD NCS1_P1_SERVER 10.10.10.194</td>
</tr>
<tr>
<td>Novell AFP</td>
<td>AFPBIND ADD NCS1_P1_SERVER 10.10.10.204</td>
</tr>
<tr>
<td>Novell CIFS</td>
<td>CIFS ADD .CN=NCS1_P1_SERVER.O=novell.T=CLUSTER.</td>
</tr>
</tbody>
</table>

### Linux

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Script Command for Load Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCP</td>
<td># mount the NCP volume</td>
</tr>
<tr>
<td></td>
<td>exit_on_error ncpcon mount $NCP_VOLUME=VOL_ID,PATH=$MOUNT_POINT</td>
</tr>
<tr>
<td></td>
<td>exit_on_error ncpcon bind --ncpservename=NCS1_P1_SERVER</td>
</tr>
<tr>
<td></td>
<td>--ipaddress=10.10.10.194</td>
</tr>
<tr>
<td>Novell AFP</td>
<td>exit_on_error cluster_afp.sh add NCS1_P1_SERVER 10.10.10.204</td>
</tr>
<tr>
<td>Novell CIFS</td>
<td>exit_on_error novcifs --add --vserver=.CN=NCS1_P1_SERVER.O=novell.T=TREE-188.</td>
</tr>
<tr>
<td></td>
<td>--ip-addr=&lt;virtual_server_ip_address&gt;</td>
</tr>
</tbody>
</table>

3.6.2 File Access Protocol Commands for Unload Scripts

This section provides examples of the Novell AFP commands for NSS pool cluster resource unload scripts on NetWare and Linux.

- “NetWare” on page 27
- “Linux” on page 27
Planning the Conversion of Load and Unload Scripts

NetWare

### 3.6.3 File Access Protocol Commands for Monitor Scripts

This section provides examples of the Novell AFP commands for NSS pool cluster resource monitor scripts on Linux.

If AFP is enabled as an advertising protocol on an NSS pool cluster resource on NetWare, the AFP monitoring command is added to the new monitor script for the resource on OES.

If CIFS is enabled as an advertising protocol on an NSS pool cluster resource on NetWare, the CIFS monitoring command is added to the new monitor script for the resource on OES.

The default Time-out value for the Monitor script is set to 6 minutes.

Monitoring is disabled while the cluster is in mixed mode. Monitoring can be enabled for the resource after the final cluster conversion is complete. See “Enabling Monitoring and Configuring the Monitor Script” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

- “NetWare” on page 27
- “Linux” on page 28

NetWare

The Monitor script feature is not available in Novell Cluster Services for NetWare.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Script Command for Unload Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCP</td>
<td>NUDP DEL NCS1_P1_SERVER 10.10.10.194</td>
</tr>
<tr>
<td>Novell AFP</td>
<td>AFPBIND DEL NCS1_P1_SERVER 10.10.10.204</td>
</tr>
<tr>
<td>Novell CIFS</td>
<td>CIFS DEL .CN=NCS1_P1_SERVER.O=novell.T=TREE-188.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Script Command for Unload Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCP</td>
<td>ignore_error ncpcon unbind --ncpservername=NCS1_P1_SERVER --ipaddress=10.10.10.194</td>
</tr>
<tr>
<td></td>
<td># dismount the NCP volume</td>
</tr>
<tr>
<td></td>
<td>ignore_error ncpcon dismount $NCP_VOLUME</td>
</tr>
<tr>
<td>Novell AFP</td>
<td>ignore_error cluster_afp.sh del NCS1_P1_SERVER 10.10.10.204</td>
</tr>
<tr>
<td>Novell CIFS</td>
<td>ignore_error novcifs --remove</td>
</tr>
<tr>
<td></td>
<td>--vserver=.CN=NCS1_P1_SERVER.O=novell.T=TREE-188.</td>
</tr>
<tr>
<td></td>
<td>--ip-addr=&lt;virtual_server_ip_address&gt;</td>
</tr>
</tbody>
</table>
Customizing the Translation Syntax for Converting Load and Unload Scripts

The syntax for load and unload scripts differs for NetWare and Linux platforms. A script that is valid for the NetWare platform is not necessarily recognized on the OES platform. In a mixed-platform cluster, a cluster resource’s load script and unload script must be translated to use the proper syntax when running on the NetWare or Linux nodes. Translation occurs in-memory while the cluster contains mixed-platform nodes, and during the final cluster conversion of the cluster from NetWare to Linux.

The translation between NetWare and Linux versions of the load and unload scripts is performed by the Cluster Translation Library script (/opt/novell/ncs/bin/clstrlib.py). The normal translations in the library are described in Section 3.1, “Translation of Cluster Resource Scripts for Mixed NetWare and Linux Clusters,” on page 21. If the commands in a cluster resource’s load or unload scripts are not part of the translation library, the cluster resource can end up in a comatose state.

Novell Cluster Services allows you to customize the translation syntax that is used for load and unload scripts in mixed-platform situations by defining new translation syntax in the /var/opt/novell/ncs/customized_translation_syntax file that you create. The clstrlib.py script reads the additional translation syntax from the syntax file, and processes them in addition to the normal translations in the Cluster Translation Library.

The customized translation supports using Python regular expressions to search for strings (\S+), digits (\d+), and other data types. The search is case insensitive.

**NOTE:** Refer to information about Python regular expressions to learn how to create searches for other data types.

In a text editor, create the customized_translation_syntax file with the additional translation syntax that you need, then copy the file to the /var/opt/novell/ncs/ directory on each Linux node in the mixed-platform cluster.

The syntax file should contain a four-line command for each type of translation you want to add:

<
R|D>

search_string

[replacement_data]

[preceding_data]

You can have any number of the four-line commands in the file. Use the following guidelines for creating the syntax translation commands:

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Script Command for Load Scripts</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCP</td>
<td>exit_on_error ncpcon volume V_D</td>
</tr>
<tr>
<td>Novell AFP</td>
<td>exit_on_error afpstat</td>
</tr>
<tr>
<td>Novell CIFS</td>
<td>exit_on_error rcnovell-cifs monitor</td>
</tr>
</tbody>
</table>

3.7 Customizing the Translation Syntax for Converting Load and Unload Scripts
The following four lines are sample code for a search command in the customized_translation_syntax file. The fourth line is intentionally left empty.

```
R
^\s*bind\s+IP\s+(\S+)\s(\S+)\s+address=(\d+.\d+.\d+.\d+)
ignore_error bind IP \1 \2 address=\3\n
exit_on_error ip addr add \3/32 dev \1
```

You can use the `cluster convert preview` command to verify that the customized_translation_syntax file is working as intended for a particular resource.

1. On the master node, open a terminal console as the root user, then enter

   `cluster convert preview resource_name`

### 3.8 Adding Monitor Scripts on Linux

The monitor script is available for cluster resources in Novell Cluster Services for OES. However, in a mixed-mode cluster, the cluster resources that you cluster migrate from NetWare to Linux will not have a monitor script during the conversion process. A monitor script for each of the former NetWare cluster resources is created automatically after you perform the final cluster conversion step as
After the conversion is finalized, you can use the Clusters plug-in for Novell iManager to enable monitoring independently for each cluster resource. On the Monitoring page (as shown in Figure 3-1) in the resource properties, you must specify a polling interval, a failure rate, a failure action, and a timeout value. These settings control how error conditions are resolved for the resource.

**Figure 3-1 Monitoring Page in the Cluster Resource Properties**

To monitor the health of this resource, enable Resource monitoring. You can set the interval to poll the resource’s health, and set an action if it fails to successfully load on the maximum number of local restarts. Changes other than business continuity changes made to a resource will not take affect until the resource is reloaded.

- **Enable Resource Monitoring**
  - **Polling Interval:** 1 Minutes
  - **Failure Rate**
    - **Minimum Local Failures:** 3
    - **Time Interval:** 10 Minutes
      - **(Example: 3 Failures in 5 minutes)**
  - **Failure Action**
    - Set Resource as Comatose
    - Migrate the Resource based on the Preferred Nodes List
    - Reboot the Hosting Node without Spicing or Unmounting Disks

- **OK**
- **Cancel**
- **Apply**
On the Monitor Script page in the resource properties, you must also configure the resource’s monitor script. You must take the resource offline and bring it online to apply the new settings.

Figure 3-2  Monitor Script in the Cluster Resource Properties

Sample monitor scripts are available in the cluster resource templates for the various services on OES. The following is a sample monitor script for a pool cluster resource:

```bash
#!/bin/bash
. /opt/novell/ncs/lib/ncsfuns

exit_on_error status_fs /dev/pool/P_D /opt/novell/nss/mnt/.pools/P_D nsspool
exit_on_error status_secondary_ipaddress 10.10.10.44
exit_on_error rcnovell-cifs monitor
exit_on_error afpstat
exit 0
```

There might not be a monitor script for iPrint. Print Manager has a built-in monitoring and restart capability. Using the iPrint commands in a cluster resource monitor script for iPrint might cause a conflict.

For detailed information about configuring the monitoring options and scripts, see "Enabling Monitoring and Configuring the Monitor Script" in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.
4 Converting NetWare Clusters to OES Clusters

You can use a rolling cluster conversion to convert a Novell Cluster Services cluster from NetWare 6.5 SP8 to Open Enterprise Server (OES) 2015 SP1. This section describes how to prepare for and perform the conversion, and how to manage the temporarily mixed cluster during the conversion.

- Section 4.1, “Converting NetWare Cluster Nodes to OES (Rolling Cluster Conversion),” on page 33
- Section 4.2, “Adding New OES Nodes to Your NetWare Cluster,” on page 36
- Section 4.3, “Removing NetWare Nodes from the Cluster,” on page 38
- Section 4.4, “Finalizing the Cluster Conversion,” on page 39

4.1 Converting NetWare Cluster Nodes to OES (Rolling Cluster Conversion)

Performing a rolling cluster conversion from NetWare to OES lets you keep your cluster up and running and lets your users continue to access cluster resources while the conversion is being performed.

During a rolling cluster conversion, one server is converted to Linux while the other servers in the cluster continue running NetWare. Then another server can be converted to OES, and then another, until all servers in the cluster have been converted to Linux.

**IMPORTANT:** Before you begin, ensure that your system meets the requirements and caveats in “Planning for Novell Cluster Services” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide. Also verify that your system meets the requirements in Chapter 1, “Planning the Cluster Conversion,” on page 9.

If you are converting from NetWare on physical servers to OES on virtual servers (guest operating systems running on virtual machines), you can use the same methods and processes as those used on a physical server. No additional changes or special configuration is required. See “Mixed Physical and Virtual Node Clusters” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

To perform a rolling cluster conversion from NetWare to OES:

1. Before you add the first Linux node to the NetWare cluster, if the NetWare cluster uses an SBD, ensure that the device (or devices) being used by the SBD are marked as *Shareable for Clustering*.

   You can use NSSMU or iManager to mark the SBD devices as shareable. It is not necessary to bring the cluster down when changing the device attribute to *Shareable for Clustering*.

   Using NSSMU:
   1a Log in to the master node of the NetWare cluster as the administrator user.
   1b Enter `nssmu` at the server console prompt.
In the NSSMU main menu, select Devices.

In the Devices list, highlight the device that contains the SBD partition, then press F5 to select it.

Press F6 to mark the device as Shareable for Clustering.

If the SBD partition is mirrored, repeat Step 1d and Step 1e to also mark the mirror device as Shareable for Clustering.

Press Esc to exit NSSMU.

Make a note of the services that are installed on the server you are converting.

You might want to install the same components on the Linux node if they are available.

On the NetWare server that you want to convert to Linux, remove eDirectory.

You can do this by running NWConfig, then selecting Directory Options <install NDS> > Remove Directory Services from this server.

Bring down the NetWare server you want to convert to Linux.

Any cluster resources that were running on the server should fail over to another server in the cluster.

You can also manually cluster migrate the resources to another server in the cluster prior to bringing down the server. This prevents the resources from failing back to the node after you have completed the upgrade.

Use eDirectory tools to remove (delete) the NetWare node’s Cluster Node object, the Server object, and all objects related to the downed NetWare server.

Depending on your configuration, there could be 10 or more objects that relate to the downed NetWare server.

Run DSRepair from another server in the eDirectory tree to fix any directory problems.

If DSRepair finds errors or problems, run it multiple times until no errors are returned.

Install OES on the server, but do not install the Novell Cluster Services option in OES Services at this time.

You can use the same server name and IP address that were used on the NetWare server. This is suggested, but not required.

See the OES 2015 SP1: Installation Guide for more information.

Set up and verify SAN connectivity for the Linux node.

Consult your SAN vendor documentation for SAN setup and connectivity instructions.

Install Novell Cluster Services and add the node to your existing NetWare 6.5 cluster.

Log in to the OES server as the root user.

In YaST, select Open Enterprise Server > OES Install and Configuration.

On the Software Selection page under OES Services, click Novell Cluster Services.

Services that you have already installed are indicated by a blue check mark in the status check box next to the service.

For information about other install options, see "Installing Novell Cluster Services during an OES Installation” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

Click Accept to begin the install, then click Continue to accept changed packages.

Continue through the installation process until you reach the Open Enterprise Server Configuration page.
Reconfigure **LDAP Configuration of Open Enterprise Services** to specify the credentials for the container administrator user (or non-administrator user) who has the eDirectory rights needed to install Novell Cluster Services.

For information about what rights are needed, see “Assigning Install Rights for Container Administrators or Non-Administrator Users” in the *OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide*.

9f1 On the Open Enterprise Server Configuration page under **LDAP Configuration of Open Enterprise Services**, click the disabled link to enable re-configuration.

The sentence changes to **Reconfiguration is enabled**.

9f2 Click the **LDAP Configuration of Open Enterprise Services** link to open the LDAP Configuration page.

9f3 Specify the following values:

- **Admin name and context**: The user name and context (in LDAP form) of the container administrator user (or non-administrator user) who has the eDirectory rights needed to install Novell Cluster Services.

- **Admin password**: The password of the container administrator (or a non-administrator user).

9f4 Click **Next**.

The install returns to the Open Enterprise Server Configuration page.

9g On the Open Enterprise Server Configuration page under **Novell Cluster Services**, click the disabled link to enable configuration.

The sentence changes to **Configuration is enabled**.

9h Click the **Novell Cluster Services** link to open the Novell Cluster Services Configuration page.

9i Click **Existing Cluster**, specify the fully distinguished name (FDN) of the cluster, then click **Next**.

**IMPORTANT**: Use the comma format illustrated in the example. Do not use dots.

This is the name and eDirectory context of the cluster that you are adding this server to.

9j Select the IP address that Novell Cluster Services will use for this node.

Some servers have multiple IP addresses. This step lets you choose which IP address Novell Cluster Services uses.

9k Deselect **Start Services Now**.

9l Click **Next**, then continue through the rest of the OES installation.

9m After the install is complete, use the Software Updater (or other update methods) to install any patches from the OES patch channel and the SUSE Linux Enterprise Server patch channel for the installed versions of OES and SLES.

10 If you have a shared disk system on the cluster, enter `sbdutil -f` at the Linux terminal console to verify that the node can see the cluster (SBD) partition on the SAN.

`sbdutil -f` also tells you the device on the SAN where the SBD partition is located.

11 Reboot the server.

12 (Optional) Manually migrate the resources that were on the old server nodes to this Linux server.

Some cluster resources for services on NetWare cannot be used on Linux. See Chapter 1, “Planning the Cluster Conversion,” on page 9.
The resources can automatically fail back if all of the following apply:

- The failback mode for the resources was set to Auto.
- You used the same node number for this Linux server that was used for the former NetWare server.
  
  This only applies if this Linux server is the next server added to the cluster.
- This Linux server is the preferred node for the resources.

13 Continue with Section 4.2, “Adding New OES Nodes to Your NetWare Cluster,” on page 36.

4.2 Adding New OES Nodes to Your NetWare Cluster

You can add new OES cluster nodes to your existing NetWare cluster without bringing down the cluster.

1 Before you add the first Linux node to the NetWare cluster, if the NetWare cluster uses an SBD, ensure that the device (or devices) being used by the SBD are marked as Shareable for Clustering.

You can use NSSMU or iManager to mark the SBD devices as shareable. It is not necessary to bring the cluster down when changing the device attribute to Shareable for Clustering.

Using NSSMU:

1a Log in to the master node of the NetWare cluster as the administrator user.
1b Enter nssmu at the server console prompt.
1c In the NSSMU main menu, select Devices.
1d In the Devices list, highlight the device that contains the SBD partition, then press F5 to select it.
1e Press F6 to mark the device as Shareable for Clustering.
1f If the SBD partition is mirrored, repeat Step 1d and Step 1e to also mark the mirror device as Shareable for Clustering.
1g Press Esc to exit NSSMU.

2 Install OES on the new node, but do not install the Novell Cluster Services option from OES Services at this time.
See the “OES 2015 SP1: Installation Guide” for more information.

3 Set up and verify SAN connectivity for the new OES node.
Consult your SAN vendor documentation for SAN setup and connectivity instructions.

4 Install Novell Cluster Services on the OES node.

5 After the install, add the server to the NetWare cluster:

For detailed instructions, see “Adding a Node to an Existing Cluster” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

5a Log in to the OES server as the root user.
5b In YaST, select Open Enterprise Server > OES Install and Configuration.
5c On the Software Selection page under OES Services, verify that Novell Cluster Services is selected, then click Accept to continue to the configuration.

Services that you have already installed are indicated by a blue check mark in the status check box next to the service.
5d On the Software Configuration page, enable Novell Cluster Services configuration, then click the Novell Cluster Services link.

5e When you are prompted, enter the credentials of the LDAP administrator that is configured for the server.

5f On the Novell Cluster Services Configuration page, add the server to the existing NetWare cluster, then click Next.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>New or Existing Cluster</td>
<td>Select Existing Cluster.</td>
</tr>
<tr>
<td>Cluster FDN</td>
<td>Browse to select the Cluster object for the NetWare cluster, or type the cluster fully distinguished name. For example: cn=nwcluster,ou=clusters,o=mycompany</td>
</tr>
</tbody>
</table>

5g On the Proxy User Configuration page, specify one of the following users as the NCS Proxy user, then click Next.

- **OES Common Proxy User**: If the OES Common Proxy User is enabled in eDirectory, the Use OES Common Proxy User check box is automatically selected and the NCS Proxy User Name and Specify NCS Proxy User Password fields are populated with the credentials of the OES Common Proxy User.

- **LDAP Admin User**: If the OES Common Proxy User is disabled in eDirectory, the Use OES Common Proxy User check box is automatically deselected and the NCS Proxy User Name and Specify NCS Proxy User Password fields are populated with the credentials of the LDAP Admin user. The fields are also automatically populated with the LDAP Admin credentials if you deselect the Use OES Common Proxy User check box.

- **Another Administrator User**: Deselect the Use OES Common Proxy User check box, then specify the credentials of an administrator user.

You can reset the default settings by clicking Back to return to the Novell Cluster Services Configuration page, then clicking Next to continue again to the Proxy User Configuration page.

5h On the Configuration page, specify the following parameters, then click Finish.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP address of this node</td>
<td>If the server has multiple network adapters, select the IP address that Novell Cluster Services will use for this node.</td>
</tr>
<tr>
<td>Start Cluster Services now</td>
<td>Deselect the check box. You will start Novell Cluster Services software on this node manually for the conversion process.</td>
</tr>
</tbody>
</table>
5i On the OES Server Configuration page, scroll down to the Novell Cluster Services entry to review the summary of the Cluster Services configuration, then click Next. Wait while Novell Cluster Services is configured.

5j After the configuration is completed, click Finish to exit the OES Configuration page, then exit YaST.

6 If you have a shared disk system on the cluster, enter `sbdutil -f` at the Linux terminal console to verify that the node can see the cluster (SBD) partition on the SAN. `sbdutil -f` will also tell you the device on the SAN where the SBD partition is located.

7 Start cluster software by going to the `/etc/init.d` directory and running `novell-ncs start`. You must be logged in as root to run `novell-ncs start`.

8 Add and assign cluster resources to the new Linux cluster node. See “Configuring Preferred Nodes and Node Failover Order for a Resource” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

9 After you have added OES nodes and cluster migrated all resources to OES nodes, continue with Section 4.3, “Removing NetWare Nodes from the Cluster,” on page 38.

4.3 Removing NetWare Nodes from the Cluster

After your OES cluster nodes are set up and resources have been migrated to them from the NetWare nodes, you are ready to remove the NetWare nodes from the cluster.

To remove the NetWare nodes from the cluster:

1 Log in to the NetWare node as the administrator user.

2 Check the cluster status and verify that all cluster resources have been migrated to the Linux nodes.

   `cluster status`

3 Remove the NetWare node from the cluster by entering

   `cluster leave`

4 Stop Novell Cluster Services from running on the NetWare node by entering

   `uldncs`

5 Remove the NetWare node’s Cluster Node object and the NCS attributes from its Server object.

   5a In a web browser, open iManager, then log in to the eDirectory tree that contains the node you want to manage.

   **IMPORTANT:** Log in as an administrator user who has sufficient rights in eDirectory to delete and modify eDirectory objects.
5b Delete the node’s Cluster Node object from the cluster container:
5b1 Select Directory Administration > Delete Objects.
5b2 Browse to the Cluster container ( ) of the cluster, locate and select the Cluster Node object ( ) for the NetWare node in the container, then click OK.
5b3 On the Delete Objects page, click OK, then click OK again to confirm the deletion of the Cluster Node object.
5c Select Directory Administration > Modify Object, select the NetWare node’s Server object, remove its NCS attributes, then click OK to save and apply your changes.

6 Repeat this process to remove each of the remaining NetWare nodes in the cluster.
7 After you have removed each NetWare node from the cluster and removed each node’s Cluster Node object and the NCS attributes from its Server object, continue with Section 4.4, “Finalizing the Cluster Conversion,” on page 39.

4.4 Finalizing the Cluster Conversion

After you have converted all nodes in a former NetWare 6.5 SP8 cluster to OES, you must finalize the conversion process by issuing the `cluster convert` command on one Linux cluster node. The `cluster convert` command moves cluster resource load and unload scripts from the files where they were stored on Linux cluster nodes to the Cluster Resource objects in eDirectory. This enables a Linux cluster that has been converted from NetWare to utilize eDirectory like the former NetWare cluster.

**WARNING:** After you finalize the cluster conversion, rollback to NetWare is not supported. All of the scripts for the NetWare nodes are deleted and are no longer available.

To finalize the cluster conversion:

1 Log in as the root user on one of the Linux cluster nodes, then open a terminal console.
2 Verify that NetWare nodes are not part of the cluster. At the command prompt, enter

```bash
cluster status
```

If there is a NetWare node, remove it as described in Section 4.3, “Removing NetWare Nodes from the Cluster,” on page 38.

3 Verify that every NetWare nodes Node objects and NCS attributes in the Server object are properly removed from eDirectory.

In iManager, use the Directory Administration role to verify that each former NetWare node’s Cluster Node object was removed and that the NCS attributes were removed from its Server object. See Step 5 in Section 4.3, “Removing NetWare Nodes from the Cluster,” on page 38.

4 Verify the load and unload scripts for the cluster resources that you migrated from NetWare to OES. For each resource, enter the following at the command prompt:

```bash
cluster convert preview resource_name
```

The `preview` switch lets you view the resource load and unload script changes that will be made when the conversion is finalized.

Replace `resource_name` with the name of a resource that you want to preview. You can preview the information for all cluster resources by issuing the command without specifying a resource name. You can use the `cluster convert preview` command at any time before the cluster conversion is finalized.
5 After you have confirmed the readiness of the cluster to be finalized, run `cluster convert commit` as the root user at the terminal console of one Linux cluster node to finalize the conversion.

**WARNING:** After the `cluster convert commit` command is given, the conversion is finalized. There is no rollback to NetWare.

The `cluster convert commit` command generates or regenerates the cluster resource templates that are included with Novell Cluster Services for Linux. In addition to generating Linux cluster resource templates, this command deletes all NetWare cluster resource templates that have the same name as Linux cluster resource templates.

The cluster resource templates are automatically created when you create a new Linux cluster, but are not created when you convert an existing NetWare cluster to Linux.

6 Update the cluster configuration on all nodes by running the cluster configuration daemon. Enter the following command as the root user on every node in the cluster:

```
/opt/novell/ncs/bin/ncs-configd.py -init
```

This removes the NetWare nodes from the list of nodes in the cluster so they are not displayed in iManager.
Novell Apple Filing Protocol (AFP) for Linux is available for Open Enterprise Server (OES) 2015 SP1.

After you set up Novell AFP on the Linux node and before you finalize the NetWare-to-Linux conversion, use the AFP function in the Migration Tool to convert the configuration. See “Migrating AFP to OES 2015 SP1” in the OES 2015 SP1: Migration Tool Administration Guide.

The commands in the scripts are also different. After the migration, modify the load and unload scripts on the Linux server. See Section 3.6, “Comparing File Access Protocol Commands in NSS Pool Resource Scripts,” on page 26.

AFP on Linux supports NCP cross-protocol file locking, which allows NCP, AFP, and CIFS users to access files on an NSS volume concurrently without data corruption by locking the files across protocols. On Linux, the cross-protocol file locking parameter for NCP Server is enabled by default. Verify that the Cross-Protocol File Locking parameter is enabled on each node in the cluster if you plan to give both NCP users and AFP users access to NSS volume in the cluster. See “Configuring Cross-Protocol File Locks for NCP Server” in the OES 2015 SP1 Beta: NCP Server for Linux Administration Guide.
The Apache HTTP Server is an open source web server developed by the Apache Software Foundation (http://www.apache.org). On an Open Enterprise Server (OES) 11 or later cluster, you can use Novell Cluster Services to cluster the web content for your personalized websites. The Apache service is not cluster aware and must run on each server in the cluster.

This section describes key considerations for configuring the Apache virtual hosts for your personalized websites. The scripts for your existing Apache cluster resources and the resource’s node preferences must be manually modified to use Apache commands for Linux when you convert a cluster from NetWare to Linux.

- Section 6.1, “Prerequisites for Reusing NetWare Apache Cluster Resources on Linux,” on page 43
- Section 6.2, “Using Apache HTTP Server on OES Servers,” on page 44
- Section 6.3, “Converting the Apache Cluster Resource,” on page 56
- Section 6.4, “Troubleshooting the Apache HTTP Server,” on page 57
- Section 6.5, “Additional Information,” on page 58

### 6.1 Prerequisites for Reusing NetWare Apache Cluster Resources on Linux

The following setup is required to reuse the Apache cluster resources from your NetWare cluster:

- When you install OES services on the server, Novell-ready versions of Apache 2 (Prefork, 64-bit) and Tomcat 6 are automatically installed and configured. You manually manage Apache services with the Apache configuration files. Use a text editor to create or modify the configuration files, then gracefully restart the Apache HTTP Server daemon (rcapache2 graceful) to apply the changes.

**WARNING:** Do not install the Linux Web and LAMP pattern. Do not use the HTTP Server option in YaST to configure Apache or virtual host settings on an OES server. It overwrites essential OES settings for Apache and breaks the existing setup. For recovery information, see Section 6.4.1, “Apache Server Errors after Using the HTTP Server Option in YaST,” on page 57.

- To reuse an NSS pool cluster resource that contains your web content, you must install Novell Storage Services for Linux on each OES node in the cluster. See “Installing and Configuring Novell Storage Services” in the OES 2015 SP1: NSS File System Administration Guide for Linux.

- If you host multiple websites on a single server on NetWare, you must configure an Apache virtual host for each website on one OES node, then copy the configuration files to every OES node in the cluster.

- In a Novell Cluster Services cluster, the directories you specify in the DocumentRoot directive and any Alias directives for a virtual host should reside on the same cluster resource so they can fail over together. The location that contains the web content should be a directory on the volume, not the root of the volume. Specify the full Linux path of the directory. Linux paths are case sensitive.
For example, Novell Cluster Services scripts assume that the pool’s volumes are mounted in the default NSS location of /media/nss/<volume_name>. The full Linux path of the /www/mysite path on an NSS volume APACHEVOL is /media/nss/APACHEVOL/www/mysite

- The following permissions are required:
  - The user wwwrun must be the file owner of the website directories and files. The group can be the system root or the Apache group www.
  - If web content resides on an NSS volume, the following additional permissions are required:
    - Enable the eDirectory user wwwrun and group www with Linux User Management (LUM). OES automatically creates and LUM-enables the user and group when you install the first OES server in an eDirectory tree.
    - Assign the eDirectory user wwwrun as a file system trustee with Read and File Scan rights for the directory you specify in the DocumentRoot directive in the virtual host configuration file.

These permissions are also required for web content hosted on an NCP-enabled Linux volume.

For information about the default OES setup for Apache and setting up virtual hosts, see Section 6.2, "Using Apache HTTP Server on OES Servers," on page 44.

6.2 Using Apache HTTP Server on OES Servers

When you set up OES services on the server, Novell-ready versions of Apache 2 HTTP Server software (Prefork, 64-bit) and Tomcat 6 are automatically installed. Apache and the OES Welcome website are automatically configured for non-secure port 80 and secure port 443. The Apache HTTP Server daemon (httpd2) starts automatically on server restart.

To set up personalized websites, you must manually create a virtual host configuration file for each website. Templates for secure SSL virtual host and non-secure virtual host configuration files are available in the /etc/apache2/vhosts.d/ directory. Use a text editor to create or modify the configuration files, then gracefully restart the Apache HTTP Server daemon (rcapache2 graceful) to apply the changes.

**WARNING:** Do not use the HTTP Server option in YaST to configure Apache or virtual host settings on an OES server. It overwrites essential OES settings for Apache and breaks the existing setup. For recovery information, see Section 6.4.1, "Apache Server Errors after Using the HTTP Server Option in YaST," on page 57.

- Section 6.2.1, "Understanding the Default OES Setup of Apache HTTP Server," on page 45
- Section 6.2.2, "Manually Configuring Apache," on page 46
- Section 6.2.3, "Creating and Configuring a Virtual Host for Each Website," on page 47
- Section 6.2.4, "Requiring Strong Ciphers," on page 49
- Section 6.2.5, "Configuring an SSL Certificate for the Server," on page 50
- Section 6.2.6, "Configuring Apache to Listen on Multiple Ports," on page 51
- Section 6.2.7, "Configuring Permissions for the Website DocumentRoot Directory," on page 51
- Section 6.2.8, "Configuring a Web Location that Requires LDAP Authentication," on page 53
- Section 6.2.9, "Starting, Stopping, or Restarting the Apache Daemon," on page 55
- Section 6.2.10, "Viewing the Apache Log Files," on page 56
6.2.1 Understanding the Default OES Setup of Apache HTTP Server

When you install services from the OES Add-On disk, the following Apache setup is configured:

- “Apache and Tomcat Installation” on page 45
- “Apache HTTP Server Configuration” on page 45
- “Apache User wwwrun and Group www” on page 45
- “Virtual Host for the OES Welcome Website” on page 46
- “Secure SSL Virtual Host for the Default Website” on page 46
- “Secure SSL Virtual Host for the Novell iManager Website” on page 46

Apache and Tomcat Installation

Novell-ready versions of Apache 2 HTTP Server software (Prefork, 64-bit) and Tomcat 6 are automatically installed when you set up OES services on a server.

Apache HTTP Server Configuration

OES configures Apache settings in the `/etc/sysconfig/apache2` global configuration file and the `/etc/apache2/conf.d/oes_httpd.conf` configuration file.

The `/etc/sysconfig/apache2` configuration file controls some global settings of Apache, such as modules to load, additional configuration files to include, server flags to apply when the Apache HTTP Server daemon (`httpd2`) is started, and flags that should be added to the command line.

Apache User wwwrun and Group www

Apache uses the user `wwwrun` identity to serve files to clients of your website. OES and Apache configure the following during the OES installation:

- The Apache installation creates a local group `www` and user `wwwrun` on the server.
  You configure the user `wwwrun` as the file owner of the website’s main directory and files.
- OES creates the group `www` and the user `wwwrun` in eDirectory when you install an OES server in an eDirectory tree for the first time. The user `wwwrun` is added as a member of the group `www`. The user `novlxsrvd` is also created and added to the group `www`.
- OES enables the group `www` and its member users (`wwwrun` and `novlxsrvd`) for Linux with Linux User Management (LUM).
  If your website is hosted on an NSS volume or an NCP-enabled Linux volume, you must assign the eDirectory user `wwwrun` as a file system trustee of the website’s main directory, and give the trustee Read and File Scan rights.

For information about changing the file owner or configuring a file system trustee, see Section 6.2.7, “Configuring Permissions for the Website DocumentRoot Directory,” on page 51.
Virtual Host for the OES Welcome Website

OES automatically configures the OES Welcome website in the /etc/opt/novell/httpd/conf.d/welcome-apache.conf file. Listening is set up on port 80 in the /etc/apache2/listen.conf file. Port 80 is opened in the firewall. The Apache HTTP Server daemon (httpd2) starts automatically on server restart.

Apache serves the Welcome page for the OES server at

http://<server_dns_or_ip_address>

Secure SSL Virtual Host for the Default Website

OES automatically configures a default secure virtual host (_default_:443) in the /etc/apache2/vhost.d/vhost-ssl.conf file. It sets up listening on port 443 in the /etc/apache2/listen.conf file. It opens port 443 in the firewall. The default virtual host configuration is automatically loaded first. It is also used when a domain name does not match a virtual host configuration. The default virtual host defines a custom log /var/log/apache2/ssl_request_log to capture events for SSL requests. An Include directive in the /etc/apache2/vhost.d/vhost-ssl.conf file automatically loads the virtual hosts that are defined in the /etc/opt/novell/httpd/sslconf.d/*.conf files.

Secure SSL Virtual Host for the Novell iManager Website

If you install Novell iManager on an OES server, the iManager installation automatically configures a secure virtual host for iManager and Novell Portal Services (NPS) in the /etc/opt/novell/iManager/nps-Apache.conf file. A symbolic link in the /etc/opt/novell/httpd/sslconf.d/ directory points to the nps-Apache.conf file. This allows the virtual host to be automatically included along with the default secure virtual host when Apache is restarted.

Aliases are defined in the nps-Apache.conf file to hit the website with any of the following URLs:

https://<server_dns_or_ip_address>/nps/iManager.html
https://<server_dns_or_ip_address>/nps
https://<server_dns_or_ip_address>/iManager.html

6.2.2 Manually Configuring Apache

On OES servers and Novell Open Workgroup Suite (NOWS) Small Business Edition (SBE) servers, you must manually configure Apache settings, OES virtual hosts, and virtual hosts for your personalized websites. Use a text editor to create or modify the configuration files, then gracefully restart the Apache HTTP Server daemon (rcapache2 graceful) to apply the changes.

**WARNING:** Do not use the HTTP Server option in YaST to manage Apache or the virtual host settings on an OES server. It overwrites essential OES settings for Apache and breaks the existing setup. For recovery information, see Section 6.4.1, “Apache Server Errors after Using the HTTP Server Option in YaST,” on page 57.

6.2.3 Creating and Configuring a Virtual Host for Each Website

On Linux, the Apache HTTP server can serve multiple universal resource identifiers (URIs) from a single instance of Apache running on the server. That is, multiple websites, such as www.example.com and www.example.net, can be run from a single web server. Each website is referred to as a virtual host. Virtual hosts can be name based, IP based, or port based.

You can set up personalized websites by manually creating a virtual host configuration file for each website. Templates for secure SSL virtual host and non-secure virtual host configuration files are available in the /etc/apache2/vhosts.d/ directory.

When you cluster-enable the web content by using Novell Cluster Services, use the IP address of the cluster resource for the virtual host. This ensures that the website traffic is directed to the cluster node where the web content cluster resource is currently active. Do not use the server node’s IP address or the master IP address of the cluster. Specify the Linux file path to the web content.

On OES servers, you create and configure a separate virtual host configuration file for each website that you want to host in the cluster. The following procedure provides basic information about setting up the file. Refer to other sections in this document to learn about the key settings that are available. For detailed information, see the Apache Virtual Host documentation website (http://httpd.apache.org/docs/2.2/vhosts/).

1 Choose an OES node in the cluster, then log in as the root user.
2 Create a copy of the virtual host template file in the /etc/apache2/vhosts.d/ directory.
   The /etc/apache2/vhosts.d/ directory contains a basic template (vhost.template) for a non-secure virtual host and an SSL template (vhost-ssl.template) for a secure virtual host.
3 Rename the file with a name for your virtual host, and add the .conf file extension, such as mysite-Apache.conf.
4 Open the virtual host file in a text editor and configure the virtual host settings for your personalized website:
   4a If the web content is clustered with Novell Cluster Services, set the VirtualHost directive to the IP address or DNS host name assigned to the cluster resource:

   <VirtualHost hostname>
   
   For example, if the DNS name is mysite.example.com, specify mysite as the VirtualHost.

   <VirtualHost mysite>
   
   4b Set the value of the DocumentRoot directive to the Linux path of the directory where you placed your web content, and specify the directory options for this location.

   The target directory must contain an index.html file, which is the root document for the virtual host. Specify the Linux path to the directory. For example, if you place your web content in an NSS volume path APACHEVOL:\www\mysite, the Linux path is /media/nss/APACHEVOL/www/mysite.

   DocumentRoot "/media/nss/APACHEVOL/www/mysite"
   
   <Directory "/media/nss/APACHEVOL/www/mysite”>
   # Possible options are "None", "All" or any combination of:
   # Indexes Includes FollowSymLinkx SymLinksifOwnerMatch ExecCGI MultiViews

   Options Indexes MultiViews
   AllowOverride None
   Order allow,deny
   Allow from all
   </Directory>
4c Configure the host settings as desired for other directives in the file.

The minimum settings for a non-secure website are shown in the following example:

```<VirtualHost mysite>
DocumentRoot "/media/nss/APACHEVOL/www/mysite"
ServerAdmin  mysite-admin@example.com
ServerName   mysite.example.com
ErrorLog     /var/log/apache2/error_log
TransferLog  /var/log/apache2/access_log
#CustomLog   /var/log/apache2/mysite.example.com-access_log combined

HostnameLookups On
UseCanonicalName On
ServerSignature Off
</Directory>
</VirtualHost>```

4d (Optional) Specify alias paths in the virtual host configuration file.

For example, specify an alias for a Support web location that has a `support` directory at the same level as `mysite`. Include the `Alias` and `Directory` directives before the `<VirtualHost>` close tag.

```Alias /support "/media/nss/APACHEVOL/www/support"
<Directory "media/nss/APACHEVOL/www/support">
  Options Indexes MultiViews
  AllowOverride None
  Order deny,allow
  Allow from all
</Directory>```

For information about alias paths that require LDAP authentication, see Section 6.2.8, “Configuring a Web Location that Requires LDAP Authentication,” on page 53.

4e Save the virtual host configuration file.

5 (Optional) In the `/etc/apache2/listen.conf` file, add a `Listen` directive that specifies the IP address that you assigned to your cluster-enabled pool, and specify the port to use.

OES configures Apache to listen on non-secure port 80 by default. It listens for all traffic.

6 Make the websites visible on your network or to the world:

6a Add the site name and IP address resolution to your DNS server to make them visible.

6b If you use a non-standard port, open the port in the node’s firewall.

6c If the traffic is from outside the firewall, open the port in the network firewall.

7 Gracefully restart the Apache HTTP Server daemon to apply the virtual host configuration:

`rcapache2 graceful`

Each `.conf` file is automatically included in the Apache configuration when you restart Apache.
8 Set up the virtual host for each of the remaining nodes:

8a Log in to the next node as the root user.

8b Copy the virtual host configuration file (such as /etc/apache2/vhosts.d/mysite-apache.conf) to the next node.

8c Create a local Linux path to the website that you specified in the DocumentRoot directive and to any paths you specified in Alias directives, then make the user wwwrun the owner of the directory and its contents.

When Apache is started or restarted, it looks for the paths specified in your website’s virtual host configuration file. If a path does not exist, Apache reports an error but it loads the virtual host. Users access the site via the IP address or DNS name of the cluster resource, so web content is served only on the node where the resource is active.

When a cluster resource is not active on a node, the volume subdirectory (such as APACHEVOL) in the /media/nss directory is normally removed, and the path to the website does not exist. Creating the local path allows Apache to find the path even when the resource is not active on the node, and no error is reported when Apache loads. When the resource is taken offline, NSS does not remove the volume directory because it is now non-empty (it contains the local paths you create). The local path should not contain files. To add or remove web content files, access the NSS volume via the IP address of the cluster resource.

Enter the following commands for the website path and alias paths. The chown command changes the group to the Apache www group unless the group is the root user.

```
mkdir -p /media/nss/<volume_name>/<path>
chown wwwrun:www /media/nss/<volume_name>/<path>
```

For example, enter

```
mkdir -p /media/nss/APACHEVOL/www/mysite
chown wwwrun:www /media/nss/APACHEVOL/www/mysite
mkdir -p /media/nss/APACHEVOL/www/support
chown wwwrun:www /media/nss/APACHEVOL/www/support
```

8d Open a terminal console as the root user, then gracefully restart Apache:

```
rcaapache2 graceful
```

8e Repeat these steps on each of the remaining nodes in turn.

**IMPORTANT:** Any time that you make changes to the virtual host configuration file, you must copy the modified file to every node in the cluster, and gracefully restart Apache on each node.

### 6.2.4 Requiring Strong Ciphers

We recommend that you secure your web solution by requiring strong ciphers when the client is negotiating the connection in the SSL handshake.

In OES 11 SP1 and later servers, the weak SSL ciphers are disabled by default in the /etc/apache2/vhosts.d/vhost-ssl.conf file:

```
# SSL Cipher Suite:
SSLCipherSuite ALL:!aNULL:!eNULL:!SSLv2:!LOW:!EXP:!MD5:@STRENGTH
```
On OES 11 and earlier servers, we recommend that you enable only the strongest ciphers: RSA, HIGH, and SSLv2.

To enable strong ciphers and disable weak ciphers in OES 11 and earlier:

1. In a text editor, modify the `/etc/apache2/vhosts.d/vhost-ssl.conf` file to require strong ciphers. Modify the default settings by placing a plus sign (+) before RSA, HIGH, and SSLv2, and placing an exclamation mark (!) before the weaker ciphers:

   ```
   # SSL Cipher Suite:
   ```

2. Gracefully restart Apache on the server:

   ```
   rcapache2 graceful
   ```

3. Repeat this process on every Linux node in the cluster.

   You can alternatively copy the Apache SSL configuration file (`/etc/apache2/vhosts.d/vhost-ssl.conf`) to every Linux node in the cluster, and then restart Apache.

### 6.2.5 Configuring an SSL Certificate for the Server

OES automatically configures secure SSL communications for a default virtual host (`_default_:443`). SSL is enabled in the Apache global configuration file (`/etc/sysconfig/apache2`) with the following directive:

```
APACHE_SERVER_FLAGS="SSL"
```

The default SSL configuration is defined in the `/etc/apache2/vhosts.d/vhost-ssl.conf` file. It uses an `INCLUDE` directive for the `/etc/opt/novell/httpd/sslconf.d/*.conf` files. This target directory contains the configuration files (or symbolic links to them) for OES virtual hosts that require SSL, such as the `nps-Apache.conf` file that is used for the Novell iManager tool.

By default, OES sets up an SSL certificate file and key file for the server by using certificates generated with the eDirectory Server Certificates service in NetIQ Certificate Server. Table 6-1 identifies the location of the SSL certificate and key files that are referenced by the `SSLCertificateFile` and `SSLCertificateKeyFile` directives in the `/etc/apache2/vhosts.d/vhost-ssl.conf` file.

<table>
<thead>
<tr>
<th>OES Server Certificate File</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSL Certificate File</td>
<td><code>/etc/ssl/servercerts/servercert.pem</code></td>
</tr>
<tr>
<td>SSL Certificate Key File</td>
<td><code>/etc/ssl/servercerts/serverkey.pem</code></td>
</tr>
</tbody>
</table>

**IMPORTANT:** If you use SSL, set up a server certificate for each virtual host unless you use a wildcard certificate.

If you modify the content or location of the certificate and key files, gracefully restart the Apache HTTP Server daemon (`rcapache2 graceful`) to apply the new values.
6.2.6 Configuring Apache to Listen on Multiple Ports

The `Listen` directive in the `/etc/apache2/listen.conf` file tells the Apache HTTP Server to accept incoming requests on the specified port or an address-and-port combination. If the directive specifies only a port, the server listens to the given port on all interfaces. If the directive specifies an IP address and port combination, the server listens on the given port and network interface.

By default, OES configures Apache to listen on non-secure port 80 and secure port 443 in the `/etc/apache2/listen.conf` file. If a firewall is used on the server, port 80 and port 443 are automatically opened in the firewall. The ports are not bound to a particular IP address, so Apache responds to requests on all IP interfaces on the server.

```
Listen 80

<IfDefine SSL>
  <IfDefine !NOSSL>
    <IfModule mod_ssl.c>
      Listen 443
    </IfModule>
  </IfDefine>
</IfDefine>
```

You can configure multiple `Listen` directives to specify multiple IP addresses and ports. The server responds to requests from any of the listed addresses and ports. For information about formats and options for the `Listen` directive, see the `Listen Directive` (http://httpd.apache.org/docs/2.2/mod/mpm_common.html#listen) in the Apache MPM Common Directives collection.

If you configure non-standard ports for your personalized websites, you must add a `Listen` directive in the `/etc/apache2/listen.conf` file, then gracefully restart the Apache HTTP Server daemon (`rcapache2 graceful`) to apply the changes. Ensure that you open the port in the firewall.

6.2.7 Configuring Permissions for the Website DocumentRoot Directory

Apache uses the user `wwwrun` identity to serve files to clients of your website. You must configure permissions for the website content that allow Apache to serve the files to client users.

- “Setting the User `wwwrun` as the Owner of the Website’s Directory and Files” on page 51
- “Setting User `wwwrun` as a File System Trustee of the Website’s Directory” on page 52

Setting the User `wwwrun` as the Owner of the Website’s Directory and Files

The user `wwwrun` must be the file owner of the website’s main directory and files.

1. Log in as the `root` user, and open a terminal console.
2. Change directory to go to the directory that contains the main directory of your website. This is the directory you specify as the `DocumentRoot` in the virtual host configuration file.
   For example, if the `DocumentRoot` is `/media/nss/APACHEVOL/www/mysite`, enter
   ```
   cd /media/nss/APACHEVOL/www
   ```
3. Change the owner of the website’s directory and files to user `wwwrun`. Enter:
chown -R wwwrun:www mysite

This recursively modifies the owner to user wwwrun for the directory and the subdirectories and files it contains. It changes the group to www unless the group is set to the root user.

4 In a file browser, view the directory's properties to verify that the owner was changed.

You can also use the `ls -al <path>` command to list the directory and view the owner, group, and permissions.

### Setting User wwwrun as a File System Trustee of the Website’s Directory

OES automatically creates the user wwwrun and group www in eDirectory. Both are LUM-enabled. You can verify their configuration by using the Directory Administration option and Linux User Management option in Novell iManager.

If your website is hosted on an NSS volume or an NCP-enabled Linux volume, you must assign the eDirectory user wwwrun as a file system trustee of the website’s main directory, and give the trustee Read and File Scan rights. You can also set the www group as a trustee with Read and File Scan rights.

1 Log in to Novell iManager as an administrator user.
2 In the iManager toolbar, click the View Objects icon.
3 In the Tree view, select the volume, then browse the file system to locate the directory that contains your website’s content.
4 Select the check box next to the directory, then select Actions > Properties.
5 On the Properties page, select Rights.
6 Click the Add Trustee browse icon to open the Object Selector.
7 Locate and select the user wwwrun, then click OK.
The user wwwrun is added as a trustee with the default Read and File Scan rights.

8 Click Apply or OK to save the changes.

6.2.8 Configuring a Web Location that Requires LDAP Authentication

If you have documents or a location that requires restricted web access, you can set up Apache to enforce eDirectory authentication and force the authentication to be done over https. This solution can be used on individual directories, URLs, or the entire Apache server.

The following example creates a single secure location so that any document that is referenced under the directory requires authentication. For example, the URL www.example.com can have public access, while the URL www.example.com/secure and documents it contains require authentication. Authentication should be done over a secure connection (https) rather than a non-secure connection (http). All http attempts are redirected to https for the given location.

1 Ensure that the rewrite module is enabled in the /etc/sysconfig/apache2 global configuration file. OES enables this module by default.

   Open the /etc/sysconfig/apache2 file in a text editor, and verify that rewrite is listed in the modules defined in the APACHE_MODULES directive.

2 Configure the permissions for the user wwwrun on the target directory:

   2a Change the owner to the Apache user wwwrun:
chown -R wwwrun:www /media/nss/APACHEVOL/www/secure

This changes the group to the Apache group www unless the group is the root user.

2b For an NSS volume or an NCP-enabled Linux volume, configure the user wwwrun as a file system trustee of the /media/nss/APACHEVOL/www/secure directory, and give the trustee Read and File Scan rights.

See “Setting User wwwrun as a File System Trustee of the Website’s Directory” on page 52.

3 In a text editor, create a copy of the /etc/apache2/vhosts.d/vhosts-ssl.template file to create a secure.conf configuration file.

4 Allow for all http requests for the /secure alias to be redirected to https. Add the following directives to the secure.conf file:

RewriteEngine On
RewriteRule ^/secure https://%{SERVER_NAME}/secure [L,R]

5 If the location that contains secure information exists outside the DocumentRoot directory, create an alias to the directory. Add the following line to the secure.conf file:

Alias /secure "<path_to_directory>/secure"

For a cluster resource, the secure directory ideally resides on the same clustered volume as the website, and at the same directory level as DocumentRoot for the website:

Alias /secure "/media/nss/APACHEVOL/www/secure"

6 Under the Alias directive, add the option for LDAP authentication under the Directory directive in the secure.conf file. Specify the IP address or DNS name of the website's cluster resource.

<Directory "media/nss/APACHEVOL/www/secure">
    Options Indexes MultiViews
    AllowOverride None
    Order deny,allow
    Allow from all
    AuthType Basic
    AuthName "Protected"
    require valid-user
    AuthLDAPAuthoritative On
    AuthLDAPURL ldaps://<cluster_resource_ip_address_or_dns_name>/o=corp?uid?sub
</Directory>

7 Save the /etc/apache/vhosts.d/secure.conf file.

8 Open a terminal console as the root user, then gracefully restart the Apache daemon:

rcapache2 graceful

9 Verify that Apache is able to start.

If there are errors, make corrections in the configuration file, then restart the Apache daemon.

10 In a web browser, go to the website with http and verify that you are redirected to https, and that you can authenticate against the /secure alias.
Starting, Stopping, or Restarting the Apache Daemon

The Apache HTTP Server program runs as a daemon (httpd2) that executes continuously in the background to handle requests. OES configures the daemon to start automatically on system restart. You must restart Apache to apply any changes you make to the Apache or virtual host configuration files, or to add new virtual host configuration files. A graceful restart does not disrupt the service.

In a cluster, you manually copy the virtual host configuration files for clustered personalized websites to every node in the cluster. When Apache starts on each node, it reads the configuration file and is available to serve the site when the resource is active on the node. You do not add Apache commands in the resource’s load and unload scripts. All requests to a clustered website are sent to the DNS name or IP address of the cluster resource, and not to a specific node. The site’s requests are served by the Apache process that runs on the node where the cluster resource is currently active.

To start, stop, or restart the Apache daemon, use the /usr/sbin/rcapache2 commands in Table 6-2:

### Table 6-2 /usr/sbin Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rcapache2 start</td>
<td>Starts the httpd2 parent process. The parent process reads its configuration files and opens log files, and then spawns the child processes to serve hits. OES configures the Apache daemon to start automatically on server restart.</td>
</tr>
<tr>
<td>rcapache2 stop</td>
<td>Causes the parent process to immediately attempt to kill all of its child processes. This can take several seconds. The parent exits after all child processes have exited. Any requests in progress are terminated, and no further requests are served.</td>
</tr>
<tr>
<td>rcapache2 graceful-stop</td>
<td>Causes the parent process to advise its child processes to exit after their current request (or to exit immediately if they are not serving anything). The parent removes its PID file and ceases listening on all ports. The parent continues to run, and monitors child processes that are handling requests. The parent exits after the child processes complete the pending requests and exit, or when a timeout period has elapsed (as specified by the GracefulShutdownTimeout). If the timeout is reached, any remaining child processes are automatically sent the TERM signal to force them to exit, and any requests in progress are terminated.</td>
</tr>
<tr>
<td>rcapache2 restart</td>
<td>Causes the parent process to immediately kill its child processes like the stop option, but the parent does not exit. It re-reads its configuration files, and re-opens any log files. Then it spawns a new set of child processes and continues serving hits.</td>
</tr>
<tr>
<td>rcapache2 graceful</td>
<td>Causes the parent process to advise the child processes to exit after their current request (or to exit immediately if they are not serving anything). The parent re-reads its configuration files and re-opens its log files. As each child dies, the parent replaces it with a child from the new generation of the configuration, which begins serving new requests immediately.</td>
</tr>
</tbody>
</table>
6.2.10 Viewing the Apache Log Files

The following Apache log files are located in the /var/log/apache2/ directory:

- access_log
- error_log
- rcapache2.out
- rewrite_log
- ssl_request_log

You can also specify custom logs by adding the CustomLog directive to your virtual host configuration file. For information about formatting the custom log, see Apache Module mod_log_config (http://httpd.apache.org/docs/2.2/mod/mod_log_config.html).

6.3 Converting the Apache Cluster Resource

Before you convert the Apache Cluster Resource to run on Linux servers, ensure that your servers meet the Prerequisites for Reusing NetWare Apache Cluster Resources on Linux.

1. Configure the virtual hosts for your personalized websites on each Linux node in the cluster as described in Section 6.2, “Using Apache HTTP Server on OES Servers,” on page 44.
2. In iManager, offline the NSS pool cluster resource from a NetWare node.
3. In iManager, modify the load and unload scripts to remove the Apache start and stop commands.
4. In iManager, cluster migrate the cluster resource to a Linux node. The new load script applies when the resource loads.
5. Offline the Apache cluster resource.
   Leave the resource offline until all Linux nodes have been added and the cluster conversion has been finalized.
6. In iManager, set up the preferred nodes for the Apache cluster resource to include only Linux nodes in the cluster.
7. Finalize the steps to complete the cluster conversion, then commit the conversion.
8. Online the Apache cluster resource.

   cluster online <resource_name> [node_name]

9. In a web browser, access your website to ensure that the files are available.

   If you get permission errors, check the following:
   - The user wwwrun should be set as a file system trustee of the directory that is used as the DocumentRoot for the website. Assign Read and File Scan rights to the trustee.
   - The user wwwrun should be set as the file owner of the web content.


10. Cluster migrate the resource to each node in the cluster in turn, and access the website from a web browser to ensure the site is accessible from each of its preferred nodes.
11. Cluster migrate the resource to its most preferred node.
6.4 Troubleshooting the Apache HTTP Server

This section describes some issues you might experience with Apache HTTP Server and provides suggestions for resolving or avoiding them. For additional troubleshooting information, see the Novell Technical Support Knowledgebase (http://www.novell.com/support).

- Section 6.4.1, “Apache Server Errors after Using the HTTP Server Option in YaST,” on page 57
- Section 6.4.2, “Files Downloaded from NetStorage Are 0 Bytes,” on page 57

6.4.1 Apache Server Errors after Using the HTTP Server Option in YaST

If you use the HTTP Server option in YaST to manage Apache or virtual hosts, the option can overwrite essential OES settings and load the wrong modules, which breaks the default Apache HTTP Server setup. See TID 7002562 (http://www.novell.com/support/kb/doc.php?id=7002562) in the Novell Knowledgebase.

If you have used the HTTP Server option in YaST and Apache is no longer working, recover the OES default Apache HTTP Server setup by doing the following:

1. As the root user, open the /etc/sysconfig/apache2 file in a text editor and modify the following directives:
   - **Proxy module:** In the APACHE_MODULES= line in the file, ensure that the proxy module is listed before the proxy_ajp module. For example (some modules are not listed for ease of reading the example):
     
     ```
     APACHE_MODULES="cgi dir rewrite ssl proxy proxy_ajp ssl"
     ```
   - **SSL module:** In the APACHE_MODULES= line in the file, ensure that the ssl module is listed. For example (some modules are not listed for ease of reading the example):
     
     ```
     APACHE_MODULES="cgi dir rewrite ssl proxy proxy_ajp ssl"
     ```
   - **Prefork mode:** Apache should run in prefork mode rather than worker mode. To force this, ensure that the APACHE_MPM= line is set to "prefork". For example:
     
     ```
     APACHE_MPM="prefork"
     ```
   - **SSL:** Ensure secure communications by enabling the SSL flag. For example:
     
     ```
     APACHE_SERVER_FLAGS="SSL"
     ```

2. Gracefully restart Apache to apply the changes. As the root user, enter the following command at a console prompt:

   ```
   rcapаче2 graceful
   ```

6.4.2 Files Downloaded from NetStorage Are 0 Bytes

After you lock down ciphers for an Apache HTTP Server to use only the strongest SSL ciphers, all of the files downloaded from NetStorage are 0 bytes in size.

NetStorage might not work as expected if you lock down Apache HTTP Server to disallow low and medium SSL ciphers. Try allowing medium SSL cipher settings to see if that is sufficient, then add back low cipher settings if necessary.
For other SSL cipher configuration options, see *SSL/TLS Strong Encryption: How-To* (http://httpd.apache.org/docs/2.2/ssl/ssl_howto.html) at Apache.org.

### 6.5 Additional Information

The latest Apache documentation is available on the [Apache HTTP Server Version 2.2 Documentation website](http://httpd.apache.org/docs-2.2/).
eDirectory Server Certificates

NetIQ Certificate Server provides two categories of services: Certificate Authority (CA) and eDirectory Server Certificates.

- The Certificate Authority services include the Enterprise CA and CRL (Certificate Revocation List). Only one server can host the CA, and normally that same server hosts the CRLs if they are enabled (although if you move the CA to a different server, the CRLs usually stay on the old server). The CA and CRL services are not cluster-enabled. There are no cluster-specific tasks for them.
- The eDirectory Server Certificates service is not clustered. However, clustered applications that use the server certificates must be able to use the same server certificates on whichever cluster node they happen to be running. You must set up Server Certificate objects in a clustered environment to ensure that your cryptography-enabled applications that use Server Certificate objects always have access to them.

The Server Certificates objects are created differently on Linux, and cannot be directly reused from the NetWare server. The differences and alternatives for setting up certificates for OES servers are described in the following sections:

- Section 7.1, “Server Certificates Changes in OES 11 and Later,” on page 59
- Section 7.2, “Using Internal Certificates in a Cluster,” on page 60
- Section 7.3, “Using External Certificates in a Cluster,” on page 60

7.1 Server Certificates Changes in OES 11 and Later

The Server Certificates service can create certificates for eDirectory services to use when you install the operating system. In addition, custom certificates can be created after the install by using Novell iManager or command line commands.

- Section 7.1.1, “Using eDirectory Server Certificates in a Cluster,” on page 59
- Section 7.1.2, “Using eDirectory Server Certificates for HTTPS Services,” on page 60

7.1.1 Using eDirectory Server Certificates in a Cluster

In a NetWare cluster, you might have copied the Server Certificate objects to all nodes in the cluster using backup and restore functions for Server Certificate objects. This functionality is also available for OES clusters. You can use the backup and restore feature for Server Certificate objects to duplicate the object’s keying material from one node on the cluster to all nodes.

For information about setting up server certificates in a Novell Cluster Services cluster, see the following sections of the NetIQ Certificate Server Administration Guide:

- “Server Certificate Objects and Clustering”
- “Backing Up a Server Certificate Object”
- “Restoring a Server Certificate Object”
7.1.2 Using eDirectory Server Certificates for HTTPS Services

For NetWare, OES2 or later, all applications are integrated with eDirectory. This allows applications to automatically use the server certificates created by Certificate Server directly from eDirectory.

However, for OES1, many native Linux applications (such as Apache and Tomcat) are not integrated with eDirectory and therefore, cannot automatically use the certificates created by Certificate Server directly from eDirectory. By default, these services use the self-signed common server certificate created by YaST:

- **Certificate file:** /etc/ssl/servercerts/servercert.pem
- **Key file:** /etc/ssl/servercerts/serverkey.pem

Self-signed certificates provide minimal security and limited trust, and are not in compliance with the X.509 requirements as specified in RFC 2459 and RFC 3280. We recommend that you use eDirectory certificates instead.

When installing OES2 or later on Linux, the YaST installer provides a configuration screen that allows you to specify whether you want to automatically configure the server to export eDirectory Server Certificates to the file system, eliminating the need to manually configure the server through iManager. It's selected by default. If selected, it automatically replaces the existing server certificate and key files (YaST or third-party) with an eDirectory server certificate and key files.

For more information on how to manually configure OES1 servers to use eDirectory certificates, see NetIQ Certificate Server Administration Guide.

7.2 Using Internal Certificates in a Cluster

NetIQ Certificate Server can be used to create certificates that allow you to specify an alternative IP address or DNS address by adding it in the Subject Alternative Name extension. This requires that your DNS service be configured to reflect the cluster IP/DNS address as the default (or first) address. If the DNS service is set up correctly, the cluster applications can use the default certificates without needing any administration.

Ensure that the DNS service is configured to use the cluster IP/DNS address. During the OES install, select the **Use eDirectory Certificates** option so that NetIQ Certificate Server automatically creates the SSL Certificate DNS certificate with the correct IP/DNS address. By selecting the **Use eDirectory Certificates** option during the installation and using the cluster IP/DNS address, clustered applications should be able to access the certificates without needing further configuration for the Server Certificate object.

7.3 Using External Certificates in a Cluster

External (third-party) certificates create a Server Certificate object that includes the cluster's IP and/or DNS address. Create a backup of this certificate. For each server in the cluster, create a Server Certificate object with the same name by importing the previously created backup certificate and key pair to a location on that server. This allows all of the servers in the cluster to use and share the same certificate and key pair. After all cluster nodes have the certificate, configure the cluster applications to use the server certificate.

**IMPORTANT:** This cluster task can also be used for sharing internal certificates on the cluster nodes. In early versions of Certificate Server, this was the only option available.
For information about exporting and using eDirectory Server Certificates for External Services, see “Using eDirectory Certificates with External Applications” in the NetIQ Certificate Server Administration Guide.

The external certificate method is more complicated than using internal certificates. You must create the certificate for each server in the cluster just as you did for NetWare. You must also create a configuration on the SAS:Service object for each server so that the common certificate is automatically exported to the file system where the non-eDirectory enabled applications can use it.
Novell CIFS

Novell CIFS for Linux is available for Open Enterprise Server (OES) 2015 SP1.

After you set up Novell CIFS on the Linux node and before you finalize the NetWare-to-Linux conversion, use the CIFS function in the Migration Tool to convert the configuration. See “Migrating CIFS to OES 2015 SP1” in the OES 2015 SP1: Migration Tool Administration Guide.

The commands in the scripts are also different. After the migration, you can view the revised load and unload scripts on the Linux server. See Section 3.6, “Comparing File Access Protocol Commands in NSS Pool Resource Scripts,” on page 26.

**IMPORTANT:** If the cluster resource goes comatose on the Linux server, there might be a timing issue for loading Novell CIFS. Add a `sleep` command of 5 or more seconds before the `novcifs -add` command. For example:

```
sleep 5
exit_on_error novcifs --add --vserver=.CN=NCS1_P1_SERVER.O=novell.T=TREE-188.
                         --ip-addr=10.10.10.205
```

CIFS supports NCP cross-protocol file locking, which allows NCP, AFP, and CIFS users to access files on an NSS volume concurrently without data corruption by locking the files across protocols. On Linux, the cross-protocol file locking parameter for NCP Server is enabled by default. Verify that it is enabled on each node in the cluster if you plan to give both NCP users and CIFS users access to an NSS volume in the cluster. See “Configuring Cross-Protocol File Locks for NCP Server” in the OES 2015 SP1 Beta: NCP Server for Linux Administration Guide.

CIFS supports the merged view for Novell Dynamic Storage Technology (DST) shadow volumes built with NSS volumes. Wait until the cluster conversion is complete before attempting to set up DST shadow volumes in the OES cluster.
9 Novell Distributed File Services VLDB

The Novell Distributed File Services volume location database (VLDB) .dat file format is the same on both NetWare and Linux. The shared NSS volume that contains the .dat file can be cluster migrated to the Linux server.

Use one of these two methods for migrating the VLDB from NetWare to Linux:

- Section 9.1, “Cluster Migrating the Shared NSS Volume for the VLDB,” on page 65
- Section 9.2, “Adding a Linux Server as a Replica Site,” on page 66

9.1 Cluster Migrating the Shared NSS Volume for the VLDB

Use this method if you want to use the same shared disk where the VLDB is currently stored.

1. For each Linux node where you expect to run the VLDB service, install Novell Storage Services and any of its dependent services on the Linux node, then add it to the mixed cluster that you are converting.

2. For each of the Linux nodes, assign the node’s nssadmin user as a trustee of the container that is configured as the Management Context for the VLDB, and give the user at least the Read and Compare rights to the [All Attribute Rights] property.

   IMPORTANT: If the Management Context is configured to use the container that contains a node’s Server object, the nssadmin User object for that server is already a trustee of the container and has the Supervisor right. Do not modify the existing rights settings for this nssadmin User object when you add rights for the [All Attribute Rights] property.

   2a. In iManager, select Rights > Modify Trustees.
   2b. Select the container that is configured as the Management Context, then click OK.
   2c. Click Add Trustee, select the nssadmin User object, then click OK.

       The nssadmin User object is in the same container as its server. The user name format is servnameadmin.context. For example, if the server name is server1.ou1.mycompany, then server1admin.ou1.mycompany is the nssadmin user name.

   2d. Click Assigned Rights for the selected nssadmin User object.
   2e. Assign the Read and Compare rights to the [All Attribute Rights] property, then click Done.
   2f. Click Apply to save and apply the changes.

3. Cluster migrate the DFS cluster resource from NetWare to Linux.

4. On the Linux node where the VLDB is active, offline the DFS cluster resource.

5. Remove the NetWare clusters from the cluster by using the cluster leave command, then finish the cluster conversion.

   This automatically updates the basic cluster commands in the cluster resource scripts.
Using the Clusters plug-in in iManager, modify the load script of the DFS cluster resource to change the `vldb` command to the Linux format. For example, change it from

```
vldb /dir=vldbpath
```

to

```
vldb -dir /vldbpath
```

7. Online the cluster resource.
8. Run a VLDB repair to ensure that the database is correct.

### 9.2 Adding a Linux Server as a Replica Site

Use this method if you want to use a different shared disk for the VLDB on Linux. You can do this by adding a DFS replica site on Linux.

1. Install OES on the server that you want to add to the cluster. Ensure that Novell Storage Services and any of its dependent services are installed.
2. Assign the node’s nssadmin user as a trustee of the container that is configured as the Management Context for the VLDB, and give the user at least the Read and Compare rights to the [All Attribute Rights] property.

**IMPORTANT:** If the Management Context is configured to use the container that contains a node’s Server object, the nssadmin User object for that server is already a trustee of the container and has the Supervisor right. Do not modify the existing rights settings for this nssadmin User object when you add rights for the [All Attribute Rights] property.

2a. In iManager, select Rights > Modify Trustees.
2b. Select the container that is configured as the Management Context, then click OK.
2c. Click Add Trustee, select the nssadmin User object, then click OK.
2d. Click Assigned Rights for the selected nssadmin User object.
2e. Assign the Read and Compare rights to the [All Attribute Rights] property, then click Done.
2f. Click Apply to save and apply the changes.

3. Create a shared NSS pool and volume on the OES server, or create a shared Linux POSIX volume.
4. In iManager, add the Linux server as the second VLDB replica site for the DFS management context, and point to the shared NSS volume as the VLDB location.
5. Allow the VLDB data to synchronize between the NetWare replica and the Linux replica.
6. In iManager, remove the NetWare instance of the replica site.
7. Add the Linux server to the mixed-mode NetWare cluster.
8. Continue with the cluster conversion as described in Section 4.1, “Converting NetWare Cluster Nodes to OES (Rolling Cluster Conversion),” on page 33.
The Novell DHCP Server for Linux is based on a standards-compliant implementation from ISC that is distributed with SUSE Linux Enterprise Server. DHCP uses a different schema on Linux to store the configuration in eDirectory.

After you set up Novell DHCP Server on the Open Enterprise Server SP1 and before you complete the cluster conversion, you can use the DHCP option for the Migration Tool to convert the configuration from NetWare to OES. You cannot directly reuse the data. Migrate your DHCP server data, then perform the post-migration tasks to set up the configuration in the OES nodes of the cluster.

- Section 10.1, “Setting Up Novell DHCP on OES,” on page 67
- Section 10.2, “Prerequisites for Migration,” on page 67
- Section 10.3, “Migrating the DHCP Configuration from NetWare to Linux Clusters in the Same Tree,” on page 67
- Section 10.4, “Post-Migration Tasks,” on page 68

10.1 Setting Up Novell DHCP on OES

Novell DHCP Server for OES 11 and later supports using a shared Linux POSIX file system or a shared NSS file system for the cluster resource. Set up DHCP on the OES servers by using one of the following methods in the OES 2015 SP1 Beta: Novell DNS/DHCP Services for Linux Administration Guide:

- “Configuring DHCP with Novell Cluster Services for the NSS File System”
- “Configuring DHCP with Novell Cluster Services for the Linux File System”

10.2 Prerequisites for Migration

For more information about prerequisites, see “Migration Requirements” for DHCP in the OES 2015 SP1: Migration Tool Administration Guide.

10.3 Migrating the DHCP Configuration from NetWare to Linux Clusters in the Same Tree

In this scenario, both the NetWare server and the OES server are in the same eDirectory tree. The NetWare source server must be running NetWare 6.5 SP8 with the latest patches applied. The Linux target server must be running OES 2015 SP1 on 64-bit hardware.

Run the DHCP function in the Migration Tool from one of the OES nodes. Perform the Tree Level Migration with the same Source server (tree to which NetWare clustered nodes are attached) and Target server (tree to which the Linux clustered nodes are attached). This ensures that the entire NetWare DHCP configuration data is available for OES DHCP.
See “Migrating DHCP” in the OES 2015 SP1: Migration Tool Administration Guide, and follow the instructions for NetWare and Linux in the same eDirectory tree.

IMPORTANT: Before starting the DHCP server on the Linux cluster, stop the DHCP server on the NetWare cluster.

10.4 Post-Migration Tasks

1 Log in as the root user to the OES node where you ran the migration, then open a terminal console.

2 Online the DHCP service cluster resource by entering

   cluster online resource_name

3 On the Linux node where you ran the migration:
   3a Open the /mount_path/etc/dhcpd.conf file in a text editor. Replace mount_path with the Linux path to the folder in the shared volume where DHCP-specific directories are created.
   3b In the /mount_path/etc/dhcpd.conf file, change the value for the ldap-dhcp-server-cn parameter to the cn of the migrated DHCP server, then save your changes.
   3c Copy the migrated_server.leases file from /var/opt/novell/dhcp/leases/ folder or to the lease path specified in the Migration Tool to the /mount_path/var/lib/dhcp/db/ folder, then rename it to dhcpd.leases.

4 Stop the DHCP server on the NetWare cluster by taking the NetWare DHCP cluster resource offline.

5 Start the DHCP server on the Linux cluster.

   rcnovell-dhcpd start
11 DNS Server

You can migrate the data from the Novell DNS Server on NetWare to a Novell DNS Server on Linux after you have installed and set up DNS services on an Open Enterprise Server (OES) 2015 SP1 node in the cluster. You cannot directly reuse the data.

- Section 11.1, “Prerequisites for Migration,” on page 69
- Section 11.2, “Migrating the DNS Configuration from NetWare to Linux Clusters in the Same Tree,” on page 69
- Section 11.3, “Post-Migration Tasks,” on page 69

11.1 Prerequisites for Migration

For information about prerequisites, see “Migrating DNS to OES 2015 SP1” in the OES 2015 SP1: Migration Tool Administration Guide.

11.2 Migrating the DNS Configuration from NetWare to Linux Clusters in the Same Tree

In this scenario, both the NetWare server and the OES server are in the same eDirectory tree. The NetWare source server must be running NetWare 5.1 SP8 or later versions. The Linux target server must be running OES 2015 SP1 on 64-bit hardware.

Use iManager to move the DNS server from a NetWare NCP server to an OES NCP server. For information see “Using Java Console to Migrate Servers within the Same eDirectory Tree” in the OES 2015 SP1: Migration Tool Administration Guide.

11.3 Post-Migration Tasks

See “Post-Migration Procedure” in the OES 2015 SP1: Migration Tool Administration Guide.

1. Use iManager or the Java Management Console to check for the existence of the following objects:
   - DNS-DHCP
   - DNDHCP-GROUP
   - RootServerInfo
   - DNS Server object

2. Use the Clusters plug-in for iManager to verify the Cluster load script and unload script of the DNS cluster resources.
   See “DNS Load, Unload, and Monitor Scripts” in the OES 2015 SP1 Beta: Novell DNS/DHCP Services for Linux Administration Guide.

3. Start the DNS server on the OES cluster.
12 Novell iPrint

This section describes how to convert the iPrint cluster resource from NetWare 6.5 SP8 to Open Enterprise Server (OES) 2015 SP1.

- Section 12.1, "Installing iPrint on the OES Nodes," on page 71
- Section 12.2, "Setting Up iPrint on the OES Nodes," on page 71
- Section 12.3, "Migrating the iPrint Cluster Resource from NetWare to OES," on page 74
- Section 12.4, "Finalizing the Cluster Conversion," on page 75
- Section 12.5, "Additional Information," on page 75

12.1 Installing iPrint on the OES Nodes

Prepare the first OES server for use with iPrint in a cluster:

1. Install the following services on an OES server:
   - Novell iPrint
   - Novell Storage Services
   - Novell Cluster Services (but do not configure at install time)
   
   Select at least these services and any dependent services that each one requires.

2. After the install, add the server to the NetWare cluster:
   
   For instructions, see Section 4.2, “Adding New OES Nodes to Your NetWare Cluster,” on page 36.

12.2 Setting Up iPrint on the OES Nodes

Perform the steps in this section to set up iPrint and an iPrint cluster resource on the OES nodes in the mixed-mode cluster.

- Section 12.2.1, “Preparing the OES Nodes for iPrint,” on page 71
- Section 12.2.2, “Setting Up iPrint on the OES iPrint Cluster Resource,” on page 72
- Section 12.2.3, “Setting Up Preferred Nodes for the OES iPrint Cluster Resource,” on page 73
- Section 12.2.4, “Editing the Load and Unload Scripts for the OES iPrint Cluster Resource,” on page 73
- Section 12.2.5, “Verifying the Status of the iPrint Setup,” on page 74

12.2.1 Preparing the OES Nodes for iPrint

Because iPrint on NetWare and iPrint on Linux are different, cluster migrating the iPrint cluster resource from NetWare to Linux is not an option. You create a new pool cluster resource on an OES node that will be the iPrint cluster resource on Linux. To set up iPrint on each server, you move the
iPrint configuration information from the default Linux installation path on each node to the newly created shared NSS pool resource. Later, you will move the iPrint Driver Store and Print Manager information from the NetWare resource to the OES resource.

1 In a web browser, open iManager, then use the Storage role to create a new shared pool and volume on one of the OES servers where iPrint is installed.

This is the iPrint cluster resource that will contain the iPrint data.

For information about creating a clustered NSS pool and volume, see “Creating Cluster-Enabled Pools and Volumes” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

2 On the first OES node, set up clustering for iPrint on the shared NSS volume that you created in Step 1.

2a Log in as the root user to the OES node where the shared pool resource is active, then open a terminal console.

2b Go to the /opt/novell/iprint/bin directory, then run the iprint_nss_relocate script by entering

```
./iprint_nss_relocate -a admin_fdn -p admin_password -n nss_volume_path -l cluster [-c <Specify Container FDN where iPrint LUM object already exists or should be created>] [-w <Specify Container FDN where Apache LUM objects exist>]
```

Replace admin_fdn with the comma-delimited fully distinguished name of the iPrint administrator user (such as cn=admin,o=mycompany). Replace admin_password with the actual password of the specified iPrint administrator user. Replace nss_volume_path with the Linux path (such as /media/nss/NSSVOL1) to the shared NSS volume where you want to relocate the iPrint configuration data.

For information about the script options, see “Setting up iPrint on the NSS File System” in the OES 2015 SP1: iPrint Linux Administration Guide.

For example, enter

```
./iprint_nss_relocate -a cn=admin,o=mycompany -p password -n /media/nss/NSSVOL1 -l cluster -c o=mycompany,t=iPrint_Tree -w o=mycompany,t=iPrint_Tree
```

2c Review the messages displayed on the screen to confirm the data migration from the local Linux path to the shared NSS path is completed.

3 For each remaining Linux node in the cluster where iPrint is installed, set up clustering for iPrint by doing the following:

3a Log in as the root user to the OES node where the shared pool resource is active, then open a terminal console.

3b Cluster migrate the shared NSS pool resource from the active OES node to this OES node by entering

```
cluster migrate resource_name node_name
```

3c Log in to the newly active OES node as the root user, then open a terminal console.

3d Run the iprint_nss_relocate script as described in Step 2b, using the same values.

3e Repeat Step 3a through Step 3d until all of the OES nodes are configured for iPrint.

12.2.2 Setting Up iPrint on the OES iPrint Cluster Resource

1 In iManager, select iPrint > Create Driver Store, then create a Driver Store on the OES node where the iPrint cluster resource is active.
12.2.3 Setting Up Preferred Nodes for the OES iPrint Cluster Resource

Configure the Preferred Nodes list for the Linux shared NSS pool cluster resource to prevent an inadvertent failback of the resource to a NetWare server.

1. In iManager, click Clusters > Cluster Manager, then select the cluster where the Linux shared NSS pool resource is currently active.
2. Select the link for the OES shared NSS pool cluster resource to open its Properties page.
3. Go to the Preferred Nodes tab.
4. Move all of the NetWare nodes from the Assigned Nodes list to Unassigned Nodes list.
5. Click OK to save your changes.

12.2.4 Editing the Load and Unload Scripts for the OES iPrint Cluster Resource

Edit the load and unload scripts for the OES iPrint cluster resource.

1. Edit the load script. Add the following lines to the existing load script before the `exit 0` statement:

```bash
ignore_error mv /media/nss/NSSVOL1/var/opt/novell/iprint/iprintgw.lpr /media/nss/NSSVOL1/var/opt/novell/iprint/iprintgw.lpr.bak
```

**NOTE:** Replace `/media/nss/NSSVOL1` in the above command with your actual cluster volume mount point.

```bash
exit_on_error rcnovell-idsd start
exit_on_error rcnovell-ipsmd start
```

The daemons can also be started by using the file path `/etc/init.d/novell-idsd start` and `/etc/init.d/novell-ipsmd start`.

2. Edit the unload script. Add the following lines to the existing unload script after the `exit` statement:

```bash
ignore_error rcnovell-ipsmd stop
ignore_error rcnovell-idsd stop
```
The daemons can also be stopped by using the file path `/etc/init.d/novell-ipsmd stop` and `/etc/init.d/novell-idsd stop`.

3 Activate the load and unload scripts by taking the resource offline, then bringing the resource online.

### 12.2.5 Verifying the Status of the iPrint Setup

Verify that the iPrint cluster resource is working by cluster migrating the OES iPrint cluster resource to each OES node in turn and performing the following checks:

1. Log in as the `root` user on the OES node where the iPrint cluster resource is active, then open a terminal console.
2. Check the status of the Print Manager and Driver Store.
   
   ```
   rcnovell-ipsmd status
   rcnovell-idsd status
   ```
3. Test the ability of `iprntman` to authenticate the admin user (or other user given with `miggui`).
   ```
   iprntman psm -l -u admin
   ```
4. Cluster migrate the iPrint cluster resource to another OES node by entering
   ```
   cluster migrate resource_name node_name
   ```
5. Repeat this check for each OES node in the mixed-mode cluster.

### 12.3 Migrating the iPrint Cluster Resource from NetWare to OES

After iPrint is configured for the OES nodes, you are ready to migrate the iPrint Driver Store and Print Manager information from the NetWare iPrint cluster resource to the OES iPrint cluster resource.

Perform the following steps in "Migrating an iPrint Cluster Resource" in the OES 2015 SP1: Migration Tool Administration Guide.

1. Perform the pre-migration checks as described in "Pre-Migration iPrint Configuration" in the OES 2015 SP1: Migration Tool Administration Guide.
2. Perform a consolidated migration of the iPrint service as described in "iPrint Consolidate Migration" in the OES 2015 SP1: Migration Tool Administration Guide.
   
   Start the Migration Tool from the target server (the OES node where the iPrint cluster resource is active).
   
   For the source server, authenticate by using the IP address or DNS name of the NetWare iPrint cluster resource.
   
   For the target server, authenticate by using the IP address or DNS name of the Linux iPrint cluster resource.

3. Verify that the migration was successful as described in "Verifying the Result of the iPrint Migration" in the OES 2015 SP1: Migration Tool Administration Guide.
4. Transition the Transition end-user printing from NetWare to Linux.
   - Offline the NetWare iPrint cluster resource.
   - View the NetWare iPrint cluster load script's `/DNSNAME` value.
Configure DNS to resolve the /DNSNAME value to the IP address of the target Linux cluster resource hosting the Print Manager.

**NOTE:** The propagation of the DNS change might take time, depending on your network.

DNSNAME is the address that the clients use to find the NetWare Print Manager. The same DNSNAME is used to find the Linux Print Manager.

- Update each of the Linux node `/etc/hosts` files to resolve to the Linux iPrint cluster IP address.
- Update the `/etc/opt/novell/iprint/conf/ipsmd.conf` PSMHostAddress value to the /DNSNAME.
- Restart the Print Manager.

(Optional) Perform the post-migration steps as described in “Transfer ID” and “Migrating an iPrint Cluster Resource” in the *OES 2015 SP1: Migration Tool Administration Guide*.

For detailed information about iPrint migration requirements, pre-migration configuration, migration procedures, post-migration tasks, and troubleshooting, see “Migrating iPrint to OES 2015 SP1” in the *OES 2015 SP1: Migration Tool Administration Guide*.

### 12.4 Finalizing the Cluster Conversion

After your OES iPrint setup is working as expected, finalize the cluster conversion, as described in Section 4.4, “Finalizing the Cluster Conversion,” on page 39.

### 12.5 Additional Information

See the following Novell Support Technical Information Documents (TIDs) in the Novell Knowledgebase for more information about migrating iPrint from NetWare to OES:

- **TID 7005448:** Migrating an iPrint Cluster from NetWare to OES 2 (http://www.novell.com/support/)
- **TID 7004455:** iPrint Migration Best Practices (http://www.novell.com/support/)
SUSE Linux Enterprise Server (SLES) 11 Service Pack 3 (SP3) and Novell Open Enterprise Server 2015 provide an open source version of the MySQL 5.5.x software that is offered under the GNU General Public License (GPL) Version 2. Version 5.0.x is available on SLES 11 SP2 and OES 11 SP1, and earlier versions. MySQL can be used with Novell Cluster Services to provide high availability support to the customers you service with MySQL. This helps prevent interruptions of access for the MySQL database.

**IMPORTANT:** As stated in the [Release Notes for SUSE Linux Enterprise Server 11 SP3 and earlier](http://www.novell.com/linux/releasenotes/x86_64/SUSE-SLES/11-SP3/), the open source MySQL packages require additional support contracts to be obtained by the customer in order to receive full support.

The MySQL database format is upgraded from version 5.0 to version 5.5 in SUSE Linux Enterprise Server 11 SP3 and OES 11 SP2. For information about upgrading the database format, see "Upgrading from MySQL 5.0 to MySQL 5.5 Introduces a New Database Format" in the [OES 2015 SP1 Beta: Web Services and Applications Guide](http://www.novell.com/linux/release_11.3/).

MySQL is installed on all nodes where you want it to run, but a database runs on only one node in the cluster at a time. The MySQL configuration files are modified on each node to point to a path on a Linux Logical Volume Manager (LVM) volume group cluster resource that contains the MySQL database files. You cluster-enable the volume group by using the MySQL template, then configure its resource load, unload, and monitoring scripts, set its resource failover and failback modes, and assign the resource to specific nodes in the cluster. When a node fails where the resource is online, the resource fails over to the next preferred node in the cluster.

**IMPORTANT:** Refer to the official MySQL 5.5 documentation for information about configuring, managing, and using MySQL. For information, see the [MySQL Documentation Library: MySQL Reference Manuals](http://dev.mysql.com/doc/).

The instructions in this section describes how to set up MySQL in a Novell Cluster Services cluster.

- Section 13.1, “Prerequisites for Clustering MySQL,” on page 78
- Section 13.2, “Installing and Enabling MySQL,” on page 78
- Section 13.3, “Creating an LVM Volume Group and Logical Volume,” on page 81
- Section 13.4, “Configuring MySQL on the LVM Logical Volume,” on page 86
- Section 13.5, “Cluster-Enabling MySQL on the Logical Volume,” on page 87
- Section 13.6, “File Location,” on page 90
- Section 13.7, “Security Considerations for the MySQL Configuration,” on page 91
- Section 13.8, “Additional Information,” on page 92
13.1 Prerequisites for Clustering MySQL

The following setup is required for clustering the MySQL database files with Novell Cluster Services:

- Novell Cluster Services must be installed and configured as described in “Installing, Configuring, and Repairing Novell Cluster Services” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.
- MySQL must be installed on every node in the cluster where you want MySQL to run. The installation is described in Section 13.2, “Installing and Enabling MySQL,” on page 78.
- The SAN device that you want to use for the MySQL database must be accessible to all nodes in the cluster. It will be activated on only one node at a time.
- You must create a shared Linux Logical Volume Management (LVM) volume group where you will store the MySQL database and configuration file. This setup is described in Section 13.3, “Creating an LVM Volume Group and Logical Volume,” on page 81.

13.2 Installing and Enabling MySQL

Before you configure MySQL with Novell Cluster Services, MySQL must be installed and configured properly on all servers in the cluster where you intend to run it. You can use the YaST Software Management tool to install the MySQL and the MySQL Client packages. Other MySQL packages are available that allow you to use MySQL with Perl, PHP, Postfix, or Python, but this guide does not cover their installation or use.

<table>
<thead>
<tr>
<th>Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mysql</td>
<td>Provides the MySQL software and database.</td>
</tr>
<tr>
<td>mysql-client</td>
<td>Provides the MySQL client command line program that acts as a text-based front end for the MySQL Server. It is used for issuing queries and viewing the results interactively from a terminal window</td>
</tr>
</tbody>
</table>
| msql-Max         | Provides the MySQL software, database, and the following features for users that require transaction support:  
|                  |  
|                  |  - Berkeley database (BDB) tables                                           |
|                  |  - InnoDB tables                                                            |
|                  | These features provide transaction-safe tables to which locks are applied while a series of SQL queries is made. The series of queries is referred to as a transaction. |
| perl-DBD-mysql   | Provides a MySQL database driver (DBD) to support a database-independent interface (DBI) for the Perl programming language. |
| php5-mysql       | Provides a PHP plug-in that allows an Apache HTTP server to access a MySQL database. |
| postfix-mysql    | Provides a Postfix plug-in that allows a Postfix mail system to access a MySQL database. |
| python-mysql     | Provides a Python plug-in that allows you to execute SQL queries on a MySQL database through your Python application. |
Use the following procedure to install the `mysql` and `mysql-client` packages, and enable MySQL on each node in the cluster:

1. Log in to the server as the Linux root user, then open YaST.
2. Ensure that the SUSE Linux Enterprise Server 11 SPx installation CD is mounted on the server.
3. In YaST, select `Software > Software Management`, then click the `Search` tab.
4. To find the components, type `mysql` in the `Search` field, then click `Search`.
5. In the `Package` list, select `mysql` and `mysql-client`.
6. Click `Accept`, then click `Continue` for each component to confirm that you want to install it.

YaST does the following:

- Installs the MySQL Server and MySQL Client software.
  
The software is not enabled by default, and the MySQL daemon is not running at this time. No run levels are set.
- Creates the MySQL root user (a user internal to the MySQL system) as a superuser that has access rights to perform any function in MySQL. Initially, this user has no password assigned.
- Creates a default path `/var/lib/mysql` for storing databases that you create later. Initially, this directory is empty. It is populated later when you enable the MySQL service.
- Creates the `mysql` user and group on the server and makes them the owners of the default data directory `/var/lib/mysql` and its contents.
- Creates a default mount point /mnt/mysql for the database. This is where you will mount the LVM logical volume that you create for the database in Section 13.3, “Creating an LVM Volume Group and Logical Volume,” on page 81.
- Creates the default MySQL configuration file (/etc/my.cnf).

7 In YaST, enable the MySQL service:

7a Select System > System Services (Runlevel).
7b Select Expert Mode.
7c In the Service list, select the mysql daemon.
7d Click Set/Reset > Enable the Service.

Under Service will be started in the following runlevels, notice that the 2, 3, and 5 check boxes are selected by default. You don’t want the service to start on system boot because it starts when the cluster resource is brought online on a cluster node.

![YaST System Services](image)

7e In the lower right corner, click OK.
7f When you are prompted to confirm the changes, click Yes to save them.
7g Exit YaST.

8 Stop the MySQL daemon from running. In a terminal console, enter the following as the Linux root user:

```
/etc/init.d/mysql stop
```

Alternatively, you can use the rcmysql stop command.

9 Repeat Step 1 through Step 8 on each node in the cluster to install and enable MySQL.

10 After you have installed and enabled MySQL on all servers in the cluster, continue with Section 13.3, “Creating an LVM Volume Group and Logical Volume,” on page 81.
13.3 Creating an LVM Volume Group and Logical Volume

After you have installed MySQL, you are ready to set up the LVM volume group and logical volume where you will store a MySQL database. Sample values are used in the procedures in this section to help you understand what is required at each step. The overview provides only the Linux commands that you need to create and prepare the volume group for use by MySQL. The detailed description provides more information about the process, including the syntax and sample commands.

- Section 13.3.1, “Sample Values,” on page 81
- Section 13.3.2, “Setting Up the VG and LV (Overview),” on page 81
- Section 13.3.3, “Setting up the VG and LV (Detailed),” on page 82

13.3.1 Sample Values

The procedures in this section use the following parameters. Ensure that you replace the sample values with your values. The first node in the cluster is where you configure MySQL and the cluster resource.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sample Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVM physical volume</td>
<td>/dev/sdd</td>
</tr>
<tr>
<td>LVM volume group name</td>
<td>mysqlvg</td>
</tr>
<tr>
<td>LVM logical volume</td>
<td>msqllv</td>
</tr>
<tr>
<td>File system type</td>
<td>ext3</td>
</tr>
<tr>
<td>This is the file system type that you make on the LVM logical volume, such as btrfs, ext2, ext3, reiserfs, or xfs.</td>
<td></td>
</tr>
<tr>
<td>Logical volume path</td>
<td>/dev/mysqlvg/msqllv</td>
</tr>
<tr>
<td>Mount point for the logical volume</td>
<td>/mnt/mysql</td>
</tr>
<tr>
<td>Default MySQL root path</td>
<td>/var/lib/mysql</td>
</tr>
<tr>
<td>New MySQL root path</td>
<td>/mnt/mysql/var/lib/mysql</td>
</tr>
</tbody>
</table>

13.3.2 Setting Up the VG and LV (Overview)

You can create the volume group and logical volume by issuing the following LVM commands as the root user on the cluster node. This overview of the process uses the sample values. Ensure that you substitute your own values in the commands. For details, see “Setting up the VG and LV (Detailed)” on page 82.

<table>
<thead>
<tr>
<th>Command Action</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Create the LVM physical volume.</td>
<td>pvcreate /dev/sdd</td>
</tr>
<tr>
<td>2. Create the clustered LVM volume group.</td>
<td>vgcreate -c y mysqlvg /dev/sdd</td>
</tr>
</tbody>
</table>
The following procedure provides detailed instructions for creating the LVM volume group and logical volume:

1. Log in as the Linux root user to the first node of the cluster, then open a terminal console.

2. In NSSMU, initialize the SAN device that you want to use for the MySQL database, but do not mark it as shareable for clustering:
   2a. At the console prompt, launch NSSMU by entering:
       
       ```
       nssmu
       ```
   2b. Select Devices, then press Enter.
   2c. In the Devices list, select the unpartitioned device that you want to use, then press F3 to initialize it.
   2d. Read the advisory, then press Y to confirm that you want to initialize the device.
   2e. Specify the Master Boot Record (MBR) type as DOS or GPT, then press Enter.
       Typically, you use DOS format for devices up to 2 TB. You use GPT for devices greater than 2 TB.

3. Activate the volume group exclusively on the node.

   ```
   vgchange -a ey mysqlvg
   ```

4. Create the LVM logical volume.

   ```
   lvcreate -n mysqllv -L size mysqlvg
   ```

5. Add a file system to the LVM logical volume.

   ```
   mkfs -t ext3 /dev/mysqlvg/mysqllv [fs_options]
   ```

6. Create a mount point for the logical volume.

   ```
   mkdir /mnt/mysql
   ```
   You must also create this path on each node in the cluster.

7. Mount the LVM logical volume.

   ```
   mount -t ext3 /dev/mysqlvg/mysqllv /mnt/mysql
   ```

8. Create the directory structure for the MySQL database files on the mounted logical volume.

   ```
   cd /mnt/mysql
   mkdir /mnt/mysql/var
   mkdir /mnt/mysql/var/lib
   mkdir /mnt/mysql/var/lib/mysql
   ```

9. Modify the file ownership of the mount point and subdirectories.

   ```
   chown -R mysql:mysql /mnt/mysql
   ```

10. Deactivate the LVM logical volume.

    ```
    vgchange -a n mysqlvg
    ```

### 13.3.3 Setting up the VG and LV (Detailed)

The following procedure provides detailed instructions for creating the LVM volume group and logical volume:

1. Log in as the Linux root user to the first node of the cluster, then open a terminal console.

2. In NSSMU, initialize the SAN device that you want to use for the MySQL database, but do not mark it as shareable for clustering:
   2a. At the console prompt, launch NSSMU by entering:
       ```
       nssmu
       ```
   2b. Select Devices, then press Enter.
   2c. In the Devices list, select the unpartitioned device that you want to use, then press F3 to initialize it.
   2d. Read the advisory, then press Y to confirm that you want to initialize the device.
   2e. Specify the Master Boot Record (MBR) type as DOS or GPT, then press Enter.
       Typically, you use DOS format for devices up to 2 TB. You use GPT for devices greater than 2 TB.
2f Verify that the device is initialized and that it is unshared (that is, Shareable for Clustering is set to No).

![Device initialization table]

2g Exit NSSMU to return to the command prompt.

3 Create an LVM physical volume on the device (such as /dev/sdd) by entering:

```
pvcreate <device>
```

For example:

```
pvcreate /dev/sdd
No physical volume label read from /dev/sdd
Physical volume "/dev/sdd" successfully created
```

4 Create an LVM volume group (such as mysqlvg) on the physical volume by entering:

```
vgcreate -c y <vg_name> <device>
```

For example:

```
vgscreate -c y "mysqlvg" /dev/sdd
Clustered volume group "mysqlvg" successfully created
```

The volume group is automatically activated.

5 Activate the volume group exclusively on the current server by entering:

```
vgchange -a ey <vg_name>
```

The -a option activates the volume. The ey parameter specifies the values exclusively and yes.

For example:

```
vchange -a ey mysqlvg
```

6 View information about the volume group by using the `vgdisplay` command:

```
vgdisplay <vg_name>
```

Notice that 4 MB of the device are used for the volume group’s Physical Extent (PE) table. You must consider this reduction in available space on the volume group when you specify the size of the LVM logical volume in the next step (Step 7).
For example:

```
vgdisplay mysqlvg
--- Volume group ---
 VG Name           mysqlvg
 System ID                
 Format       lvm2
 Metadata Areas     1
 Metadata Sequence No 1
 VG Access         read/write
 VG Status         resizable
 MAX LV            0
 Cur LV            0
 Open LV           0
 Max PV            0
 Cur PV            1
 Act PV            1
 VG Size           508.00 MB
 PE Size           4.00 MB
 Total PE          127
 Alloc PE / Size   0 / 0
 Free  PE / Size   127 / 508.00 MB
 VG UUID           rgyAd3-U2dg-HYLw-0SyN-1o07-jBH3-qHvySe
```

7 Create an LVM logical volume (such as `mysqllv`) on the volume group by entering:

```bash
lvcreate -n <lv_name> -L size <vg_name>
```

Specify the logical volume name, size, and the name of the volume group where you want to create it. The size is specified in megabytes by default.

The logical volume full path name is `/dev/<vg_name>/<lv_name>`.

For example:

```bash
lvcreate -n "mysqllv" -L 500 "mysqlvg"
```

Logical volume "mysqllv" created

This volume's full path name is `/dev/mysqlvg/mysqllv`.

8 View information about the logical volume by entering:

```bash
lvdisplay -v <lv_path_name>
```

For example:

```bash
lvdisplay -v /dev/mysqlvg/mysqllv
--- Logical volume ---
 LV Name           /dev/mysqlvg/mysqllv
 VG Name           mysqlvg
 LV UUID           nIfsMp-a1RR-i4Lw-4Wdt-v5io-2hDN-qrWTLH
 LV Write Access   read/write
 LV Status         available
 # open            0
 LV Size           500.00 MB
 Current LE        125
 Segments          1
 Allocation        inherit
 Read ahead sectors auto
 - currently set to 1024
 Block device      253:1
```

9 Create a file system (such as Btrfs, Ext2, Ext3, ReiserFS, or XFS) on the LVM logical volume by entering:

```bash
mkfs -t <fs_type> <lv_path_name> [fs_options]
```
You can specify file system options according to the type of file system you are making. For information, see the `mkfs(8)` man page and the related man page for the file system type, such as `mkfs.btrfs(8)`, `mkfs.ext2(8)`, `mkfs.ext3(8)`, `mkfs.reiserfs(8)`, or `mkfs.xfs(8)`.

For example:

```
mkfs -t ext3 /dev/mysqlvg/mysqllv
mke2fs 1.41.9 (22-Aug-2009)
  Filesystem label=
  OS type: Linux
  Block size=1024 (log=0)
  Fragment size=1024 (log=0)
  128016 inodes, 512000 blocks
  25600 blocks (5.00%) reserved for the super user
  First data block=1
  Maximum filesystem blocks=67633152
  63 block groups
  8192 blocks per group, 8192 fragments per group
  2032 inodes per group
  Superblock backups stored on blocks:
    8193, 24577, 40961, 57345, 73729, 204801, 221185, 401409
  Writing inode tables: done
  Creating journal (8192 blocks): done
  Writing superblocks and filesystem accounting information: done

  This filesystem will be automatically checked every 29 mounts or
  180 days, whichever comes first. Use tune2fs -c or -i to override.
```

10 Create a mount point for the logical volume by entering:

```
mkdir /mnt/mysql
```

11 Mount the logical volume on the MySQL mount point by entering:

```
mount -t <fs_type> <lv_path_name> <mount_point>
```

For example:

```
mount -t ext3 /dev/mysqlvg/mysqllv /mnt/mysql
```

12 Go to the mount point location (/mnt/mysql), then create the `/var/lib/mysql` subdirectory structure by entering:

```
cd /mnt/mysql
mkdir /mnt/mysql/var
mkdir /mnt/mysql/var/lib
mkdir /mnt/mysql/var/lib/mysql
```

13 Change the owner and group owner of the `/mnt/mysql` directory and its contents to use the mysql user and group. Enter the `chown` command with the recursive (`-R`) option:

```
cd /mnt
chown -R mysql:mysql mysql
```

Another way to do this is to explicitly specify the directory path:

```
chown -R mysql:mysql /mnt/mysql
```

14 Continue with Section 13.4, “Configuring MySQL on the LVM Logical Volume,” on page 86.
13.4 Configuring MySQL on the LVM Logical Volume

MySQL databases are usually located in a subdirectory of the /var/lib/mysql/ directory. If you create a database named test, the database files are located in the /var/lib/mysql/test directory.

In order for MySQL to take advantage of the benefits provided by Novell Cluster Services, you must make some configuration changes to MySQL. On the first server, you copy the default MySQL configuration file (/etc/my.cnf) to the LVM logical volume, modify /mnt/mysql/var/lib/mysql/my.cnf file so that all datadir entries are commented out, then create a MySQL database on the LVM Logical volume.

The following instructions assume that you have not created a database on the server at this time. If a MySQL database currently exists in the default /var/lib/mysql location, the database's directory and its contents must be relocated to the new /mnt/mysql/var/lib/mysql path, rather than creating it as described in Step 6 on page 86 of the following procedure. Afterwards, ensure that you modify the ownership of the folder and files to the mysql user and group by using the chown command as illustrated in Step 13 of Section 13.3, “Creating an LVM Volume Group and Logical Volume,” on page 81.

**IMPORTANT:** After you have modified the MySQL configuration file to use the LVM logical volume path, you should always exclusively activate the volume group on the server before attempting to start the MySQL daemon. The cluster resource does this automatically in the load script.

To configure a MySQL database on the LVM logical volume:

1. Log in as the Linux root user on the first node, then open a file browser or terminal console.
2. Copy the default /etc/my.cnf configuration file to the /mnt/mysql/var/lib/mysql directory:
   ```shell
   cp /etc/my.cnf /mnt/mysql/var/lib/mysql
   ```
3. In a text editor, modify the /mnt/mysql/var/lib/mysql/my.cnf file and comment out any data directory entries, then save your changes. For example:
   ```bash
   # datadir=
   ```
4. Change the permissions on the /mnt/mysql/var/lib/mysql/my.cnf file to Read and Execute for each permission level, and change the ownership to the mysql user and group:
   ```bash
   chmod 555 /mnt/mysql/var/lib/mysql/my.cnf
   chown mysql:mysql /mnt/mysql/var/lib/mysql/my.cnf
   ```
   You can view these settings by using the `ll <filepath>` command. For example:
   ```bash
   ll /mnt/mysql/var/lib/mysql/my.cnf
   -r-xr-xr-x 1 mysql mysql 6297 2011-07-08 14:19 /mnt/mysql/var/lib/mysql/my.cnf
   ```
5. Open a terminal console as the Linux root user, then start MySQL:
   ```bash
   /etc/init.d/mysql start
   ```
   Another option is to use the `rcmysql start` command.
6. Create a database named data on the LVM logical volume:
   ```bash
   mysql_install_db --datadir=/mnt/mysql/var/lib/mysql/data --user=mysql
   ```
7 Set the ownership of the data database to be the mysql user and group:
   
   ```bash
   chown -R mysql:mysql /mnt/mysql/var/lib/mysql/data
   ```

8 Stop the MySQL daemon from running:
   
   ```bash
   /etc/init.d/mysql stop
   ```
   Another option is to use the `rcmysql stop` command.

9 Deactivate the LVM volume group:
   
   ```bash
   vgchange -a n <vg_name>
   ```
   For example:
   
   ```bash
   vgchange -a n mysqlvg
   ```


# 13.5 Cluster-Enabling MySQL on the Logical Volume

Now that you have configured MySQL for the LVM logical volume, you are ready to cluster-enable MySQL. In iManager, you use the Novell Cluster Services MySQL template to create a cluster resource for the LVM volume group that contains the MySQL database. The resource’s load script starts the MySQL daemon when the resource is brought online, and the unload script stops it when the resource is taken offline.

The sample scripts in this section use the following sample parameters. Ensure that you replace the sample values with your values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sample Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource IP Address</td>
<td>10.10.10.44</td>
</tr>
<tr>
<td>MOUNT_FS</td>
<td>ext3</td>
</tr>
<tr>
<td>VOLGROUP_NAME</td>
<td>mysqlvg</td>
</tr>
<tr>
<td>MOUNT_DEV</td>
<td>/dev/$VOLGROUP_NAME/mysqllv</td>
</tr>
<tr>
<td>MOUNT_POINT</td>
<td>/mnt/mysql</td>
</tr>
<tr>
<td>MySQL_ROOT</td>
<td>$MOUNT_POINT/var/lib/mysql</td>
</tr>
</tbody>
</table>

Use the following procedure to create the MySQL cluster resource for the LVM volume group:

1 In iManager, select **Clusters > Cluster Options**, then browse to select the cluster.

2 Under the **Cluster Objects** title, click **New**.

3 On the **New Resource > Resource Type** page, specify **Resource** as the type, then click **Next**.
4 On the New Resource > Cluster Resource Information page, specify a cluster resource name, browse to select the MySQL_Template, then click Next.

Do not select Online Resource after Create. You must configure the resource scripts and settings before bringing the resource online.

5 On the Load Script page, modify the definition fields for your MySQL resource, file system type, volume group name, logical volume name, and mount point, then click Next.

The following load script uses the sample values from the MySQL setup:

```
#!/bin/bash
. /opt/novell/ncs/lib/ncsfuncs

# define the IP address
RESOURCE_IP=10.10.10.44
# define the file system type
MOUNT_FS=ext3
# define the volume group name
VOLGROUP_NAME=mysqlvg
# define the device
MOUNT_DEV=/dev/$VOLGROUP_NAME/mysqllv
# define the mount point
MOUNT_POINT=/mnt/mysql
# define MySQL database root
MySQL_ROOT=$MOUNT_POINT/var/lib/mysql

# activate the volume group
exit_on_error vgchange -a ey $VOLGROUP_NAME

# mount the file system
exit_on_error mount_fs $MOUNT_DEV $MOUNT_POINT $MOUNT_FS

# add the IP address
exit_on_error add_secondary_ipaddress $RESOURCE_IP

# start MySQL
/usr/bin/mysqld_safe --user=mysql --pid-file=$MySQL_ROOT/mysql.pid --socket=$MySQL_ROOT/mysql.sock --datadir=$MySQL_ROOT --bind-address=$RESOURCE_IP &>/dev/null &

# return status
exit 0
```
6 On the Unload Script page, modify the definition fields for your MySQL resource, file system type, volume group name, logical volume name, and mount point, then click Next.

The following unload script uses the sample values from the MySQL setup:

```bash
#!/bin/bash
. /opt/novell/ncs/lib/ncsfuncs

# define the IP address
RESOURCE_IP=10.10.10.44
# define the file system type
MOUNT_FS=ext3
# define the volume group name
VOLGROUP_NAME=mysqlvg
# define the device
MOUNT_DEV=/dev/$VOLGROUP_NAME/mysqllv
# define the mount point
MOUNT_POINT=/mnt/mysql

# define MySQL database root
MySQL_ROOT=$MOUNT_POINT/var/lib/mysql

# request MySQL stop
ignore_error killproc -p $MySQL_ROOT/mysql.pid -TERM /usr/sbin/mysqld

# del the IP address
ignore_error del_secondary_ipaddress $RESOURCE_IP

# umount the file system
sleep 10 # if not using SMS for backup, please comment out this line
exit_on_error umount_fs $MOUNT_DEV $MOUNT_POINT $MOUNT_FS

# deactivate the volume group
exit_on_error vgchange -a n $VOLGROUP_NAME

# return status
exit 0
```

7 On the Monitoring Script page, modify the definition fields for your MySQL resource, file system type, volume group name, logical volume name, and mount point, then click Next.

The following monitoring script uses the sample values from the MySQL setup:

```bash
#!/bin/bash
. /opt/novell/ncs/lib/ncsfuncs

# define the IP address
RESOURCE_IP=10.10.10.44
# define the file system type
MOUNT_FS=ext3
# define the volume group name
VOLGROUP_NAME=mysqlvg
# define the device
MOUNT_DEV=/dev/$VOLGROUP_NAME/mysqllv
# define the mount point
MOUNT_POINT=/mnt/mysql

# define MySQL database root
MySQL_ROOT=$MOUNT_POINT/var/lib/mysql

# check the logical volume
```
exit_on_error status_lv $MOUNT_DEV
#
exit_on_error status_fs $MOUNT_DEV $MOUNT_POINT $MOUNT_FS
#
exit_on_error add_secondary_ipaddress $RESOURCE_IP
#
exit_on_error checkproc -p $MySQL_ROOT/mysql.pid /usr/sbin/mysqld
#
exit 0

8 On the Resource Policies page, specify the Resource Behavior, Start Mode, Failover Mode, and Failback Mode, then click Next.

For information about these fields, see “Configuring the Start, Failover, and Failback Modes for Cluster Resources” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

9 On the Resource Preferred Nodes page, assign the nodes where MySQL is installed, then click Finish.

The resource appears in the Cluster Objects list:

10 Bring the MySQL resource online. Select Clusters > Cluster Manager, select the MySQL resource check box, then click Online.

If the resource goes comatose, offline the resource, then open its properties page and re-verify the scripts.

13.6 File Location

During the MySQL installation, the following files are unpacked or created by YaST:

<table>
<thead>
<tr>
<th>MySQL Component</th>
<th>Default Location in OES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MySQL daemon for start, stop, and restart commands</td>
<td>/etc/init.d/mysql</td>
</tr>
<tr>
<td>Configuration files</td>
<td>/etc/my.cnf</td>
</tr>
<tr>
<td></td>
<td>/etc/mysqlaccess.conf</td>
</tr>
<tr>
<td>Database files</td>
<td>/var/lib/mysql</td>
</tr>
<tr>
<td>Man pages</td>
<td>/usr/share/man/man1</td>
</tr>
<tr>
<td>Documentation (MySQL Readme)</td>
<td>/usr/share/doc/packages/mysql</td>
</tr>
<tr>
<td>Log file</td>
<td>/var/lib/mysql/mysqlld.log</td>
</tr>
</tbody>
</table>

The MySQL log file can also be accessed via a hard link from /var/log/mysqlld.log.
13.7 Security Considerations for the MySQL Configuration

Consider the security measures in this section when working with MySQL.

- Section 13.7.1, “MySQL Ports,” on page 91
- Section 13.7.2, “Securing MySQL,” on page 91

13.7.1 MySQL Ports

MySQL uses port 3306 by default. Additional ports are assigned sequentially as 3307, 3308, and so on. These ports must be open in the firewall in order to allow remote access to the MySQL database.

13.7.2 Securing MySQL

The default installation of MySQL provides some configuration settings, an anonymous user, and the test database that can possibly compromise security in a production environment:

- The root user can connect from the local host or remotely.
- An anonymous user is also created and can connect from the local host or remotely.
- Any local user on the server can connect to the test database without a password and be treated as the anonymous user.
- The anonymous user can perform any function on any databases named test or with a name that begins with test_.
For production servers, we recommend that you secure your MySQL service by setting a password for the MySQL root user. This is a password for the MySQL administrator user, which is a root user within the MySQL system. It is not the Linux root user.

1. To set the password and log in to MySQL on the server, enter the following commands:

   /usr/bin/mysqladmin -u root password <new_password>
   /usr/bin/mysqladmin -u root -h <server_fdn_name> password <new_password>

   For example:

   /usr/bin/mysqladmin -u root password novell
   /usr/bin/mysqladmin -u root -h myserver1.europe.example.com password novell

   Alternatively, you can run the `mysql_secure_installation` command as the Linux root user, complete the fields that make sense for your MySQL configuration, then use:

   /usr/bin/mysql_secure_installation

   We recommend that you configure the following secure settings:

   - Set a password for the MySQL root user.
   - Remove MySQL anonymous users.
   - Disallow remote login for the MySQL root user.
     The MySQL root user is allowed to connect to the database, but only from the local host.
   - Remove the test database.
   - Reload the Privileges table.

### 13.8 Additional Information

The following resources are available to help you manage and use MySQL:


- After you have installed MySQL and the MySQL client on the server, the following man pages are available for MySQL utilities by entering the `man <mysql_utility>` command:

  - `mysql(1)`
  - `mysqladmin(1)`
  - `mysqlbinlog(1)`
  - `mysqlbug(1)`
  - `mysqlcheck(1)`
  - `mysqld_multi(1)`
  - `mysqld_safe(1)`
  - `mysqldump(1)`
  - `mysql_secure_installation(1)`
  - `mysql_fix_extensions(1)`
  - `mysql_fix_privilege_tables(1)`
  - `mysqlimport(1)`
  - `mysql_install_db(1)`
  - `mysqlsecure_installation(1)"
- mysqlshow(1)
- mysqlupgrade(1)
Consider the guidelines in this section when converting Novell Storage Services (NSS) pool cluster resources from NetWare 6.5 SP8 to Open Enterprise Server (OES) 2015 SP1.

- Section 14.1, “NSS Pool Cluster Migration,” on page 95
- Section 14.2, “NSS File System Migration to NCP Volumes or Linux POSIX File Systems,” on page 95
- Section 14.3, “Estimated Time Taken to Build the Trustee File on Linux,” on page 95
- Section 14.4, “Using Antivirus Software for NSS and NCP Volumes on Linux,” on page 96

14.1 NSS Pool Cluster Migration

In the mixed-mode cluster, NSS pool cluster resources created on NetWare can be failed over or cluster migrated to nodes that are running OES where NSS is installed and running.

For information about NSS differences in OES 11 and later, see “NSS Pools (Storage Manager)” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.

Some NSS features are not available or work differently on Linux. See “Cross-Platform Issues for NSS” in the OES 2015 SP1: NSS File System Administration Guide for Linux.

Pool snapshots use different technologies on NetWare and Linux. Pool snapshots are not supported for shared pools on Linux.

IMPORTANT: Ensure that you delete pool snapshots for all clustered pools before you begin the cluster conversion.

14.2 NSS File System Migration to NCP Volumes or Linux POSIX File Systems

To move data from NSS file systems on NetWare to NCP volumes or to Linux POSIX file systems on Linux, you must use the Migration tool. See “Migrating File Systems to OES 2015 SP1” in the OES 2015 SP1: Migration Tool Administration Guide.

14.3 Estimated Time Taken to Build the Trustee File on Linux

On Linux, NCP Server stores file system trustees and rights information in the .NetWare/.trustee_database.xml file at the root of each NSS volume or NCP volume. The NSS file system also stores this information in its file system metadata as it does on NetWare. This database file is updated when you:

- Add file system trustees and rights
- Delete file system trustees and rights
- Modify file system trustees and rights

When you migrate an NSS volume from NetWare to Linux, the trustee database file does not exist. NCP Server reads the trustee and rights information from the NSS file system metadata, validates the User object, and stores the settings in a .NetWare/.trustee_database.xml file at the root of the volume. The information collection process begins automatically when the NSS volume is mounted on the OES server.

Testing found that building the initial database on Linux for an existing volume takes about one minute per 50,000 storage objects. Testing was done on the following configuration for the target server:

HP DL380 G5
2 Quad-Core Intel Xeon CPU E5345 @ 2.33 GHz
12 GB RAM
1 Gigabit NIC
2 HBAs with 4 paths to the EMC DMX Symmetrix Storage with 4 gigabits per second (Gbps) bandwidth

To follow the synchronization between the file system and the trustee file, look for output in the /var/opt/novell/log/ncp2nss.log file.

14.4 Using Antivirus Software for NSS and NCP Volumes on Linux

For information about using antivirus software for NSS volumes and NCP volumes on your OES servers, see “McAfee Antivirus Requires Additional Configuration” in the OES 2015 SP1: Planning and Implementation Guide.
Table A-1 compares the features and capabilities of Novell Cluster Services on Open Enterprise Server (OES) 2015 SP1 and NetWare 6.5 SP8.

**Table A-1  Comparison of Novell Cluster Services for Linux and NetWare**

<table>
<thead>
<tr>
<th>Feature or Capability</th>
<th>Cluster Services for Linux</th>
<th>Cluster Services for NetWare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>OES 2015 SP1</td>
<td>NetWare 6.5 SP8</td>
</tr>
<tr>
<td>Two-node cluster with OES license</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Up to 32 nodes in a single cluster with additional license</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Guest servers on Xen VMs as cluster nodes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Guest servers on KVM VMs as cluster nodes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Guest servers on VMware as cluster nodes</td>
<td>Yes</td>
<td>Yes, where NetWare is supported by the VMware product See <a href="#">OES 2015 SP1 Beta: Novell Cluster Services Implementation Guide for VMware</a>.</td>
</tr>
<tr>
<td>Novell Business Continuity Clustering support</td>
<td>BCC 2.0 for OES 11 SP1</td>
<td>BCC 1.1 SP2 for NetWare 6.5 SP8</td>
</tr>
<tr>
<td>Administrator users</td>
<td>The administrator user whose credentials you provide during the installation is the cluster administrator. The tree administrator user is not automatically given rights. Rights must be granted manually. See “Configuring Additional Administrators” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.</td>
<td>The administrator user whose credentials you provide during the installation is the cluster administrator. For NetWare, rights are automatically extended to the tree administrator user.</td>
</tr>
<tr>
<td>OES Common Proxy User</td>
<td>Supported</td>
<td>Not applicable</td>
</tr>
<tr>
<td>NCS_Management Group</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Preferred list for LDAP servers</td>
<td>Yes; in the /etc/opt/novell/ncs/clstrlib.conf file</td>
<td>No</td>
</tr>
<tr>
<td>Directory-based cluster configuration</td>
<td>Yes; common schema for NetWare and Linux</td>
<td>Yes; common schema for NetWare and Linux</td>
</tr>
<tr>
<td>Feature or Capability</td>
<td>Cluster Services for Linux</td>
<td>Cluster Services for NetWare</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Directory schema extension during the first Novell Cluster Services installation in a</td>
<td>The user who installs the first instance of Novell Cluster Services in a tree must have schema extension rights. The schema extension can be performed separately from the Novell Cluster Services installation by a user with schema extension rights. See “Extending the eDirectory Schema to Add Cluster Objects” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide. Afterwards, any administrator with sufficient rights can install Novell Cluster Services. See “Assigning Install Rights for Container Administrators or Non-Administrator Users” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.</td>
<td>The user who installs the first instance of Novell Cluster Services in a tree must have schema extension rights.</td>
</tr>
<tr>
<td>tree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward migration for Novell Cluster Services</td>
<td><strong>OES 11 SP2 to OES 2015 SP1:</strong> Down cluster and rolling cluster upgrade are supported. See “Upgrading OES 11 Clusters” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>OES 2 SP3 to OES 2015 SP1:</strong> Down cluster and rolling cluster upgrade are supported. Special handling is required for Linux POSIX file system cluster resources. See “Upgrading Clusters from OES 2 SP3 to OES 2015” in the OES 2015 SP1 Beta: Novell Cluster Services for Linux Administration Guide.</td>
<td><strong>NetWare 6.5 SP7 to NetWare 6.5 SP8:</strong> Down cluster and rolling cluster upgrade are supported. <strong>NetWare 6.0 to NetWare 6.5 SP7 or later:</strong> Down cluster and rolling cluster upgrade are supported. <strong>NetWare 5.1 to NetWare 6.5 SP7 or later:</strong> Only the down cluster upgrade is supported.</td>
</tr>
<tr>
<td>Cluster conversion from NetWare to Linux</td>
<td><strong>NetWare 6.5 SP8 to OES 2015 SP1:</strong> Down cluster and rolling cluster conversion are supported. After all nodes have been converted, use the <code>cluster commit</code> command to finalize the conversion.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>mixed-mode Linux and NetWare clusters</td>
<td>Supported only for rolling cluster conversions from NetWare to Linux.</td>
<td>Supported only for rolling cluster conversions from NetWare to Linux.</td>
</tr>
<tr>
<td>Feature or Capability</td>
<td>Cluster Services for Linux</td>
<td>Cluster Services for NetWare</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>SBD (split-brain detector)</td>
<td>Yes; during the install on the first server in the cluster, or by using the sbdutil after the install and before adding a second node to the cluster.</td>
<td>Yes; during the install on the first server in the cluster.</td>
</tr>
<tr>
<td>Mirrored SBD</td>
<td>During the install.</td>
<td>During the install on the first server in the cluster, or by using the sbdutil after the install.</td>
</tr>
<tr>
<td></td>
<td>After the install and before adding a second node to the cluster by using the sbdutil and specifying two devices.</td>
<td>Mirroring an existing SBD by using NLVM.</td>
</tr>
<tr>
<td>Shared disks</td>
<td>Fibre Channel SAN LUNs</td>
<td>Fibre Channel SAN LUNs</td>
</tr>
<tr>
<td></td>
<td>iSCSI SAN LUNs</td>
<td>iSCSI SAN LUNs</td>
</tr>
<tr>
<td></td>
<td>SCSI disks (shared external drive arrays)</td>
<td>SCSI disks (shared external drive arrays)</td>
</tr>
<tr>
<td>Cluster-aware shared devices</td>
<td>Share devices by using NLVM, NSMNU, or the Storage plug-in to iManager.</td>
<td>Share devices by using NSMNU or the Storage plug-in to iManager.</td>
</tr>
<tr>
<td>Requires Novell Storage Services (NSS)</td>
<td>Required to use NLVM and NSMNU to manage devices, and to create NSS pools as cluster resources.</td>
<td>NSS is the default file system on NetWare. Novell Cluster Services is not supported on NetWare traditional volumes.</td>
</tr>
<tr>
<td>Volume manager for NSS pools</td>
<td>Novell Linux Volume Manager NLVM</td>
<td>NetWare Segment Manager</td>
</tr>
<tr>
<td>Volume manager for Linux POSIX file systems</td>
<td>Novell Linux Volume Manager NLVM</td>
<td>NetWare Segment Manager</td>
</tr>
<tr>
<td>Requires NCP (NetWare Core Protocol)</td>
<td>NCP Server is required for all storage resources that use NCP, including NSS pools, NCP volumes, and Dynamic Storage Technology shadow volume pairs.</td>
<td>NCP is the default file access protocol on NetWare.</td>
</tr>
<tr>
<td></td>
<td>NCP is optional for clustered Linux LVM volume groups and volumes.</td>
<td></td>
</tr>
<tr>
<td>Feature or Capability</td>
<td>Cluster Services for Linux</td>
<td>Cluster Services for NetWare</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>NSS pools as cluster resources</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Shareable for Clustering</td>
<td></td>
<td>See &quot;Setting Up Cluster Resources for Novell Cluster Services&quot; in the NW6.5 SP8: Novell Cluster Services 1.8.5 Administration Guide.</td>
</tr>
<tr>
<td>Multiple-Server Activation Prevention (MSAP)</td>
<td></td>
<td>Shareable for Clustering</td>
</tr>
<tr>
<td>Cluster volume broker; Linux kernel module handles NSS pool events.</td>
<td></td>
<td>Multiple-Server Activation Prevention (MSAP)</td>
</tr>
<tr>
<td>Linux POSIX file systems as cluster resources</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Shareable for Clustering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linux POSIX file systems as cluster resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCP volumes on Linux POSIX file systems as cluster resources</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Dynamic Storage Technology shadow volume pairs as cluster resources</td>
<td>Yes; by combining the load and unload scripts for shared NSS pools and managing the pair as a single cluster resource.</td>
<td>Not supported by Dynamic Storage Technology.</td>
</tr>
<tr>
<td>Dynamic Storage Technology shadow volume pairs as cluster resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xen virtual machines as cluster resources</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>iManager</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Clusters plug-in and Storage Management plug-in for iManager</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>My Clusters and My Resources feature of the Clusters plug-in</td>
<td>Yes</td>
<td>Can be used to manage NetWare 6.5 SP8 servers, but cannot be run on NetWare servers.</td>
</tr>
<tr>
<td>Feature or Capability</td>
<td>Cluster Services for Linux</td>
<td>Cluster Services for NetWare</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>----------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Cluster-enabling NSS pools by using the Storage plug-in for iManager</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cluster-enabling NSS pools by using the NSS Management Utility (NSSMU)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Creating cluster enabled NSS pools by using NLVM commands</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Creating cluster enabled LVM volume groups by using NSSMU</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Creating cluster enabled LVM volume groups by using NLVM commands</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Command line interface</td>
<td>Yes; using the terminal console as the root user</td>
<td>Yes; using the terminal console</td>
</tr>
<tr>
<td>XML-based API</td>
<td>Yes; same as NetWare except that it uses the /_adminfs path on Linux.</td>
<td>Yes; same as for Linux except that it uses the _admin volume on NetWare.</td>
</tr>
<tr>
<td>Load, unload, and monitor scripts</td>
<td>Yes</td>
<td>Load and unload scripts; no monitoring</td>
</tr>
<tr>
<td>NCP support for accessing files on shared NSS pools</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>NCP support for accessing files on shared NCP volumes on Linux POSIX file systems</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>NCP support for accessing files on Dynamic Storage Technology volumes made up of two NSS volumes</td>
<td>Yes</td>
<td>DST not available</td>
</tr>
<tr>
<td>Novell AFP support for accessing files on shared NSS pools</td>
<td>Yes; cross-protocol file locking available with NCP and Novell CIFS, or with NCP and Novell Samba</td>
<td>Yes; with cross-protocol file locking</td>
</tr>
<tr>
<td>Novell CIFS support for accessing files on shared NSS pools</td>
<td>Yes; cross-protocol file locking available with NCP and Novell AFP, or with NCP and Novell Samba</td>
<td>Yes; with cross-protocol file locking</td>
</tr>
<tr>
<td>Feature or Capability</td>
<td>Cluster Services for Linux</td>
<td>Cluster Services for NetWare</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Novell CIFS support for accessing files on Dynamic Storage Technology volumes made up of two NSS volumes</td>
<td>Yes; cross-protocol file locking available in NCP</td>
<td>DST not available</td>
</tr>
<tr>
<td>Linux Samba/CIFS support for accessing files on shared NSS pools on Linux</td>
<td>Yes; cross-protocol file locking available in NCP Requires users to be Linux-enabled with Linux User Management. Requires Universal Password.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Linux Samba/CIFS support for accessing files on shared Linux POSIX file systems</td>
<td>Yes Requires users to be enabled with Linux User Management. Requires Universal Password.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Leverage Heartbeat 2 resource agents</td>
<td>Yes</td>
<td>Not applicable</td>
</tr>
<tr>
<td>LAN fault tolerance</td>
<td>Channel bonding See /usr/src/linux/Documentation/bonding.txt</td>
<td>NIC teaming See &quot;NIC Teaming&quot; in the NW 6.5 SP8: TCP/IP Administration Guide</td>
</tr>
<tr>
<td>Cascade failover prevention</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Master node election process</td>
<td>New master election process as described in “Electing a Master Node”.</td>
<td>Old master election process</td>
</tr>
<tr>
<td>Monitor script</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Resource Mutual Exclusion Groups</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>NCS-level monitoring of the NDSD daemon</td>
<td>Yes, OES 11 SP2 or later</td>
<td>No</td>
</tr>
<tr>
<td>STONITH</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>VLAN support</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Comparing Resources Support for Linux and NetWare

Table B-1 compares clustering support for using Novell Cluster Services on Open Enterprise Server 2015 SP1 and on NetWare 6.5 SP8.

NSS pool cluster resources can be cluster migrated from NetWare to Linux as part of a cluster conversion. If the resource contains data only, no additional steps are required. However, clustered services can require special handling. See the OES 2015 SP1 Beta: Novell Cluster Services NetWare to Linux Conversion Guide.

Table B-1 Comparison of Clustering Support for Services on Linux and NetWare

<table>
<thead>
<tr>
<th>Service</th>
<th>NetWare 6.5 SP8</th>
<th>OES 2015</th>
<th>For conversion information, see</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>See “Setting Up for Macintosh” in the NW 6.5 SP8: AFP, CIFS, and NFS (NFAP) Administration Guide.</td>
<td>See “Configuring AFP with Novell Cluster Services for an NSS File System” in the OES 2015 SP1: Novell AFP for Linux Administration Guide.</td>
<td></td>
</tr>
<tr>
<td>Apache Web Server</td>
<td>Yes</td>
<td>Yes; use the standard Apache Web Server for Linux.</td>
<td>See Chapter 6, “Apache HTTP Server,” on page 43.</td>
</tr>
<tr>
<td></td>
<td>See “Apache with Novell Cluster Services” in the NW6.5 SP8: Novell Cluster Services 1.8.5 Resource Configuration Guide.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIFS (Windows File Services)</td>
<td>Yes; Novell CIFS</td>
<td>Yes; Novell CIFS</td>
<td>See Chapter 8, “Novell CIFS,” on page 63.</td>
</tr>
<tr>
<td></td>
<td>See “Setting CIFS for Windows” in the NW 6.5 SP8: AFP, CIFS, and NFS (NFAP) Administration Guide.</td>
<td>See “Configuring CIFS with Novell Cluster Services for an NSS File System” in the OES 2015 SP1: Novell CIFS for Linux Administration Guide.</td>
<td></td>
</tr>
<tr>
<td>DFS (Novell Distributed File Services) Volume location database (VLDB)</td>
<td>Yes</td>
<td>Yes</td>
<td>See Chapter 9, “Novell Distributed File Services VLDB,” on page 65.</td>
</tr>
<tr>
<td></td>
<td>See “Clustering Novell Distributed File Services” in the NW 6.5 SP8: Novell Distributed File Services Administration Guide.</td>
<td>See “Clustering Novell Distributed File Services* in the OES 2015 SP1: Novell Distributed File Services Administration Guide for Linux.</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>NetWare 6.5 SP8</td>
<td>OES 2015</td>
<td>For conversion information, see</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See “Clustering in NetWare 6.5” in the NW 6.5 SP8: Novell DNS/ DHCP Services Administration Guide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See “Configuring DHCP with Novell Cluster Services for the Linux File System” in the OES 2015 SP1 Beta: Novell DNS/ DHCP Services for Linux Administration Guide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNS</td>
<td>Yes</td>
<td>Yes</td>
<td>See Chapter 11, “DNS Server,” on page 69.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See “Creating a Cluster-Enabled DNS Server” in the NW 6.5 SP8: Novell DNS/DHCP Services Administration Guide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See “Configuring DNS with Novell Cluster Services” in the OES 2015 SP1 Beta: Novell DNS/ DHCP Services for Linux Administration Guide.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Storage Technology service</td>
<td>Not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be used in a cluster, but the service is not clustered.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DST runs on each OES node and you set the global server-level parameters to be the same on each one.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>See also Storage, DST shadow volume pairs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eDirectory 8.8x</td>
<td>No</td>
<td>No</td>
<td>eDirectory has its own redundancy built in (multiple replicas) and would not benefit from being clustered.</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exteNd Application Server and MySQL</td>
<td>Yes; NetWare 6.5 SP2 or earlier.</td>
<td>Not available on Linux.</td>
<td>This install option was discontinued beginning in NetWare 6.5 SP3.</td>
</tr>
<tr>
<td></td>
<td>See “Configuring Novell exteNd Application Server and MySQL with Novell Cluster Services” in the NW6.5 SP8: Novell Cluster Services 1.8.5 Resource Configuration Guide.</td>
<td></td>
<td>See also MySQL.</td>
</tr>
<tr>
<td>Service</td>
<td>NetWare 6.5 SP8</td>
<td>OES 2015</td>
<td>For conversion information, see</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------</td>
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<td>--------------------------------</td>
</tr>
<tr>
<td>FTP Server</td>
<td>Yes</td>
<td>No; use the Novell FTP (Pure-FTPd) solution.</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See “Cluster-Enabling NetWare FTP Server” in the NW 6.5 SP8: Novell FTP Administration Guide.</td>
<td></td>
</tr>
<tr>
<td>Identity Manager Bundle Edition</td>
<td>Can be used in a cluster, but is not clustered. Requires Identity Manager 3.5.</td>
<td>Can be used in a cluster, but is not clustered. Requires Identity Manager 4.0.2.</td>
<td>See the Identity Manager 4.0.2 Overview Guide.</td>
</tr>
<tr>
<td>iPrint</td>
<td>Yes</td>
<td>Yes</td>
<td>See Chapter 12, “Novell iPrint,” on page 71.</td>
</tr>
<tr>
<td></td>
<td>See the NW 6.5 SP8: iPrint Administration Guide.</td>
<td>See “Configuring iPrint with Novell Cluster Services” in the OES 2015 SP1: iPrint Linux Administration Guide.</td>
<td></td>
</tr>
<tr>
<td>MySQL</td>
<td>Yes</td>
<td>Yes; use the standard MySQL service for Linux.</td>
<td>See Chapter 13, “MySQL,” on page 77.</td>
</tr>
<tr>
<td></td>
<td>See “Configuring MySQL on Novell Clustering Services” in the NW 6.5 SP8: Novell MySQL Administration Guide.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCP Server</td>
<td>Can be used in a cluster, but is not clustered.</td>
<td>Can be used in a cluster, but is not clustered. NCP Server runs on each server node in the cluster. It should have the same configuration on each node of the cluster.</td>
<td>See also Storage, NCP volumes on Linux POSIX file systems.</td>
</tr>
<tr>
<td>NetStorage</td>
<td>Yes</td>
<td>Yes</td>
<td>No known issues.</td>
</tr>
<tr>
<td>NFS</td>
<td>Yes</td>
<td>No; use the standard Linux solution for NFS.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>See “Cluster-Enabling Native File Access for UNIX” in the NW 6.5 SP8: AFP, CIFS, and NFS (NFAP) Administration Guide.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>NetWare 6.5 SP8</td>
<td>OES 2015</td>
<td>For conversion information, see</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------</td>
<td>----------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Novell iFolder 2.1.x</td>
<td>Yes</td>
<td>Not applicable</td>
<td>iFolder 2.1x is replaced by Novell iFolder 3.9.</td>
</tr>
<tr>
<td>Novell iFolder 3.9</td>
<td>Not applicable</td>
<td>Yes</td>
<td>See “Clustering IFolder Servers with Novell Cluster Services for Linux” in the Novell iFolder 3.9.2 Administration Guide.</td>
</tr>
<tr>
<td>Printing</td>
<td>Yes</td>
<td>Yes</td>
<td>See iPrint.</td>
</tr>
<tr>
<td>Storage, DST shadow volume pairs</td>
<td>Not applicable</td>
<td>Yes</td>
<td>DST shadow volumes are on shared NSS pools that are created separately, then managed in the same load/unload scripts.</td>
</tr>
<tr>
<td>Storage, NCP volumes on Linux POSIX file systems</td>
<td>Not applicable</td>
<td>Yes</td>
<td>The NCP Server service is not clustered; its volumes can be clustered.</td>
</tr>
<tr>
<td>Storage, NetWare Traditional volumes</td>
<td>No</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Storage, NSS pools and volumes</td>
<td>Yes</td>
<td>Yes</td>
<td>See Chapter 14, “Novell Storage Services Pools,” on page 95.</td>
</tr>
<tr>
<td>Tomcat</td>
<td>Yes</td>
<td>Yes; native to Linux</td>
<td>You cannot convert the NetWare Tomcat configuration for a Linux server.</td>
</tr>
</tbody>
</table>

For cross-platform issues, see “Cross-Platform Issues for NSS” in the OES 2015 SP1: NSS File System Administration Guide for Linux.
<table>
<thead>
<tr>
<th>Service</th>
<th>NetWare 6.5 SP8</th>
<th>OES 2015</th>
<th>For conversion information, see</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xen guest servers as nodes in a</td>
<td>Virtualized NetWare nodes can be used in NetWare clusters. Nodes can be any</td>
<td>Virtualized OES nodes can be used in OES clusters. Nodes can be any</td>
<td>See “Configuring Novell Cluster Services in a Virtualization Environment”.</td>
</tr>
<tr>
<td>cluster</td>
<td>combination of virtual and physical servers.</td>
<td>combination of virtual and physical servers.</td>
<td></td>
</tr>
<tr>
<td>Xen virtual machines on the</td>
<td>Not applicable</td>
<td>Yes; use the Xen and XenLive templates.</td>
<td>See “Virtual Machines as Cluster Resources”.</td>
</tr>
<tr>
<td>host server</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware guest servers as nodes</td>
<td>For VMware products that support NetWare, virtualized NetWare nodes can be</td>
<td>Virtualized OES nodes can be used in OES clusters. Nodes can be any</td>
<td></td>
</tr>
<tr>
<td>in a cluster</td>
<td>used in NetWare clusters. Nodes can be any combination of virtual and physical</td>
<td>combination of virtual and physical servers.</td>
<td>See OES 2015 SP1 Beta: Novell Cluster Services Implementation Guide for VMware.</td>
</tr>
<tr>
<td></td>
<td>servers.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>