Serviceguard NFS Toolkit A.11.31.02, A.11.11.06, and A.11.23.05 Administrator's Guide

HP-UX 11i v1, v2, and v3

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1 Overview of Serviceguard NFS

Serviceguard NFS is a tool kit that enables you to use Serviceguard to set up highly available NFS servers.

You must set up a Serviceguard cluster before you can set up Highly Available NFS. For instructions on setting up a Serviceguard cluster, see the *Managing Serviceguard* manual.

Serviceguard NFS is a separately purchased set of configuration files and control script, which you customize for your specific needs. These files, once installed, are located in `/opt/cmcluster/nfs`.

Serviceguard allows you to create high availability clusters of HP 9000 Series 800 computers on HP-UX 11i v1 and HP-UX 11i v2 systems. On HP-UX 11i v3 systems, clusters may comprise of both HP Integrity servers and HP 9000 Series 800 computers. A high availability computer system allows applications to continue in spite of a hardware or software failure. Serviceguard systems protect users from software failures as well as from failure of a system processing unit (SPU) or local area network (LAN) component. In the event that one component fails, the redundant component takes over, and Serviceguard coordinates the transfer between components.

An NFS server is a host that "exports" its local directories (makes them available for client hosts to mount using NFS). On the NFS client, these mounted directories look to users like part of the client's local file system.

With Serviceguard NFS, the NFS server package containing the exported file systems can move to a different node in the cluster in the event of failure. After Serviceguard starts the NFS package on the adoptive node, the NFS file systems are re-exported from the adoptive node with minimum disruption of service to users. The client side hangs until the NFS server package comes up on the adoptive node. When the service returns, the user can continue access to the file. You do not need to restart the client.

Limitations of Serviceguard NFS

The following limitations apply to Serviceguard NFS:

- Applications lose their file locks when an NFS server package moves to a new node. Therefore, any application that uses file locking must reclaim its locks after an NFS server package fails over.

  An application that loses its file lock due to an NFS package failover does not receive any notification. If the server is also an NFS client, it loses the NFS file locks obtained by client-side processes.

NOTE: Beginning with Serviceguard NFS A.11.11.03 and A.11.23.02, you can address this limitation by enabling the File Lock Migration feature (see "Overview of the NFS File Lock Migration Feature" (page 11)).

For HP-UX 11i v2 and 11i v3, the feature functions properly without a patch.

- If a server is configured to use NFS over TCP and the client is the same machine as the server, which results in a loopback NFS mount, the client may hang for about 5 minutes if the package is moved to another node. The solution is to use NFS over UDP between NFS-HA-server cross mounts.
- The `/etc/rmtab`file is not synchronized when an NFS package fails over to the standby node. This is caused by the design of NFS, which does not keep track of the state of the`rmtab`. The man page for `rmtab`contains a warning that it is not always totally accurate, so it is also unreliable in a standard NFS server / NFS client environment.
- AutoFS mounts may fail when mounting file systems exported by an HA-NFS package soon after that package has been restarted. To avoid these mount failures, AutoFS clients should wait at least 60 seconds after an HA-NFS package has started before mounting file systems exported from that package.

NOTE: You cannot use Serviceguard NFS for an NFS diskless cluster server.

Overview of Serviceguard NFS Toolkit A.11.31.02 with Serviceguard A.11.18 and Veritas Cluster File System Support

The Serviceguard NFS Toolkit A.11.31.02 now supports Serviceguard A.11.18, which is configured with Veritas Cluster File System (CFS). The Serviceguard CFS feature enables you to create a file system that can be mounted by all nodes in a cluster environment. By configuring Serviceguard NFS Toolkit to utilize CFS, simultaneous access to files and file systems is expanded to multiple NFS servers. It provides performance improvement and cache coherency.

For detailed information using the Serviceguard NFS Toolkit A.11.31.02 with Serviceguard A.11.18 and CFS support, see *Serviceguard NFS Toolkit Support for Cluster File System* at:

`http://docs.hp.com/en/ha.html#Highly%20Available%20NFS`

The *Serviceguard NFS Toolkit Support for Cluster File System* must be considered as an addendum to this guide.

HP recommends that you use the Serviceguard CFS feature instead of setting up the server-to-server cross-mounting configuration as show in "Example Four - Two Servers with NFS Cross-Mounts" (page 61).

The toolkit provides support for the variable `HA_NFS_SCRIPT_EXTENSION` in the `nfs.cntl` control script. This new variable can be used to modify the name of the NFS

specific control shell script, `hanfs.sh`, which is associated with a package. For example, if you set the `HA_NFS_SCRIPT_EXTENSION` variable to `hapkg` or `hapkg.sh`, then the NFS specific control script executed by the package corresponding to the `nfs.cntl` file is `hanfs.hapkg.sh`. The default name of the shell script for the `HA_NFS_SCRIPT_EXTENSION` variable is `hanfs.sh`.

Limitations

HA Serviceguard NFS Toolkit A.11.31.02 does not support the modular package feature introduced with Serviceguard A.11.18. Support for modular packages is planned for a future Serviceguard NFS Toolkit release.

Overview of the NFS File Lock Migration Feature

Serviceguard NFS introduced the "File Lock Migration" feature beginning with versions A.11.11.03 and A.11.23.02. The detailed information on this feature is as follows:

- Each HA/NFS package designates a unique holding directory located in one of the filesystems associated with the package. In other words, an empty directory is created in one of the filesystems that moves between servers as part of the package. This holding directory is a configurable parameter and must be dedicated to hold the Status Monitor (SM) entries only.
- A new script, `nfs.flm`, periodically (default value is five seconds; you can change this value by modifying the `PROPAGATE_INTERVAL` parameter in the `nfs.flm` script) copies SM entries from the `/var/statmon/sm` directory into the package holding directory. To edit the `nfs.flm` script, see "Editing the File Lock Migration Script (nfs.flm)" (page 34).
- Upon package failover, the holding directory transitions from the primary node to the adoptive node, because it resides in one of the filesystems configured as part of the HA/NFS package.

  Once the holding directory is on the adoptive node, the SM entries residing in the holding directory are copied to the `/var/statmon/sm` directory on the adoptive node. This populates the new server's SM directory with the entries from the primary server.

- After failover, the HA/NFS package IP address is configured on the adoptive node, and `rpc.statd` and `rpc.lockd` are killed and restarted. This killing and restarting of the daemons triggers a crash recovery notification event, whereby `rpc.statd` sends crash notification messages to all the clients listed in the `/var/statmon/sm` directory.

  These crash recovery notification messages contain the relocatable hostname of the HA/NFS package that was previously running on the primary node and is currently running on the adoptive node.

- Any client that holds NFS file locks against files residing in the HA/NFS package (transitioned between servers) sends reclaim requests to the adoptive node (where the exported filesystems currently reside) and reclaims its locks.
- After `rpc.statd` sends the crash recovery notification messages, the SM entries in the package holding directory are removed, and the `nfs.flm` script is started on the adoptive node. The script once again copies each `/var/statmon/sm` file on the HA/NFS server into the holding directory, every five seconds. Each file residing in the `/var/statmon/sm` directory on the adoptive node following the package migration represents a client that either reclaimed its locks after failover or has established new locks after failover.

NOTE: To enable the File Lock Migration feature, you need Serviceguard version A.11.15 or above.

To ensure that the File Lock Migration feature functions properly on HP-UX 11i v1, install NFS General Release and Performance patch, PHNE_26388 (or a superseding patch). For HP-UX 11i v2 and HP-UX 11i v3, the feature functions properly without a patch.

Overview of Serviceguard NFS with Serviceguard A.11.17 Support

Serviceguard NFS Toolkit A.11.23.05 can work with Serviceguard A.11.17. Serviceguard A.11.17 supports Veritas Cluster File System (CFS) which allows a file system to be created that can be mounted by all nodes in a cluster environment. The detailed information of using Serviceguard NFS Toolkit A.11.23.05 with Serviceguard A.11.17 is as follows:

- Serviceguard NFS Toolkit A.11.23.05 supports the new variable `HA_NFS_SCRIPT_EXTENSION`in the control script (`nfs.cntl`). This new variable can be used to modify the name of the NFS specific control shell script (`hanfs.sh`) that is associated with a package.

  For example, if you set the `HA_NFS_SCRIPT_EXTENSION`variable to `hapkg` or`hapkg.sh`, then the NFS specific control script executed by the package corresponding to this `nfs.cntl` file will be `hanfs.hapkg.sh`. The default shell script name for this variable is `hanfs.sh`.

- Serviceguard with Veritas CFS feature integration provides the capability of creating a file system that can be mounted by all nodes in a cluster. The Serviceguard CFS feature provides performance improvement and cache coherency.

  HP recommends that you use the Serviceguard CFS feature instead of setting up server-to-server cross-mounting configuration. To use Serviceguard with the Veritas CFS feature, you need to install Serviceguard version A.11.17. For more information, refer to *Managing Serviceguard, 12th Edition* at the following web site:

  http://docs.hp.com/en/ha.html#Serviceguard

Serviceguard A.11.17 is not available on HP-UX 11i v1 systems, so Serviceguard CFS support is only applicable to HP-UX 11i v2.

Limitations

The following is a list of limitations when using Serviceguard NFS Toolkit A.11.23.05 with Serviceguard A.11.17:

- Serviceguard A.11.17 introduces a new `MULTI_NODE`package type which is not supported by Serviceguard NFS Toolkit. The only supported package type is `FAILOVER.`
- Serviceguard A.11.17 provides a new package configuration file template. The new package configuration file template introduces the following dependency variables:
  - `DEPENDENCY_NAME`
  - `DEPENDENCY_CONDITION`
  - `DEPENDENCY_LOCATION`

  The above parameters are not supported in Serviceguard NFS Toolkit A.11.23.05. By default, these variables are commented out in the `nfs.conf` file.

Supported Configurations

Serviceguard NFS supports the following configurations:

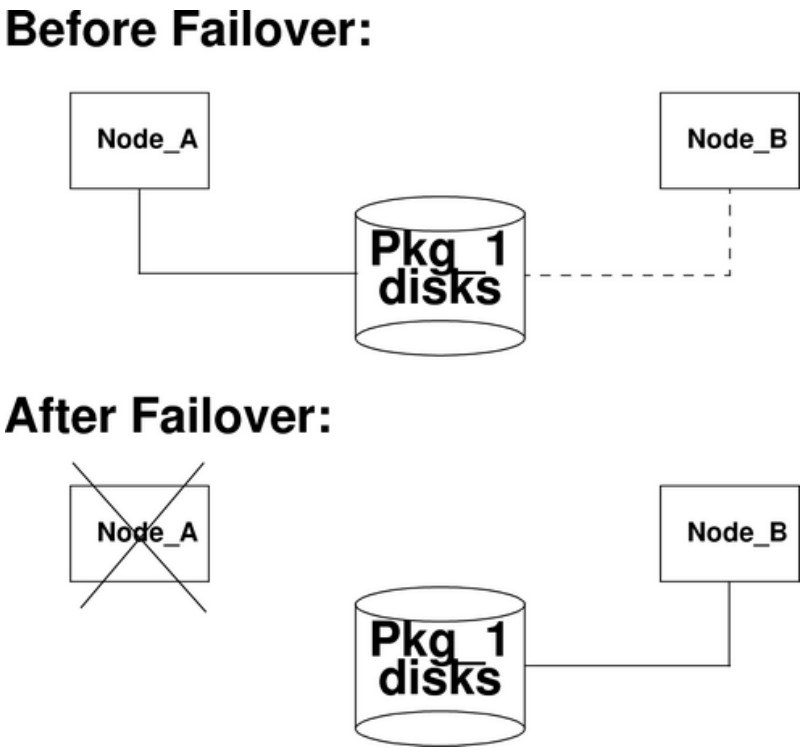
- Simple failover from an active NFS server node to an idle NFS server node.
- Failover from one active NFS server node to another active NFS server node, where the adoptive node supports more than one NFS package after the failover.
- A host configured as an adoptive node for more than one NFS package. The host may also be prevented from adopting more than one failed package at a time.
- Cascading failover, where a package may have up to three adoptive nodes.
- Server-to-server cross mounting, where one server may mount another server's file systems, and the mounts are not interrupted when one server fails.

These configurations are illustrated in the following sections.

Simple Failover to an Idle NFS Server

Figure 1-1 shows a simple failover from an active NFS server node to an idle NFS server node.

Figure 1-1 Simple Failover to an Idle NFS Server

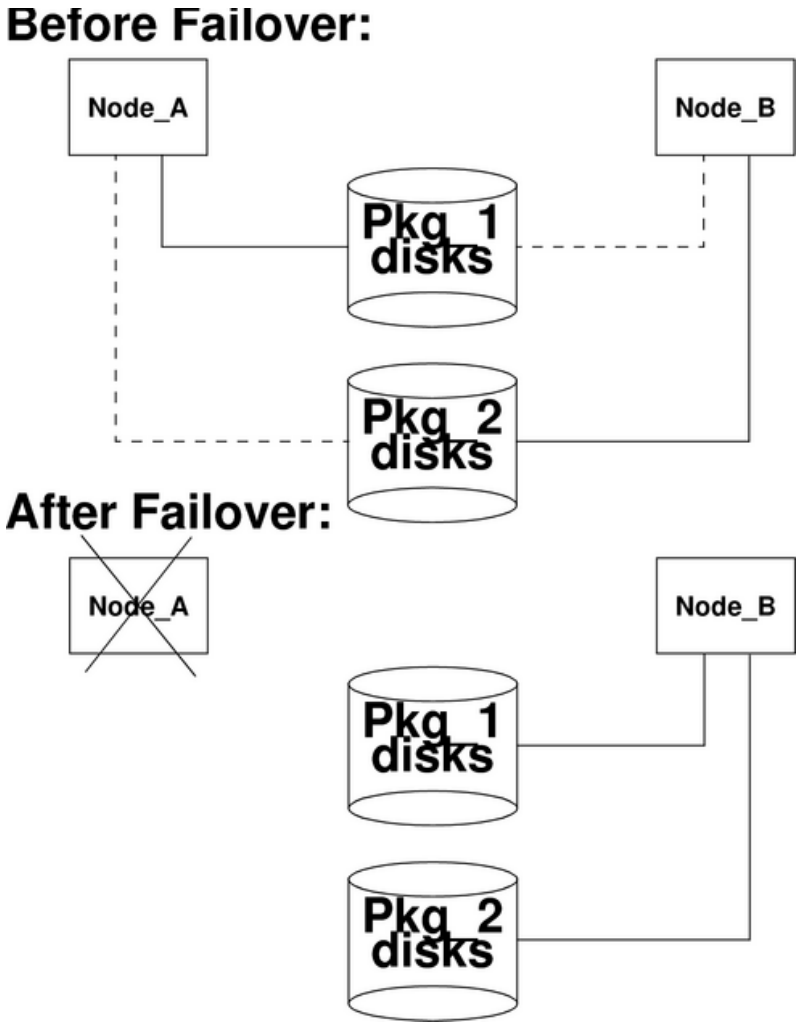


`Node_A` is the primary node for NFS server package `Pkg_1`. When `Node_A` fails, `Node_B` adopts `Pkg_1`. This means that `Node_B` locally mounts the file systems associated with `Pkg_1` and exports them. Both `Node_A` and `Node_B` must have access to the disks that hold the file systems for `Pkg_1`.

Failover from One Active NFS Server to Another

Figure 1-2 shows a failover from one active NFS server node to another active NFS server node.

Figure 1-2 Failover from One Active NFS Server to Another

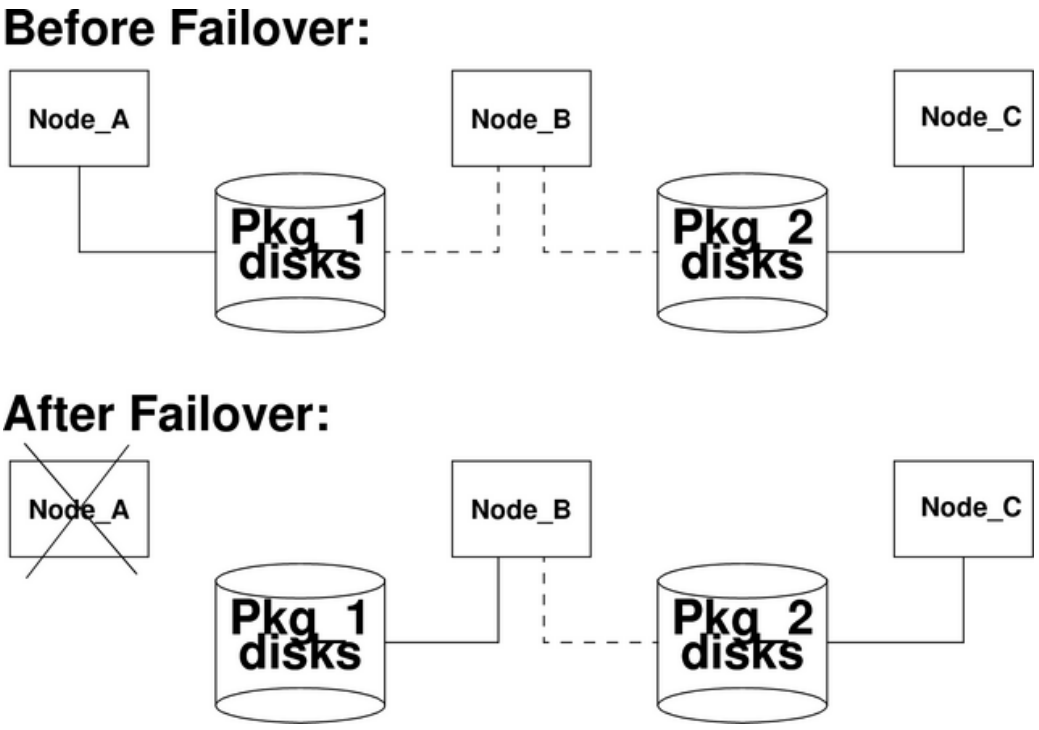


In Figure 1-2, `Node_A` is the primary node for `Pkg_1`, and `Node_B` is the primary node for `Pkg_2`. When `Node_A` fails, `Node_B` adopts `Pkg_1` and becomes the server for both `Pkg_1` and `Pkg_2`.

A Host Configured as Adoptive Node for Multiple Packages

Figure 1-3 shows a three-node configuration where one node is the adoptive node for packages on both of the other nodes. If either `Node_A` or `Node_C` fails, `Node_B` adopts the NFS server package from that node.

Figure 1-3 A Host Configured as Adoptive Node for Multiple Packages

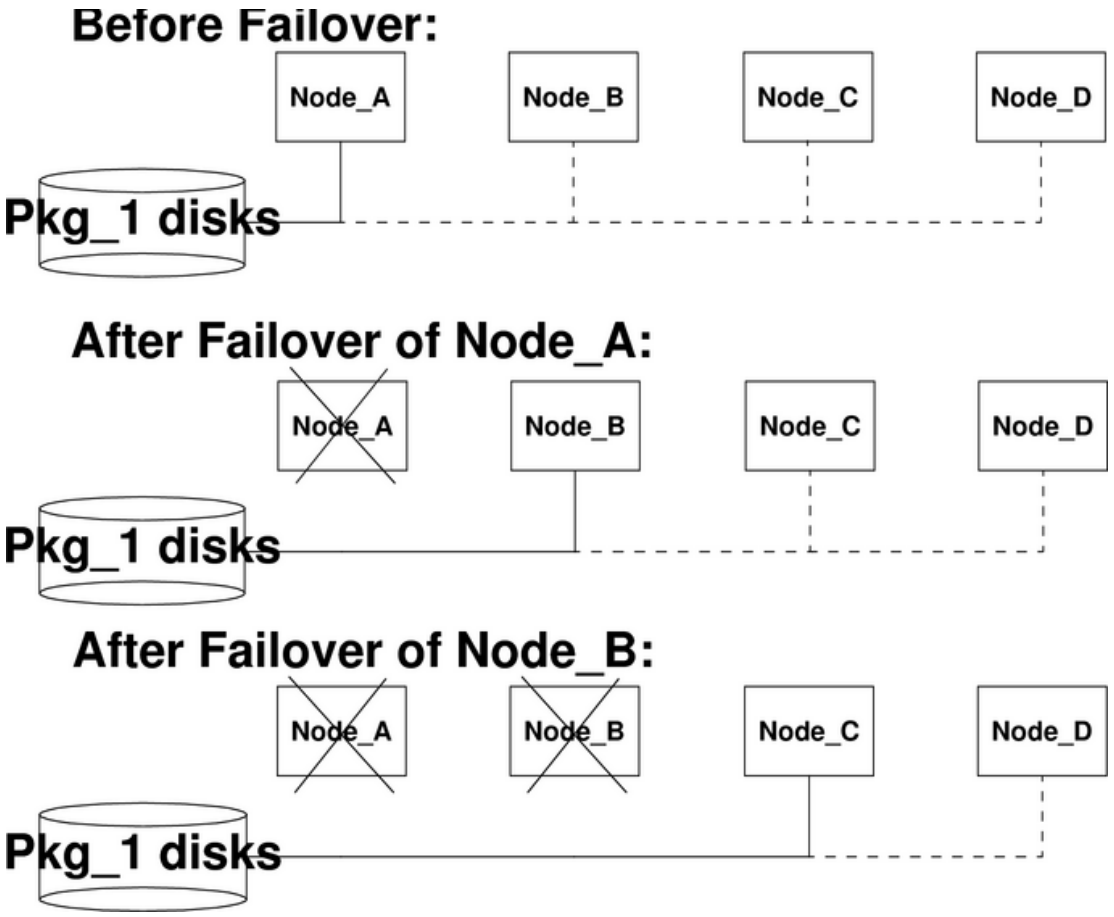


When `Node_A` fails, `Node_B` becomes the server for `Pkg_1`. If `Node_C` fails, `Node_B` will become the server for `Pkg_2`. Alternatively, you can set the package control option in the control script, nfs.cntl, to prevent `Node_B` from adopting more than one package at a time. With the package control option, `Node_B` may adopt the package of the first node that fails, but if the second node fails, `Node_B` will not adopt its package. The package control option prevents a node from becoming overloaded by adopting too many packages. If an adoptive node becomes overloaded, it can fail.

Cascading Failover with Three Adoptive Nodes

A package may be configured with up to three adoptive nodes. Figure 1-4 shows this configuration. If `Node_A` fails, `Pkg_1` is adopted by `Node_B`. However, if `Node_B` is down, `Pkg_1` is adopted by `Node_C`, and if `Node_C` is down, `Pkg_1` is adopted by `Node_D`. The adoptive nodes are listed in the package configuration file, `/etc/cmcluster/nfs/nfs.conf`, in the order in which they will be tried. Note that all four nodes must have access to the disks for the `Pkg_1` file systems.

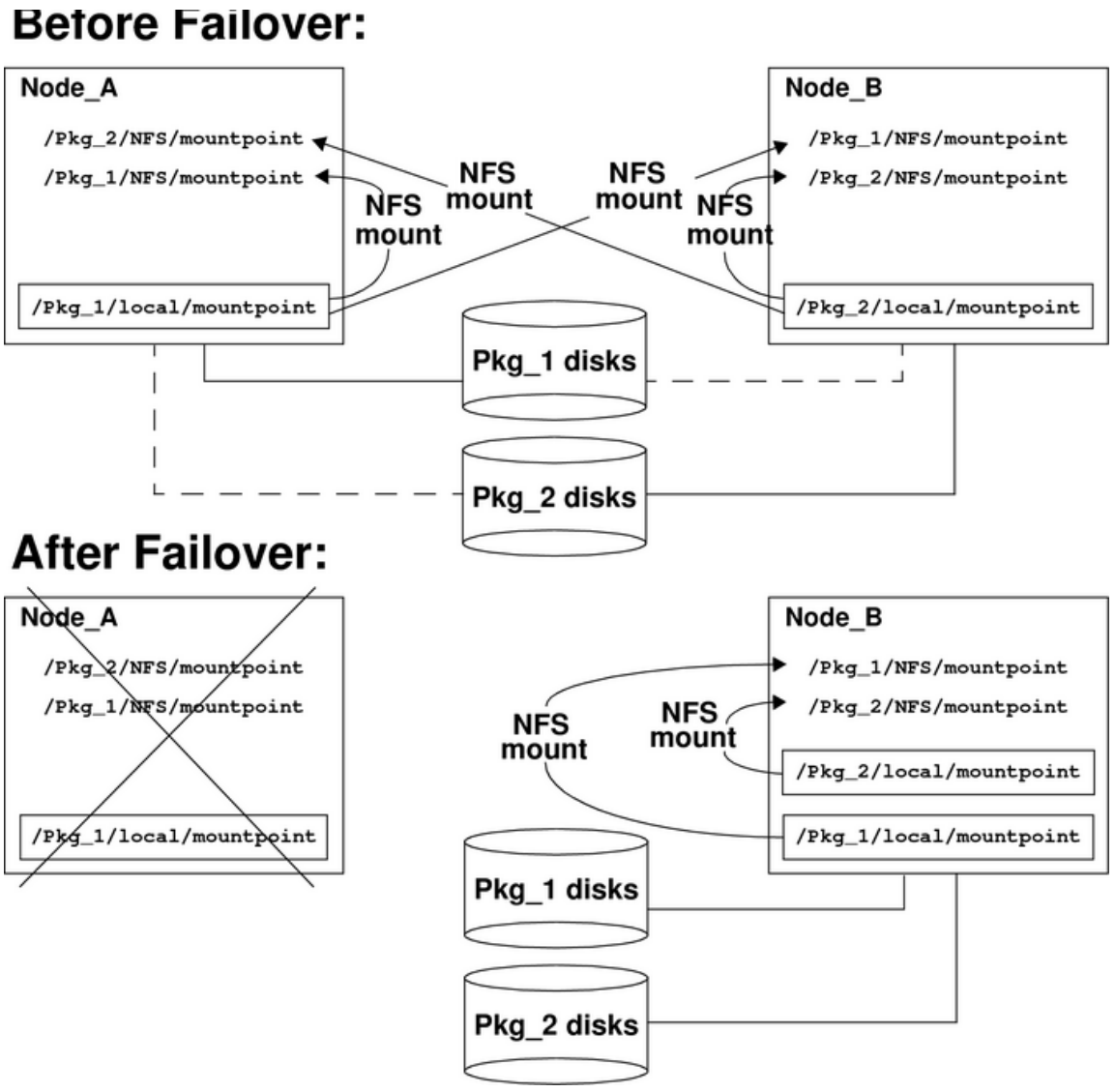
Figure 1-4 Cascading Failover with Three Adoptive Nodes



Server-to-Server Cross Mounting

Two NFS server nodes may NFS-mount each other's file systems and still act as adoptive nodes for each other's NFS server packages. Figure 1-5 illustrates this configuration.

Figure 1-5 Server-to-Server Cross Mounting



The advantage of server-to-server cross-mounting is that every server has an identical view of the file systems. The disadvantage is that, on the node where a file system is locally mounted, the file system is accessed through an NFS mount, which has poorer performance than a local mount.

Each node NFS-mounts the file systems for both packages. If `Node_A` fails, `Node_B` mounts the filesystem for `Pkg_1`, and the NFS mounts are not interrupted.

How the Control and Monitor Scripts Work

As with all Serviceguard packages, the control script starts and stops the NFS package and determines how the package operates when it is available on a particular node. The 11i v1 and 11i v2 control script (`hanfs.sh`) contains three sets of code that operate depending on the parameter - `start`, `stop`, or `file_lock_migration` - with which you call the script. On 11.0, there are two sets of code that you can call with the `start` or `stop` parameter.

Starting the NFS Services

When called with the `start` parameter, the control script does the following:

- Activates the volume group or volume groups associated with the package.
- Mounts each file system associated with the package.
- Initiates the NFS monitor script to check periodically on the health of NFS services, if you have configured your NFS package to use the monitor script.
- Exports each file system associated with the package so that it can later be NFS-mounted by clients.
- Assigns a package IP address to the LAN card on the current node.

After this sequence, the NFS server is active, and clients can NFS-mount the exported file systems associated with the package.

Starting File Lock Migration

If you call the control script with the `file_lock_migration` parameter after enabling the File Lock Migration feature, the control script does the following:

- Populates the `/var/statmon/sm` directory with the Status Monitor entries from the configured holding directory of the package, and subsequently removes the entries from the holding directory.
- Kills any running copy of the NFS File Lock Recovery synchronization script.
- Halts the `rpc.statd` and `rpc.lockd` daemons to release file locks so that file systems can be unmounted. If the server is also an NFS client, it loses the NFS file locks obtained by client-side processes when these daemons are killed.
- Restarts the `rpc.statd` and `rpc.lockd` daemons so that these daemons can manage file locks for other NFS packages running on the server. Restarting these daemons also triggers a crash recovery notification event, whereby `rpc.statd` sends crash notification messages to all clients listed in the `/var/statmon/sm` directory.
- Starts the File Lock Migration synchronization script, which periodically copies the `/var/statmon/sm` directory entries to the holding directory.

Halting the NFS Services

When called with the `stop` parameter, the control script does the following:

- Removes the package IP address from the LAN card on the current node.
- Un-exports all file systems associated with the package so that they can no longer be NFS-mounted by clients.
- Halts the monitor process.
- Halts the File Lock Migration synchronization script if you enable the File Lock Migration feature (available on 11i v1 and 11i v2).
- Halts the `rpc.statd` and `rpc.lockd` daemons to release file locks so that file systems can be unmounted. If the server is also an NFS client, it loses the NFS file locks obtained by client-side processes when these daemons are killed.
- Restarts the `rpc.statd` and `rpc.lockd` daemons so that these daemons can manage file locks for other NFS packages running on the server.
- Unmounts each file system associated with the package.
- Deactivates each volume group associated with the package.

After this sequence, the NFS package is inactive on the current node and may start up on an alternate node or be restarted later on the same node.

Monitoring the NFS Services

The monitor script `/etc/cmcluster/nfs/nfs.mon` works by periodically checking the status of NFS services using the `rpcinfo` command. If any service fails to respond, the script exits, causing a switch to an adoptive node. The monitor script provides the ability to monitor the `rpc.statd`, `rpc.lockd`, `nfsd`, `rpc.mountd`, `rpc.pcnfsd`, and `nfs.flm` processes. You can monitor any or all of these processes as follows:

- To monitor the `rpc.statd`, `rpc.lockd`, and `nfsd` processes, you must set the `NFS_SERVER` variable to 1 in the `/etc/rc.config.d/nfsconf` file. If one `nfsd` process dies or is killed, the package fails over, even if other `nfsd` processes are running.
- To monitor the `rpc.mountd` process, you must set the `START_MOUNTD` variable to 1 in the `/etc/rc.config.d/nfsconf` file. To monitor the `rpc.mountd` process, you must start it when the system boots up, not by `inetd`.
- To monitor the `rpc.pcnfsd` process, you must set the `PCNFS_SERVER` variable to 1 in the `/etc/rc.config.d/nfsconf` file.
- To monitor the `nfs.flm` process, you must enable the File Lock Migration feature. Monitor this process with the `ps` command, not with the `rpcinfo` command. If you enable the File Lock Migration feature, ensure that the monitor script name is unique for each package (for example, `nfs1.mon`).

NOTE: The file name of the`NFS_FLM_SCRIPT` script must be limited to 13 characters or fewer.

NOTE: The`nfs.mon` script uses rpcinfo calls to check the status of various processes. If the rpcbind process is not running, the `rpcinfo` calls time out after 75 seconds. Because 10 `rpcinfo`calls are attempted before failover, it takes approximately 12 minutes to detect the failure. This problem has been fixed in release versions 11.11.04 and 11.23.03.

The default NFS control script, `hanfs.sh`, does not invoke the monitor script. You do not have to run the NFS monitor script to use Serviceguard NFS. If the NFS package configuration file specifies `AUTO_RUN YES` and `LOCAL_LAN_FAILOVER YES` (the defaults), the package switches to the next adoptive node or to a standby network interface in the event of a node or network failure. However, if one of the NFS services goes down while the node and network remain up, you need the NFS monitor script to detect the problem and to switch the package to an adoptive node.

Whenever the monitor script detects an event, it logs the event. Each NFS package has its own log file. This log file is named according to the NFS control script, `nfs.cntl`, by adding a `.log` extension. For example, if your control script is called `/etc/cmcluster/nfs/nfs1.cntl`, the log file is called`/etc/cmcluster/nfs/nfs1.cntl.log`.

TIP: You can specify the number of retry attempts for all these processes in the `nfs.mon` file.

On the Client Side

The client should NFS-mount a file system using the package name in the `mount` command. The package name is associated with the package's relocatable IP address. On client systems, be sure to use a hard mount and set the proper retry values for the mount. Alternatively, set the proper timeout for automounter. The timeout should be greater than the total end-to-end recovery time for the Serviceguard NFS package—that is, running `fsck`, mounting file systems, and exporting file systems on the new node. (With journalled file systems, this time should be between one and two minutes.) Setting the timeout to a value greater than the recovery time allows clients to reconnect to the file system after it returns to the cluster on the new node.

NOTE: AutoFS mounts may fail when mounting file systems exported by an HA-NFS package soon after that package has been restarted.To avoid these mount failures, AutoFS clients should wait at least 60 seconds after an HA-NFS package has started before mounting file systems exported from that package.

2 Installing and Configuring Serviceguard NFS

This chapter explains how to configure Serviceguard NFS. You must set up your Serviceguard cluster before you can configure Serviceguard NFS. For instructions on setting up an Serviceguard cluster, see the *Managing Serviceguard* manual.

This chapter contains the following sections:

Installing Serviceguard NFS

NOTE: Serviceguard NFS Toolkit requires Serviceguard A.11.13 (or above). To enable the File Lock Migration feature (available with 11i v1 and 11i v2), you need Serviceguard A.11.15 or above.

To ensure that the File Lock Migration feature functions properly, install HP-UX 11i v1 NFS General Release and Performance Patch, PHNE_26388 (or a superseding patch). For HP-UX 11i v2, the feature functions properly without a patch.

Use the HP-UX Software Distributor (SD) to install the Serviceguard NFS file set. The following command starts the SD `swinstall` utility:

```
/usr/sbin/swinstall
```

The Software Distributor is documented in *Managing HP-UX Software with SD-UX*.

The files are installed in the `/opt/cmcluster/nfs` directory.

The following files are part of the toolkit:

README	Description of the toolkit contents
hanfs.sh	The NFS specific control script
nfs.mon	The monitor script
nfs_xmnt	A script for handling cross-mounted NFS server packages
nfs.flm	The file lock migration script (available with 11i v1 and 11i v2)

NOTE: If the Serviceguard NFS package has previously been installed, the files are in `/opt/cmcluster/nfs`. Use `swremove` to remove these files before installing the latest version of Serviceguard NFS.

To run the toolkit, you need the following files, which are part of Serviceguard:

nfs.cntl	The control script that runs and halts the package
nfs.conf	The package configuration file

You can create these two files by running the `cmmakepkg` command. Perform the following steps to set up the directory for configuring Serviceguard NFS:

NOTE: You may want to save any existing Serviceguard NFS configuration files before executing these steps.

1. Run the following command to create the package configuration template file:
   ```
   cmmakepkg -p /opt/cmcluster/nfs/nfs.conf
   ```
2. Run the following command to create the package control template file:
   ```
   cmmakepkg -s /opt/cmcluster/nfs/nfs.cntl
   ```
3. Create a directory, `/etc/cmcluster/nfs`.
4. Run the following command to copy the Serviceguard NFS template files to the newly created `/etc/cmcluster/nfs` directory:
   ```
   cp /opt/cmcluster/nfs/* /etc/cmcluster/nfs
   ```

Monitoring NFS/TCP Services with Serviceguard NFS Toolkit

In addition to monitoring NFS/UDP services, you can monitor NFS/TCP services with Serviceguard NFS Toolkit on HP-UX 11.x. For HP-UX 11.0, you need at least Serviceguard NFS Toolkit A.11.00.03 to monitor NFS/TCP services. All versions of Serviceguard NFS Toolkit for HP-UX 11i v1 and v2 can monitor NFS/TCP services.

IMPORTANT: You must enable NFS/TCP on HP-UX 11.0 for both client and server. TCP is the default transport mode on HP-UX 11i v1 and 11i v2 and thus does not need to be enabled on those systems.

Use the following steps to enable NFS/TCP on HP-UX 11.0:

1. Run the configuration command `/usr/sbin/setoncenv NFS_TCP 1`
2. Stop the NFS client with `/sbin/init.d/nfs.client stop`
3. Stop the NFS server with `/sbin/init.d/nfs.server stop`
4. Start the NFS server with `/sbin/init.d/nfs.server start`
5. Start the NFS client with `/sbin/init.d/nfs.client start`

From the NFS client, use the `mount -o proto=tcp` command to establish a TCP only connection. The mount fails if TCP is not available on the NFS server.

From the NFS client, use the `mount -o proto=udp` to command to establish a UDP only connection. The mount fails if UDP is not available on the NFS server.

To verify you are monitoring NFS/TCP services, run `nfsstat -m`. A return of `proto=tcp` means you are monitoring NFS/TCP services. A return of `proto=udp` means you are monitoring NFS/UDP services.

Use the following steps to disable NFS/TCP functionality on HP-UX 11.0:

1. Enter `/usr/sbin/setoncenv NFS_TCP 0` at the command line to sets the NFS_TCP variable in the`/etc/rc.config.d/nfsconf` to 0.
2. Stop the NFS client with `/sbin/init.d/nfs.client stop`
3. Stop the NFS server with `/sbin/init.d/nfs.server stop`
4. Start the NFS server with `/sbin/init.d/nfs.server start`
5. Start the NFS client with `/sbin/init.d/nfs.client start`

After completing the preceding procedure, NFS will establish only UDP connections on HP-UX 11.0.

Before Creating a Serviceguard NFS Package

Before creating a Serviceguard NFS package, perform the following tasks:

1. Set up your Serviceguard cluster according to the instructions in the *Managing Serviceguard* manual.

2. On the primary node and all adoptive nodes for the NFS package, set the `NFS_SERVER` variable to 1 in the `/etc/rc.config.d/nfsconf` file.

```
NFS_SERVER=1
```

Do not configure the exported directories in the `/etc/exports` file. When an NFS server boots up, it attempts to export all file systems in its `/etc/exports` file. If those file systems are not currently present on the NFS server node, the node cannot boot properly. This happens if the server is an adoptive node for a file system, and the file system is available on the server only after failover of the primary node.

3. If your NFS servers must serve PC clients, set the `PCNFS_SERVER` variable to 1 in the `/etc/rc.config.d/nfsconf` file on the primary node and each adoptive node.

```
PCNFS_SERVER=1
```

If you run the NFS monitor script, setting the `PCNFS_SERVER` variable to 1 will cause the monitor script to monitor the `pcnfsd` daemon. Then, if the `pcnfsd` daemon fails, your NFS package will fail over to an adoptive node. If you do not want to monitor `pcnfsd`, do not run the NFS monitor script, or set the `PCNFS_SERVER` variable to 0 and run `pcnfsd` manually from the command line.

4. If your NFS servers will also be NFS clients, set the `START_MOUNTD` variable to 1 in the `/etc/rc.config.d/nfsconf` file on the primary node and each adoptive node.

```
START_MOUNTD=1
```

If you configure `rpc.mountd` in the `/etc/inetd.conf` file, set the `START_MOUNTD` variable to 0. If the `START_MOUNTD` variable is set to 0, the NFS monitor script will not monitor the `rpc.mountd` process. If the `START_MOUNTD`

variable is set to 1, and you run the NFS monitor script, your NFS package will fail over to an adoptive node if `rpc.mountd` fails.

5. On the primary node and all adoptive nodes for the NFS package, set the `NUM_NFSD` variable in the `/etc/rc.config.d/nfsconf` file to the number of `nfsd` daemons required to support all the NFS packages that could run on that node at once. It is better to run too many `nfsd` processes than too few. In general, you should configure a minimum of four `nfsd` processes and at least two `nfsd` processes for each exported file system. So, for example, if a node is the primary node for a package containing two exported file systems, and it is an adoptive node for another package containing three exported file systems, you should configure it to run at least 10 `nfsd` processes.

   ```
   NUM_NFSD=10
   ```

6. Issue the following command on the primary node and all adoptive nodes to start the NFS server processes.

   ```
   /sbin/init.d/nfs.server start
   ```

7. Configure the disk hardware for high availability. Disks must be protected using HP's MirrorDisk/UX product or an HP High Availability Disk Array with PV links. Data disks associated with Serviceguard NFS must be external disks. All the nodes that support the Serviceguard NFS package must have access to the external disks. For most disks, this means that the disks must be attached to a shared bus that is connected to all nodes that support the package. For information on configuring disks, see the *Managing Serviceguard* manual.
8. Use SAM or LVM commands to set up volume groups, logical volumes, and file systems as needed for the data that will be exported to clients.

   The names of the volume groups must be unique within the cluster, and the major and minor numbers associated with the volume groups must be the same on all nodes. In addition, the mounting points and exported file system names must be the same on all nodes.

   The preceding requirements exist because NFS uses the major number, minor number, inode number, and exported directory as part of a file handle to uniquely identify each NFS file. If differences exist between the primary and adoptive nodes, the client's file handle would no longer point to the correct file location after movement of the package to a different node.

   It is recommended that filesystems used for NFS be created as journalled file systems (FStype vxfs). This ensures the fastest recovery time in the event of a package switch to another node.

9. Make sure the user IDs and group IDs of those who access the Serviceguard NFS file system are the same on all nodes that can run the package. Make sure the `/etc/passwd` and `/etc/group` files are the same on the primary node and all

adoptive nodes, or use NIS to manage the passwd and group databases. For information on configuring NIS, see the *NFS Services Administrator's Guide*.

10. Create an entry for the name of the package in the DNS or NIS name resolution files, or in `/etc/hosts`, so that users will mount the exported file systems from the correct node. This entry maps the package name to the package's relocatable IP address.
11. Decide whether to place executables locally on each client or on the NFS server. There are a number of trade-offs to be aware of regarding the location of executables with Serviceguard NFS.

    The advantages of keeping executables local to each client are as follows:

    - No failover time. If the executables are local to the client, there is no delay if the NFS server fails.
    - Faster access to the executables than accessing them through the network.

    The advantage of putting the executables on the NFS server is as follows:

    - Executable management. If the executables are located in one centralized location, the administrator must update only one copy when changes are made.

    If executables are placed on the NFS server, you need to ensure that interrupts are handled correctly in a Serviceguard environment. The client must mount the filesystem using the `nointr` option. This mount option will ensure that the executable continues running correctly on the client after a failover of the server occurs. For example, enter the following command on the NFS client:

    ```
    mount -o nointr relocatable_ip:/usr/src /usr/src
    ```

    where *`relocatable_ip`* is the IP address of the package, and `/usr/src` represents the mount points of the server and the client, respectively.

    Without the `nointr` option, if an interrupt (or a `SIGKILL`, `SIGHUP`, `SIGINT`, `SIGQUIT`, `SIGTERM`, or `SIGALRM` signal) is sent to an executable while the NFS server is failing over, NFS will terminate the executable. This is a standard feature of NFS that allows interrupts such as ^C to kill a "hung" client executable if the NFS server is down. Specifying the `nointr` option resolves this problem. See the `mount_nfs`(1M) man page for more information.

Configuring a Serviceguard NFS Package

To configure a Serviceguard NFS package, complete the following tasks, included in this section:

- "Editing the NFS Monitor Script (nfs.mon)"
- "Editing the Package Configuration File (nfs.conf)"
- "Configuring Server-to-Server Cross-Mounts (Optional)"
- "Creating the Cluster Configuration File and Bringing Up the Cluster"

Copying the Template Files

If you will run only one Serviceguard NFS package in your Serviceguard cluster, you do not have to copy the template files. However, if you will run multiple Serviceguard NFS packages, each package must have its own package configuration file and control script.

NOTE: Serviceguard NFS Toolkit requires Serviceguard A.11.13 (or above). To enable the File Lock Migration feature (available with 11i v1 and 11i v2), you need Serviceguard A.11.15 or above.

To ensure that the File Lock Migration feature functions properly, install HP-UX 11i v1 NFS General Release and Performance Patch, PHNE_26388 (or a superseding patch). For HP-UX 11i v2, the feature functions properly without a patch.

There is an additional NFS specific control script, `hanfs.sh`, which is delivered along with the Serviceguard NFS Toolkit product. All of the NFS specific functions and variables have been extracted from the original Serviceguard package control script to this control script. You must configure this control script, too.

For each Serviceguard NFS package, create a copy of the following scripts with a unique name. For example:

```
cd /etc/cmcluster/nfs
cp nfs.conf nfs1.conf
cp nfs.conf nfs2.conf
cp nfs.cntl nfs1.cntl
cp nfs.cntl nfs2.cntl
cp hanfs.sh hanfs1.sh
cp hanfs.sh hanfs2.sh
cp nfs.flm nfs1.flm
cp nfs.flm nfs2.flm
```

NOTE: The `nfs.flm` script is available on 11i v1 and 11i v2.

Editing the Control Script (nfs.cntl)

The control script, `nfs.cntl`, is different as of the A.11.11.02 and A.11.00.05 releases. For Serviceguard NFS Toolkit A.11.00.04 or lower for HP-UX 11.0 or Serviceguard NFS Toolkit A.11.11.01 or lower for HP-UX 11i v1 using Serviceguard A.11.09 (or below) framework, see "Editing nfs.cntl for NFS Toolkit A.11.00.04 and A.11.11.01 (or lower)" (page 30) to edit the control script, `nfs.cntl`.

Editing nfs.cntl for NFS Toolkit A.11.00.05, A.11.11.02 (or above) and A.11.23.01 (or above)

Starting with Serviceguard A.11.13, a package can have LVM volume groups, CVM disk groups and VxVM disk groups.

Example steps:

1. Create a separate`VG[n]` variable for each LVM volume group that is used by the package:

   ```
   VG[0]=/dev/vg01 VG[1]=/dev/vg02 ...
   ```

2. Create a separate `VXVM_DG[n]` variable for each VxVM disk group that is used by the package:

   ```
   VXVM_DG[0]=dg01 VXVM_DG[1]=dg02 ...
   ```

3. Create a separate `LV[n]` and `FS[n]` variable for each volume group/disk group and file system that will be mounted on the server:

   For the LVM example, if this package uses the file systems pkg1a and pkg1b, which are mounted on the logical volumes lvol1 and lvol2 with read and write options enter:

   ```
   LV[0]=/dev/vg01/lvol1; FS[0]=/pkg1a; FS_MOUNT_OPT[0]="-o rw"
   LV[1]=/dev/vg01/lvol2; FS[1]=/pkg1b; FS_MOUNT_OPT[1]="-o rw"
   ```

   For the VxVM example, if this package uses the file systems pkg1a and pkg1b, which are mounted on the volumes lvol1 and lvol2 with read and write options enter:

   ```
   LV[0]="/dev/vx/dsk/dg01/vol01"; FS[0]="/pkg1a"; FS_MOUNT_OPT[0]="-o rw"
   LV[1]="/dev/vx/dsk/dg01/vol02"; FS[1]="/pkg1b"; FS_MOUNT_OPT[1]="-o rw"
   ```

4. Specify the IP address for the package and the address of the subnet to which the IP address belongs:

   ```
   IP[0]=15.13.114.243 SUBNET[0]=15.13.112.0
   ```

   The IP address you specify is the relocatable IP address for the package. NFS clients that mount the file systems in the package will use this IP address to identify the server. You should configure a name for this address in the DNS or NIS database, or in the /etc/hosts file.

5. Serviceguard NFS Toolkit A.11.23.05 supports the new variable `HA_NFS_SCRIPT_EXTENSION`in the control script (`nfs.cntl`). This new variable can be used to modify the name of the NFS specific control shell script (`hanfs.sh`) that is associated with a package.

   For example, if you set the `HA_NFS_SCRIPT_EXTENSION`variable to `hapkg` or`hapkg.sh`, then the NFS specific control script executed by the package

corresponding to this `nfs.cntl` file will be `hanfs.hapkg.sh`. The default shell script name for this variable is `hanfs.sh`.

6. If two packages have the same adoptive node, and you want to prevent the adoptive node from adopting both packages at once, specify the `cmmodpkg` command with the package control option (`-d`) in the `customer_defined_run_cmds`:

```
function customer_defined_run_cmds
{
  cmmodpkg -d -n 'hostname' pkg02 &
}
```

The package control option can prevent an adoptive node from becoming overloaded when multiple packages fail over. If an adoptive node becomes overloaded, it can fail.

In this example, if a host is an adoptive node for both `pkg01` and `pkg02`, the above `cmmodpkg -d` command, in the control script for `pkg01`, would prevent the host that is running `pkg01` from adopting `pkg02`. A similar line in the control script for `pkg02` could prevent the host that is running `pkg02` from adopting `pkg01`. The ampersand (&) causes the `cmmodpkg` command to run in the background. It must run in the background to allow the control script to finish bringing up the package. The `cmmodpkg` command will hang until the package is up, so it must run in the background to allow the control script to complete.

There is a short time, after one package has failed over but before the `cmmodpkg` command has executed, when the other package can fail over and the host will adopt it. In other words, if two packages fail over at approximately the same time, a host may adopt both packages, even though the package control option is specified.

See "Example Two - One Adoptive Node for Two Packages with File Lock Migration" (page 48) for a sample configuration using the package control option.

NOTE: The NFS specific variables have been moved to NFS specific control script in Serviceguard NFS Toolkit with the A.11.11.02 and A.11.00.05 releases. See section "Editing the NFS Control Script (hanfs.sh) " (page 32) for the details.

Editing nfs.cntl for NFS Toolkit A.11.00.04 and A.11.11.01 (or lower)

For Serviceguard NFS Toolkit A.11.00.04 or lower for HP-UX 11.0 or Serviceguard NFS Toolkit A.11.11.01 or lower for HP-UX 11i v1 using Serviceguard A.11.09 (or below) framework.

Example steps:

1. Create a separate `VG[n]` variable for each volume group.

```
VG[0]=/dev/vg01 VG[1]=/dev/vg02 ...
```

2. Create a separate `LV[n]` and `FS[n]` variable for each volume group and file system that will be mounted on the server:.

```
LV[0]=/dev/vg01/lvol1;FS[0]=/ha_root
LV[1]=/dev/vg01/lvol2;FS[1]=/users/scaf
LV[2]=/dev/vg02/lvol1;FS[2]=/ha_data
```

3. Create a separate `XFS[n]` variable for each NFS directory to be exported. Specify the directory name and any export options.

   ```
   XFS[0]="/ha_root" XFS[1]="/users/scaf" XFS[2]="-o ro /ha_data"
   ```

   Do not configure these exported directories in the `/etc/exports` file. When an NFS server boots up, it attempts to export all file systems in its `/etc/exports` file. If those file systems are not currently present on the NFS server node, the node cannot boot properly. This happens if the server is an adoptive node for a file system, and the file system is available on the server only after failover of the primary node.

4. Specify the IP address for the package and the address of the subnet to which the IP address belongs.

   ```
   IP[0]=15.13.114.243 SUBNET[0]=15.13.112.0
   ```

   The IP address you specify is the relocatable IP address for the package. NFS clients that mount the file systems in the package will use this IP address to identify the server. You should configure a name for this address in the DNS or NIS database, or in the `/etc/hosts` file.

5. If you want to run the NFS monitor script , set the `NFS_SERVICE_NAME` variable to the value of the `SERVICE_NAME` variable in the package configuration file. Each package must have a unique service name.

   ```
   NFS_SERVICE_NAME[0]=nfs1.monitor
   ```

   If you do not want to run the NFS monitor script, comment out the `NFS_SERVICE_NAME` and `NFS_SERVICE_CMD` variables:

   ```
   # NFS_SERVICE_NAME[0]=nfs.monitor
   # NFS_SERVICE_CMD[0]=/etc/cmcluster/nfs/nfs.mon
   ```

   By default, the `NFS_SERVICE_NAME` and `NFS_SERVICE_CMD` variables are commented out, and the NFS monitor script is not run.

   You do not have to run the NFS monitor script. If your NFS package configuration file specifies `PKG_SWITCHING_ENABLED YES` and `NET_SWITCHING_ENABLED YES` (the defaults), the package will switch to the next adoptive node or to a standby network interface in the event of a node or network failure. The NFS monitor script causes the package failover if any of the monitored NFS services fails.

6. If you run the NFS monitor script, set the `NFS_SERVICE_CMD` variable to the full path name of the NFS monitor script.

   ```
   NFS_SERVICE_CMD[0]=/etc/cmcluster/nfs/nfs.mon
   ```

   The path name for the executable script does not have to be unique to each package. Every package can use the same script. Multiple instances of the monitor script

can run on the same node without any problems, and if a package fails over, only the instance associated with that package is killed.

If you do not want to run the NFS monitor script, comment out the NFS_SERVICE_NAME and NFS_SERVICE_CMD variables:

```
# NFS_SERVICE_NAME[0]=nfs.monitor
# NFS_SERVICE_CMD[0]=/etc/cmcluster/nfs/nfs.mon
```

By default, the NFS_SERVICE_NAME and NFS_SERVICE_CMD variables are commented out, and the NFS monitor script is not run.

7. If two packages have the same adoptive node, and you want to prevent the adoptive node from adopting both packages at once, specify the cmmodpkg command with the package control option (-d) in the customer_defined_run_cmds.

```
function customer_defined_run_cmds
{
     cmmodpkg -d -n `hostname` pkg02 &
}
```

The package control option can prevent an adoptive node from becoming overloaded when multiple packages fail over. If an adoptive node becomes overloaded, it can fail.

In this example, if a host is an adoptive node for both pkg01 and pkg02, the above cmmodpkg -d command, in the control script for pkg01, would prevent the host that is running pkg01 from adopting pkg02. A similar line in the control script for pkg02 could prevent the host that is running pkg02 from adopting pkg01. The ampersand (&) causes the cmmodpkg command to run in the background. It must run in the background to allow the control script to finish bringing up the package. The cmmodpkg command will hang until the package is up, so it must run in the background to allow the control script to complete.

There is a short time, after one package has failed over but before the cmmodpkg command has executed, when the other package can fail over and the host will adopt it. In other words, if two packages fail over at approximately the same time, a host may adopt both packages, even though the package control option is specified.

See "Example Two - One Adoptive Node for Two Packages with File Lock Migration" (page 48) for a sample configuration using the package control option.

Editing the NFS Control Script (hanfs.sh)

The hanfs.sh control script contains NFS specific control variables and functions. The sample steps are as follows:

1. Create a separate XFS[*n*] variable for each NFS directory to be exported. Specify the directory name and any export options. The directories must be defined in the above mounted file system FS list.

```
XFS[0]="-o ro /pkg1a" XFS[1]="-o rw /pkg1b"
```

Do not configure these exported directories in the /etc/exports file. When an NFS server boots up, it attempts to export all file systems in its /etc/exports file. If those file systems are not currently present on the NFS server node, the node cannot boot properly. This happens if the server is an adoptive node for a file system, and the file system is available on the server only after failover of the primary node.

2. If you wish to monitor NFS services (by running the NFS monitor script), set the NFS_SERVICE_NAME and NFS_SERVICE_CMD variables; see the following example:

```
NFS_SERVICE_NAME[0]=nfs1.monitor
NFS_SERVICE_CMD[0]=/etc/cmcluster/nfs/nfs.mon
```

If you enable the File Lock Migration feature, ensure that the monitor script name is unique for each package (for example, nfs1.mon). If the File Lock Migration feature is disabled, the monitor script name does not have to be unique to each package (for example, nfs.mon). Multiple instances of the monitor script can run on the same node without any problem. If a package fails over, only the instance associated with that package is killed.

3. You do not have to run the NFS monitor script. If your NFS package configuration file specifies AUTO_RUN YES and LOCAL_LAN_FAILOVER_ALLOWED YES (the defaults), the package switches to the next adoptive node or to a standby network interface in the event of a node or network failure. The NFS monitor script causes the package failover if any of the monitored NFS services fails.

If you do not want to run the NFS monitor script, comment out the NFS_SERVICE_NAME and NFS_SERVICE_CMD variables:

```
# NFS_SERVICE_NAME[0]=nfs.monitor
# NFS_SERVICE_CMD[0]=/etc/cmcluster/nfs/nfs.mon
```

By default, the NFS_SERVICE_NAME and NFS_SERVICE_CMD variables are commented out, and the NFS monitor script is not run.

NOTE: The Serviceguard A.11.13 configuration file includes the following changes:

- AUTO_RUN replaces obsolete PKG_SWITCHING_ENABLED.
- LOCAL_LAN_FAILOVER_ALLOWED replaces obsolete NET_SWITCHING_ENABLED.

---

4. To enable File Lock Migration (available on 11i v1 and 11i v2), set the NFS_FILE_LOCK_MIGRATION variable to 1:

```
NFS_FILE_LOCK_MIGRATION=1
```

By default, this variable is set to 0 (disabled). The NFS_FLM_SCRIPT variable is the name of the script that manages synchronization of the file lock status entries for the primary and adoptive nodes associated with this HA/NFS package. By

default, this is set to `nfs.flm`. You must assign a unique name to this script in every HA/NFS package in the cluster (for example, nfs1.flm, nfs2.flm, and so on):

```
NFS_FLM_SCRIPT="${0%/*}/nfs1.flm"
```

If you wish to monitor the File Lock Migration script, then you must also set the `NFS_FILE_LOCK_MIGRATION` and `NFS_FLM_SCRIPT` variables in the NFS monitor script.

If you enable File Lock Migration, then you can configure the File Lock Migration script (see "Editing the File Lock Migration Script (nfs.flm)" (page 34)).

NOTE: The file name of the`NFS_FLM_SCRIPT` script must be limited to 13 characters or fewer.

Editing the File Lock Migration Script (nfs.flm)

The File Lock Migration script, `nfs.flm`, handles the majority of the work involved in maintaining file lock integrity that follows an HA/NFS failover. The `nfs.flm` script includes the following configurable parameters:

- **`NFS_FLM_HOLDING_DIR`** - Name of a unique directory created in one of the shared volumes associated with this package. This directory holds copies of the `/var/statmon/sm` files for this package. You must create this directory in one of the shared volumes associated with this package so that it can migrate with the package (from the primary server to the adoptive server).

  You must dedicate this directory for holding SM entries only. In addition, you must keep it empty. This directory should not have other files or subdirectories when starting the cluster. All files in this directory are deleted after a failover.

  An example for this parameter is as follows:

  ```
  NFS_FLM_HOLDING_DIR="/pkg1a/sm"
  ```

- **`PROPAGATE_INTERVAL`** - Number of seconds between the attempts of the script to copy files from the `/var/statmon/sm` directory into the holding directory, specified by `NFS_FLM_HOLDING_DIR`. The default value of this parameter is five seconds.

  An example for this parameter is as follows:

  ```
  PROPAGATE_INTERVAL=5
  ```

NOTE: If you enable the File Lock Migration feature, an NFS client (or group of clients) may hit a corner case of requesting a file lock on the HA/NFS server and not receiving a crash recovery notification message when the HA/NFS package migrates to an adoptive node. This occurs only when the NFS client sends its initial lock request to the HA/NFS server and then the HA/NFS package moves to an adoptive node before the FLM script copies the `/var/statmon/sm` entry for this client to the package holding directory.

The probability of hitting this corner-case problem is not very high, because the SM file copy interval is very short (by default, five seconds). The chances of an NFS client (or group of NFS clients) sending its initial lock request (it must be the initial request, since this request generates the `/var/statmon/sm` file) to the HA/NFS server and having the package migrate within this same five seconds window are extremely unlikely.

If you repeatedly experience a problem with this corner-case scenario, reduce the copy time interval by setting the `PROPAGATE_INTERVAL` parameter to a lower value.

Editing the NFS Monitor Script (nfs.mon)

The NFS monitor script, `nfs.mon`, contains NFS-specific monitor variables and functions. The `nfs.mon` script is an optional component of HA/NFS. The `hanfs.sh` file specifies whether the NFS monitor script is used. The following steps describe how to configure the NFS monitor script:

1. To monitor the File Lock Migration script (`nfs.flm`), set the `NFS_FILE_LOCK_MIGRATION` variable to 1, and set the `NFS_FLM_SCRIPT` name to match the `hanfs.sh` script value for this variable:

   ```
   NFS_FILE_LOCK_MIGRATION=1 NFS_FLM_SCRIPT="${0%/*}nfs1.flm"
   ```

NOTE: The file name of the`NFS_FLM_SCRIPT` script must be limited to 13 characters or fewer.

NOTE: The nfs.mon script uses rpcinfo calls to check the status of various processes. If the rpcbind process is not running, the rpcinfo calls time out after 75 seconds. Because 10 rpcinfo calls are attempted before failover, it takes approximately 12 minutes to detect the failure. This problem has been fixed in release version 11.11.04 and 11.23.03.

2. You can call the `nfs.mon` script with the following optional arguments:
   - **Interval** - the time (in seconds) between the attempts for checking if NFS processes are up and running. The default is 10 seconds.
   - **Lockd Retry** - the number of attempts to ping `rpc.lockd` before exiting. The default is 4 attempts.
   - **Retry** - the number of attempts to ping the `rpc.statd`, `rpc.mountd`, `nfsd`, `rpc.pcnfsd`, and `nfs.flm` processes before exiting. The default is 4 attempts.
   - **Portmap Retry** - the number of attempts to ping the `rpcbind`process before exiting. The default is 4 attempts.

   These arguments are passed using the `NFS_SERVICE_CMD` line in the `hanfs.sh` file. In order to set these optional arguments, all of the preceding arguments must also be specified in the `NFS_SERVICE_CMD` line.

Editing the Package Configuration File (nfs.conf)

1. Serviceguard A.11.17 provides a new package configuration file template. The new package configuration file template introduces the following dependency variables:
   - `DEPENDENCY_NAME`
   - `DEPENDENCY_CONDITION`
   - `DEPENDENCY_LOCATION`

   The above parameters are not supported in Serviceguard NFS Toolkit A.11.23.05. By default, these variables are commented out in the `nfs.conf` file.

2. Set the `PACKAGE_NAME` variable.

   ```
   PACKAGE_NAME pkg01
   ```

   You can use the default package name if you will run only one Serviceguard NFS package on your Serviceguard cluster. Each package must have a unique name.

3. Create a `NODE_NAME` variable for each node that will run the package. The first `NODE_NAME` should specify the primary node. All the `NODE_NAME` variables following the primary node should specify the adoptive nodes, in the order in which they will be tried.

```
NODE_NAME thyme  NODE_NAME basil NODE_NAME sage
```

4. Set the `RUN_SCRIPT` and `HALT_SCRIPT` variables to the full path name of the control script (`/etc/cmcluster/nfs/nfs.cntl` or whatever you have renamed it). You do not have to specify a timeout for either script.

   ```
   RUN_SCRIPT /etc/cmcluster/nfs/nfs1.cntl
   RUN_SCRIPT_TIMEOUT NO_TIMEOUT
   HALT_SCRIPT /etc/cmcluster/nfs/nfs1.cntl
   HALT_SCRIPT_TIMEOUT NO_TIMEOUT
   ```

5. If you want to run the NFS monitor script, set the `SERVICE_NAME` variable to indicate the NFS monitor script:

   ```
   SERVICE_NAME nfs1.monitor
   ```

   Each package must have a unique service name. The `SERVICE_NAME` variable in the package configuration file must match the `NFS_SERVICE_NAME` variable in the NFS control script.

   If you do not want to run the NFS monitor script, comment out the `SERVICE_NAME` variable:

   ```
   # SERVICE_NAME nfs.monitor
   ```

6. Set the `SUBNET` variable to the subnet that will be monitored for the package.

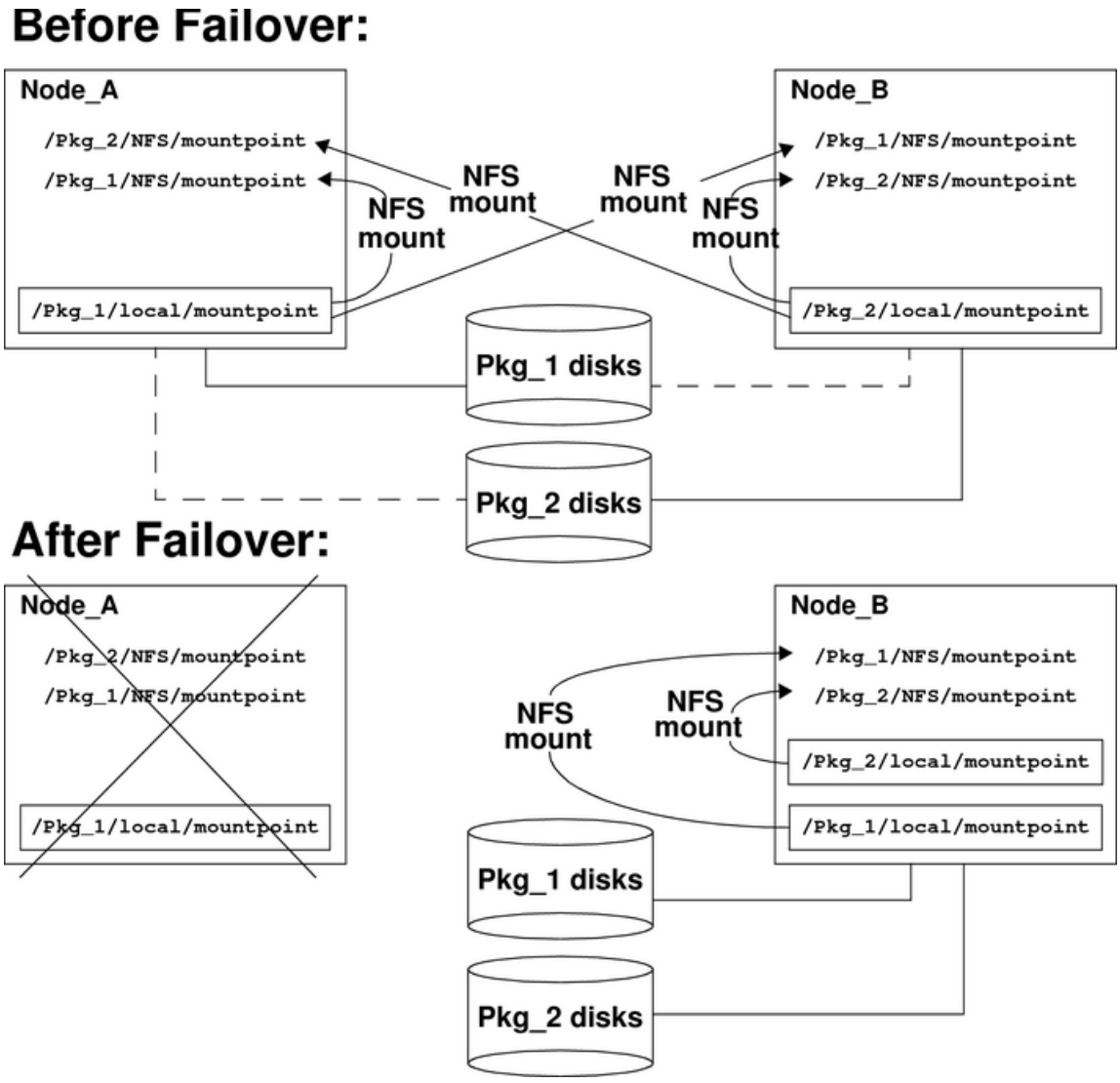
   ```
   SUBNET 15.13.112.0
   ```

You can use the default values for the rest of the variables in the package configuration file, or you can change them as needed. For instructions on modifying the default values, see the *Managing Serviceguard* manual, or read the comments in the `/opt/cmcluster/nfs/nfs.conf` template file.

Configuring Server-to-Server Cross-Mounts (Optional)

Two NFS server nodes may NFS-mount each other's file systems and still act as adoptive nodes for each other's NFS server packages. Figure 2-1 illustrates this configuration.

Figure 2-1 Server-to-Server Cross-Mounting



The advantage of server-to-server cross-mounting is that every server has an identical view of the file systems. The disadvantage is that, on the node where a file system is locally mounted, the file system is accessed through an NFS mount, which has poorer performance than a local mount.

In order to make a Serviceguard file system available to all servers, all servers must NFS-mount the file system. That way, access to the file system is not interrupted when the package fails over to an adoptive node. An adoptive node cannot access the file system through the local mount, because it would have to unmount the NFS-mounted

file system before it could mount it locally. And in order to unmount the NFS-mounted file system, it would have to kill all processes using the file system.

Follow these steps to set up an NFS package with file systems that are NFS-mounted by Serviceguard NFS servers:

1. Make a copy of the `/etc/cmcluster/nfs/nfs_xmnt` script.

   ```
   cd /etc/cmcluster/nfs cp nfs_xmnt nfs1_xmnt
   ```

2. In the copy of the `nfs_xmnt` script, create an `SNFS[n]` and `CNFS[n]` variable for each file system in the package that will be NFS-mounted by servers. The `SNFS[n]` variable is the server location of the file system, and the `CNFS[n]` variable is the client mount point of the file system.

   ```
   SNFS[0]="nfs1:/hanfs/nfsu011";CNFS[0]="/nfs/nfsu011"
   ```

   In this example, "`nfs1`" is the name that maps to the package's relocatable IP address. It must be configured in the name service used by the server (DNS, NIS, or the `/etc/hosts` file).

   If a server for the package will NFS-mount the package's file systems, the client mount point (`CNFS`) *must* be different from the server location (`SNFS`).

3. Copy the script you have just modified to all the servers that will NFS-mount the file systems in the package.
4. After the package is active on the primary node, execute the `nfs_xmnt` script on each server that will NFS-mount the file systems.

   ```
   /etc/cmcluster/nfs/nfs1_xmnt start
   ```

   Hewlett-Packard recommends that you execute the `nfs_xmnt` script from the command line after the package is active on the primary node. However, you can configure the `nfs_xmnt` script to be executed by the NFS control script in the `customer_defined_run_cmds` function.

   ```
   function customer_defined_run_cmds
   {
     /etc/cmcluster/nfs/nfs1_xmnt start
     remsh sage /etc/cmcluster/nfs/nfs1_xmnt start
   }
   ```

   The second line in the function invokes `remsh` to run the `nfs_xmnt` script on remote host `sage`.

   Running the `nfs_xmnt` script from the NFS control script guarantees that the package is active before the `mount` command executes. It prevents cross-mounted servers from becoming deadlocked while each server hangs on the `mount` command, waiting for the other server's package to become active. However, if the package fails to activate, or if the `remsh` command fails, the file systems will not be mounted, and no error will be returned. The only way to be sure the file systems are mounted successfully is to run the `nfs_xmnt` script manually on each host where the file systems should be mounted.

For an example of a configuration with cross-mounted servers, see "Example Four - Two Servers with NFS Cross-Mounts" (page 61).

Creating the Cluster Configuration File and Bringing Up the Cluster

To create the cluster configuration file, verify the cluster and package configuration files, and run the cluster, perform the following steps:

1. Use the `cmquerycl` command in the following manner to create the cluster configuration file from your package configuration files. You must run this command on all nodes in the cluster:

   ```
   cmquerycl -v -C /etc/cmcluster/nfs/cluster.conf -n basil -n
   sage -n thyme
   ```

2. Set the FIRST_CLUSTER_LOCK_VG and MAX_CONFIGURED_PACKAGES variables in the cluster.conf script on each node.
3. Verify the cluster and package configuration files on each node using the following command:

   ```
   cmcheckconf -k -v -C /etc/cmcluster/nfs/cluster.conf -P
   /etc/cmcluster/nfs/nfs1.conf -P /etc/cmcluster/nfs/nfs2.conf
   ...
   ```

4. Activate the cluster lock volume group (corresponding to the FIRST_CLUSTER_LOCK_VG value) on one node using the following command:

   ```
   vgchange -a y /dev/vg_nfsu01
   ```

5. Verify and apply the cluster and package configuration files using the following command:

   ```
   cmapplyconf -v -C /etc/cmcluster/nfs/cluster.conf -P
   /etc/cmcluster/nfs/nfs1.conf -P /etc/cmcluster/nfs/nfs2.conf
   ...
   ```

6. Deactivate the cluster lock volume group using the following command:

   ```
   vgchange -a n /dev/vg_nfsu01
   ```

7. Run the cluster using the following command:

   ```
   cmruncl -v -f
   ```

3 Sample Configurations

This chapter gives sample cluster configuration files, package configuration files, and control scripts for the following configurations:

- **Example One - Three-Server Mutual Takeover**: This configuration has three servers and three Serviceguard NFS packages. Each server is the primary node for one package and an adoptive node for the other two packages.
- **Example Two - One Adoptive Node for Two Packages with File Lock Migration**: This configuration has two packages, each owned by a different server. A third server is the adoptive node for both packages. This sample configuration uses the package control option, which prevents the adoptive node from adopting more than one package at a time. This sample configuration also enables the File Lock Migration feature.
- **Example Three - Three-Server Cascading Failover**: This configuration has three servers and two packages. One server is the primary node for both packages, and the other two servers are adoptive nodes for both packages.
- **Example Four - Two Servers with NFS Cross-Mounts**: This configuration has two servers and two packages. The primary node for each package NFS-mounts the file systems from its own package and the other package.

The sample configuration files in this chapter show only the configured values. Most of the comments are omitted.

Example One - Three-Server Mutual Takeover

This configuration has three servers and three Serviceguard NFS packages. Each server is the primary node for one package and an adoptive node for the other two packages. Figure 3-1 illustrates this configuration. Dotted lines indicate which servers are adoptive nodes for the packages.

Figure 3-1 Three-Server Mutual Takeover

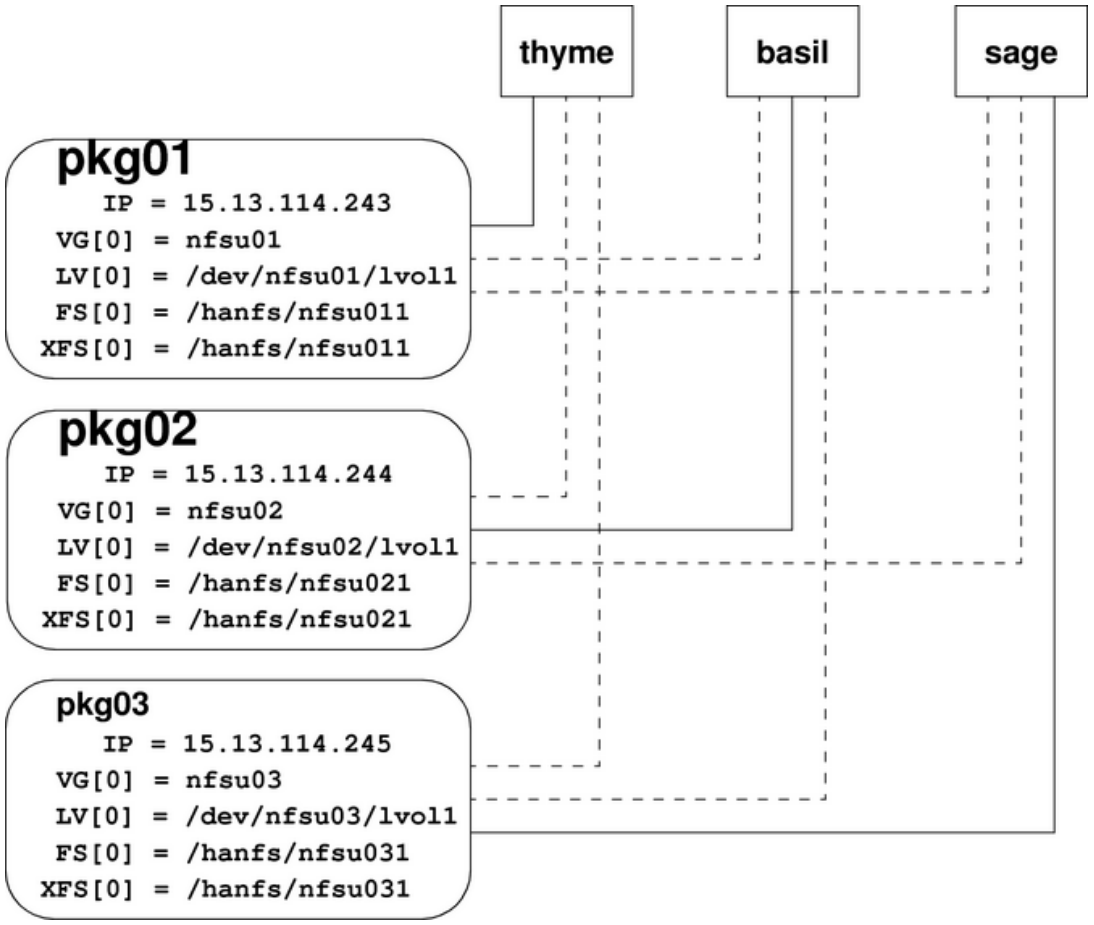
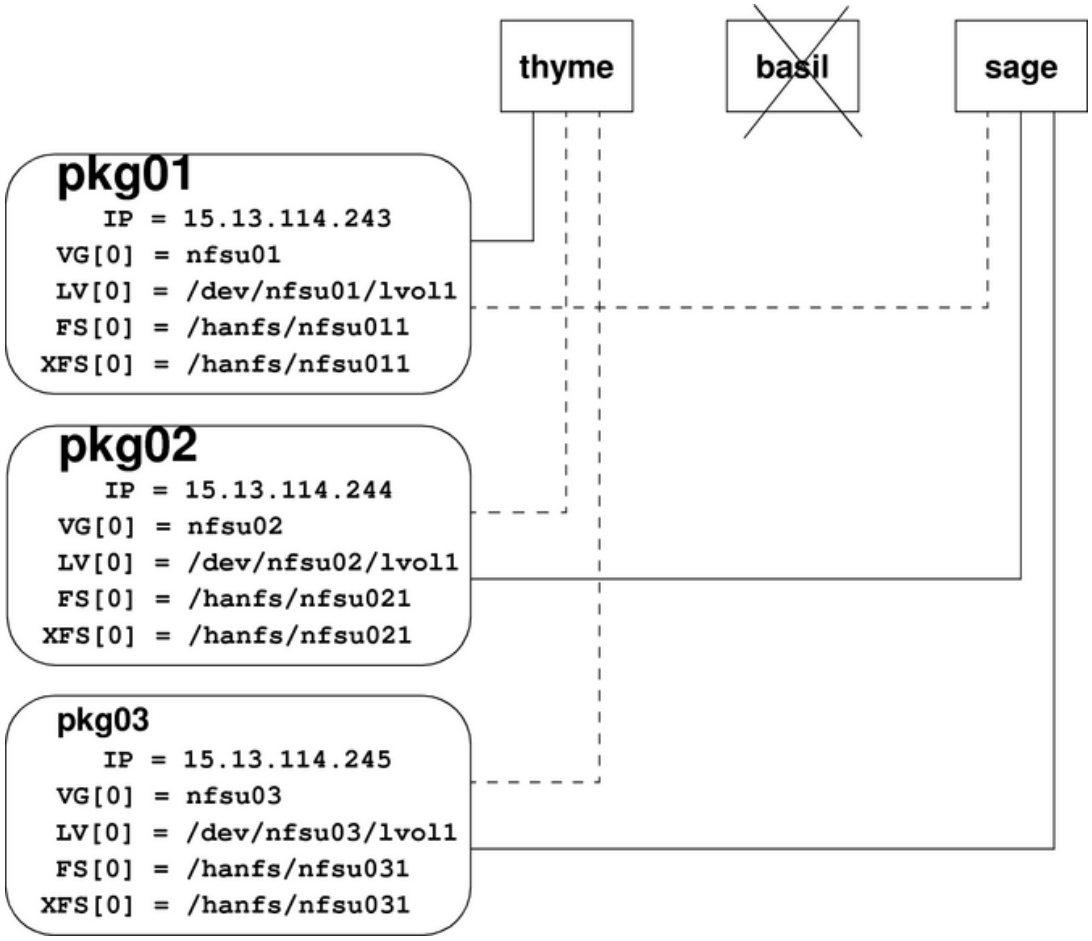


Figure 3-2 shows the three-server mutual takeover configuration after host `basil` has failed and host `sage` has adopted `pkg02`. Dotted lines indicate which servers are adoptive nodes for the packages.

Figure 3-2 Three-Server Mutual Takeover after One Server Fails



Cluster Configuration File for Three-Server Mutual Takeover

This section shows the cluster configuration file (`cluster.conf`) for this configuration example. The comments are not shown.

```
CLUSTER_NAME              MutTakOvr

FIRST_CLUSTER_LOCK_VG     /dev/nfsu01

NODE_NAME                 thyme
  NETWORK_INTERFACE       lan0
  HEARTBEAT_IP          15.13.119.146
 NETWORK_INTERFACE        lan1
 FIRST_CLUSTER_LOCK_PV   /dev/dsk/c0t1d0

NODE_NAME                 basil
  NETWORK_INTERFACE       lan0
```

```
  HEARTBEAT_IP         15.13.113.168
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c1t1d0

NODE_NAME                sage
 NETWORK_INTERFACE      lan0
  HEARTBEAT_IP         15.13.115.184
 NETWORK_INTERFACE      lan1
 NETWORK_INTERFACE      lan2
 NETWORK_INTERFACE      lan3
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c0t1d0

HEARTBEAT_INTERVAL       1000000
NODE_TIMEOUT             2000000
AUTO_START_TIMEOUT       600000000
NETWORK_POLLING_INTERVAL 2000000

MAX_CONFIGURED_PACKAGES  3

VOLUME_GROUP             /dev/nfsu01
VOLUME_GROUP             /dev/nfsu02
VOLUME_GROUP             /dev/nfsu03
```

Package Configuration File for pkg01

This section shows the package configuration file (`nfs1.conf`) for the package `pkg01` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME             pkg01
PACKAGE_TYPE             FAILOVER

FAILOVER_POLICY          CONFIGURED_NODE
FAILBACK_POLICY          MANUAL

NODE_NAME                thyme
NODE_NAME                basil
NODE_NAME                sage

AUTO_RUN                 YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED   NO

RUN_SCRIPT               /etc/cmcluster/nfs/nfs1.cntl
RUN_SCRIPT_TIMEOUT       NO_TIMEOUT
HALT_SCRIPT              /etc/cmcluster/nfs/nfs1.cntl
HALT_SCRIPT_TIMEOUT      NO_TIMEOUT

SERVICE_NAME             nfs1.monitor
SERVICE_FAIL_FAST_ENABLED NO
SERVICE_HALT_TIMEOUT     300
```

```
SUBNET                          15.13.112.0
```

NFS Control Scripts for pkg01

The nfs.cntl Control Script

This section shows the NFS control script (`nfs1.cntl`) for the pkg01 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu01

LV[0]=/dev/nfsu01/lvol1; FS[0]=/hanfs/nfsu011; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0
IP[0]=15.13.114.243
SUBNET[0]=15.13.112.0
```

The hanfs.sh Control Script

This section shows the NFS control script (`hanfs1.sh`) for the `pkg01` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu011

NFS_SERVICE_NAME[0]="nfs1.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"

NFS_FILE_LOCK_MIGRATION=0
NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

Package Configuration File for pkg02

This section shows the package configuration file (`nfs2.conf`) for the package `pkg02` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME                    pkg02
PACKAGE_TYPE                    FAILOVER

FAILOVER_POLICY                 CONFIGURED_NODE
FAILBACK_POLICY                 MANUAL
```

```
NODE_NAME                   basil
NODE_NAME                   sage
NODE_NAME                   thyme

AUTO_RUN                    YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED     NO

RUN_SCRIPT                  /etc/cmcluster/nfs/nfs2.cntl
RUN_SCRIPT_TIMEOUT          NO_TIMEOUT
HALT_SCRIPT                 /etc/cmcluster/nfs/nfs2.cntl
HALT_SCRIPT_TIMEOUT         NO_TIMEOUT

SERVICE_NAME                nfs2.monitor
SERVICE_FAIL_FAST_ENABLED NO
SERVICE_HALT_TIMEOUT       300

SUBNET                      15.13.112.0
```

NFS Control Scripts for pkg02

The nfs.cntl Control Script

This section shows the NFS control script (`nfs2.cntl`) for the pkg02 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default
CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu02  LV[0]=/dev/nfsu02/lvol1; FS[0]=/hanfs/nfsu021; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.112.244
SUBNET[0]=15.13.112.0
```

The hanfs.sh Control Script

This section shows the NFS control script (`hanfs2.sh`) for the `pkg02` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu021

NFS_SERVICE_NAME[0]="nfs2.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"
```

```
NFS_FILE_LOCK_MIGRATION=0
NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

Package Configuration File for pkg03

This section shows the package configuration file (`nfs3.conf`) for the package `pkg03` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME                pkg03
PACKAGE_TYPE                FAILOVER

FAILOVER_POLICY             CONFIGURED_NODE
FAILBACK_POLICY             MANUAL

NODE_NAME                   sage
NODE_NAME                   thyme
NODE_NAME                   basil

AUTO_RUN                    YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED      NO

RUN_SCRIPT                  /etc/cmcluster/nfs/nfs3.cntl
RUN_SCRIPT_TIMEOUT          NO_TIMEOUT
HALT_SCRIPT                 /etc/cmcluster/nfs/nfs3.cntl
HALT_SCRIPT_TIMEOUT         NO_TIMEOUT

SERVICE_NAME                nfs3.monitor
SERVICE_FAIL_FAST_ENABLED NO
SERVICE_HALT_TIMEOUT        300
SUBNET                      15.13.112.0
```

NFS Control Scripts for pkg03

The nfs.cntl Control Script

This section shows the NFS control script (`nfs3.cntl`) for the pkg03 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu03

LV[0]=/dev/nfsu03/lvol1; FS[0]=/hanfs/nfsu031; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default
```

```
FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.114.245
SUBNET[0]=15.13.112.0
```

The hanfs.sh Control Script

This section shows the NFS control script (`hanfs3.sh`) for the `pkg03` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu031

NFS_SERVICE_NAME[0]="nfs3.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"

NFS_FILE_LOCK_MIGRATION=0
NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

Example Two - One Adoptive Node for Two Packages with File Lock Migration

This configuration has two packages, each owned by a different server. The adoptive node for both packages is the same host. This sample configuration uses the package control option, which prevents the adoptive node from adopting another package if it has already adopted one. Figure 3-3 illustrates this configuration.

Figure 3-3 One Adoptive Node for Two Packages

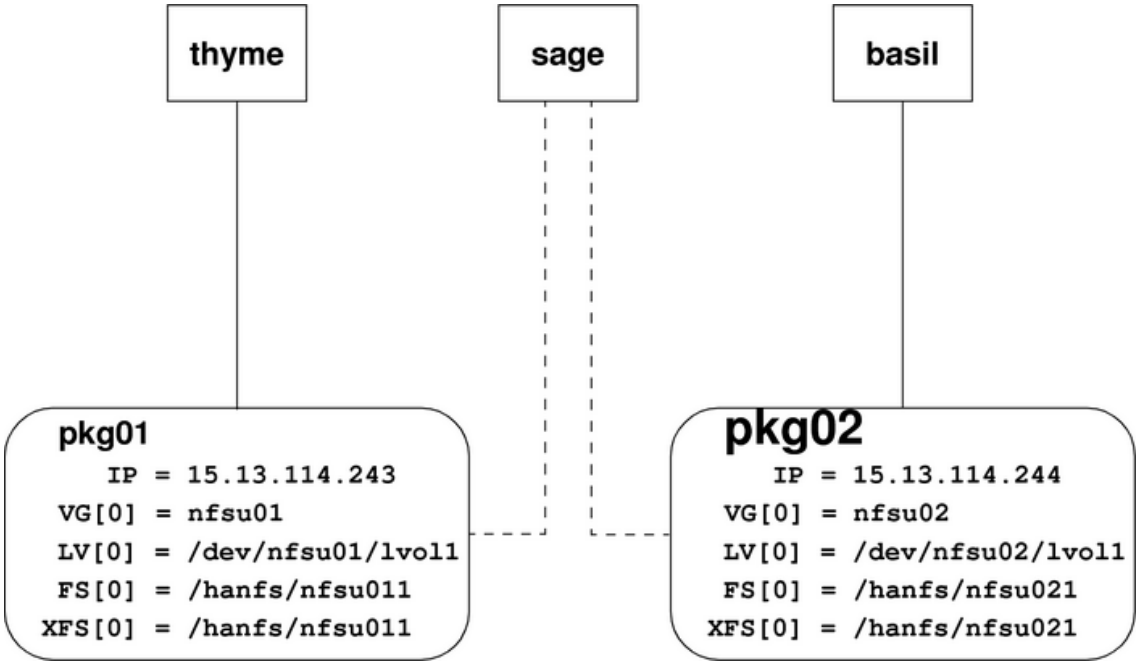
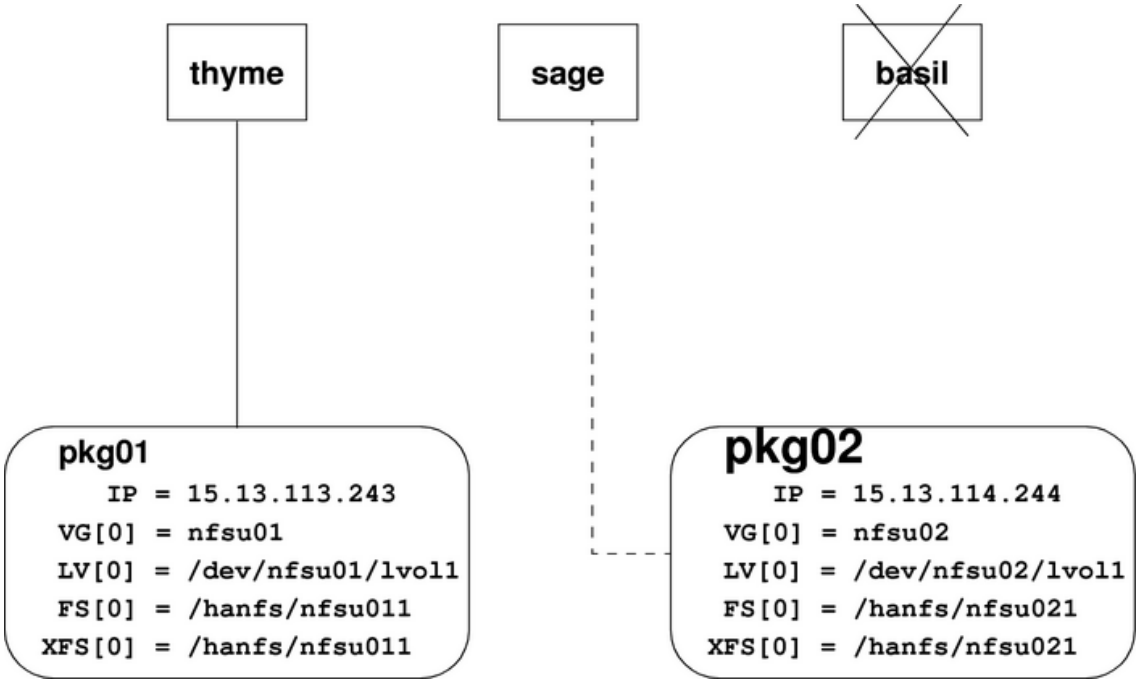


Figure 3-4 shows this sample configuration after host `basil` has failed. Host `sage` has adopted `pkg02`. The package control option prevents host `sage` from adopting another package, so host `sage` is no longer an adoptive node for `pkg01`.

Figure 3-4 One Adoptive Node for Two Packages after One Server Fails



This sample configuration also enables the File Lock Migration feature.

Cluster Configuration File for Adoptive Node for Two Packages with File Lock Migration

This section shows the cluster configuration file (`cluster.conf`) for this configuration example. The comments are not shown.

```
CLUSTER_NAME              PkgCtrl

FIRST_CLUSTER_LOCK_VG     /dev/nfsu01

NODE_NAME                 thyme
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP          15.13.119.146
 NETWORK_INTERFACE       lan1
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c0t1d0

NODE_NAME                 basil
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP          15.13.113.168
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c1t1d0

NODE_NAME                 sage
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP          15.13.115.184
 NETWORK_INTERFACE       lan1
```

```
 NETWORK_INTERFACE      lan2
 NETWORK_INTERFACE      lan3
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c0t1d0

HEARTBEAT_INTERVAL       1000000
NODE_TIMEOUT             2000000

AUTO_START_TIMEOUT       600000000
NETWORK_POLLING_INTERVAL 2000000

MAX_CONFIGURED_PACKAGES  2

VOLUME_GROUP             /dev/nfsu01
VOLUME_GROUP             /dev/nfsu02
```

Package Configuration File for pkg01

This section shows the package configuration file (`nfs1.conf`) for the package `pkg01` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME               pkg01
PACKAGE_TYPE               FAILOVER

FAILOVER_POLICY            CONFIGURED_NODE
FAILBACK_POLICY            MANUAL

NODE_NAME                  thyme
NODE_NAME                  sage

AUTO_RUN                   YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED     NO

RUN_SCRIPT                 /etc/cmcluster/nfs/nfs1.cntl
RUN_SCRIPT_TIMEOUT         NO_TIMEOUT
HALT_SCRIPT                /etc/cmcluster/nfs/nfs1.cntl
HALT_SCRIPT_TIMEOUT        NO_TIMEOUT

SERVICE_NAME               nfs1.monitor
SERVICE_FAIL_FAST_ENABLED  NO
SERVICE_HALT_TIMEOUT       300

SUBNET                     15.13.112.0
```

NFS Control Scripts for pkg01

The nfs.cntl Control Script

This section shows the NFS control script (`nfs1.cntl`) for the pkg01 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu01

LV[0]=/dev/nfsu01/lvol1; FS[0]=/hanfs/nfsu011; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.114.243
SUBNET[0]=15.13.112.0

function customer_defined_run_cmds
{
 cmmodpkg -d -n `hostname`  pkg02 &
}
```

The function `customer_defined_run_cmds` calls the `cmmodpkg` command with the package control option (`-d`). This command prevents the host that is running `pkg01` from adopting `pkg02`. The ampersand (&) causes the `cmmodpkg` command to run in the background. It must run in the background to allow the control script to complete.

There is a short time, after one primary node has failed but before the `cmmodpkg` command has executed, when the other primary node can fail and the adoptive node will adopt its package. In other words, if both `thyme` and `basil` fail at approximately the same time, host `sage` may adopt two packages, even though the package control option is specified.

If you omit the `cmmodpkg -d` command from the NFS control script, host `sage` can adopt both `pkg01` and `pkg02` if their primary nodes fail.

The hanfs.sh Control Script

This section shows the NFS control script (`hanfs1.sh`) for the `pkg01` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example enables the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu011
```

```
NFS_SERVICE_NAME[0]="nfs1.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs1.mon"

NFS_FILE_LOCK_MIGRATION=1

NFS_FLM_SCRIPT="${0%/*}/nfs1.flm"
```

NFS File Lock Migration and Monitor Scripts for pkg01

The nfs.flm Script

This section shows the NFS File Lock Migration (`nfs1.flm`) script for the `pkg01` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and comments are omitted.

```
NFS_FLM_HOLDING_DIR="/hanfs/nfsu011/sm"

PROPAGATE_INTERVAL=5
```

The nfs.mon Script

This section shows the NFS Monitor (`nfs1.mon`) script for the `pkg01` package in this sample configuration. This example includes only the file lock migration related part of the script; the remaining script is omitted.

```
NFS_FILE_LOCK_MIGRATION=1

NFS_FLM_SCRIPT="${0%/*}/nfs1.flm"
```

Package Configuration File for pkg02

This section shows the package configuration file (`nfs2.conf`) for the package `pkg02` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME                pkg02
PACKAGE_TYPE                FAILOVER

FAILOVER_POLICY             CONFIGURED_NODE
FAILBACK_POLICY             MANUAL

NODE_NAME                   basil
NODE_NAME                   sage

AUTO_RUN                    YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED      NO

RUN_SCRIPT                  /etc/cmcluster/nfs/nfs2.cntl
RUN_SCRIPT_TIMEOUT          NO_TIMEOUT
HALT_SCRIPT                 /etc/cmcluster/nfs/nfs2.cntl
HALT_SCRIPT_TIMEOUT         NO_TIMEOUT
```

```
SERVICE_NAME                nfs2.monitor
SERVICE_FAIL_FAST_ENABLED NO
SERVICE_HALT_TIMEOUT       300

SUBNET                      15.13.112.0
```

NFS Control Scripts for pkg02

The nfs.cntl Control Script

This section shows the NFS control script (`nfs2.cntl`) for the pkg02 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin
VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"
VG[0]=nfsu02

LV[0]=/dev/nfsu02/lvol1; FS[0]=/hanfs/nfsu021

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.114.244
SUBNET[0]=15.13.112.0

function customer_defined_run_cmds
{
 cmmodpkg -d -n `hostname` pkg01 &
}
```

The function `customer_defined_run_cmds` calls the `cmmodpkg` command with the package control option (`-d`). This command prevents the host that is running `pkg02` from adopting `pkg01`. The ampersand (&) causes the `cmmodpkg` command to run in the background. It must run in the background to allow the control script to complete.

There is a short time, after one primary node has failed but before the `cmmodpkg` command has executed, when the other primary node can fail and the adoptive node will adopt its package. In other words, if both `thyme` and `basil` fail at approximately the same time, host `sage` may adopt two packages, even though the package control option is specified.

If you omit the `cmmodpkg -d` command from the NFS control script, host `sage` can adopt both `pkg01` and `pkg02` if their primary nodes fail.

The hanfs.sh Control Script

This section shows the NFS control script (`hanfs2.sh`) for the `pkg02` package in this sample configuration. This example includes only the user-configured part of the script;

the executable part of the script and most of the comments are omitted. This example enables the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu021

NFS_SERVICE_NAME[0]="nfs2.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs2.mon"

NFS_FILE_LOCK_MIGRATION=1

NFS_FLM_SCRIPT="${0%/*}/nfs2.flm"
```

NFS File Lock Migration and Monitor Scripts for pkg02

The nfs.flm Script

This section shows the NFS File Lock Migration (`nfs2.flm`) script for the `pkg02` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and comments are omitted.

```
NFS_FLM_HOLDING_DIR="/hanfs/nfsu021/sm"

PROPAGATE_INTERVAL=5
```

The nfs.mon Script

This section shows the NFS Monitor (`nfs2.mon`) script for the `pkg02` package in this sample configuration. This example includes only the file lock migration related part of the script; the remaining script is omitted.

```
NFS_FILE_LOCK_MIGRATION=1

NFS_FLM_SCRIPT="${0%/*}/nfs2.flm"
```

Example Three - Three-Server Cascading Failover

This configuration has two packages and three servers. One server is the primary node for both packages. The other servers are adoptive nodes for the two packages. Figure 3-5 illustrates this configuration. Dotted lines indicate which servers are adoptive nodes for the packages.

Figure 3-5 Cascading Failover with Three Servers

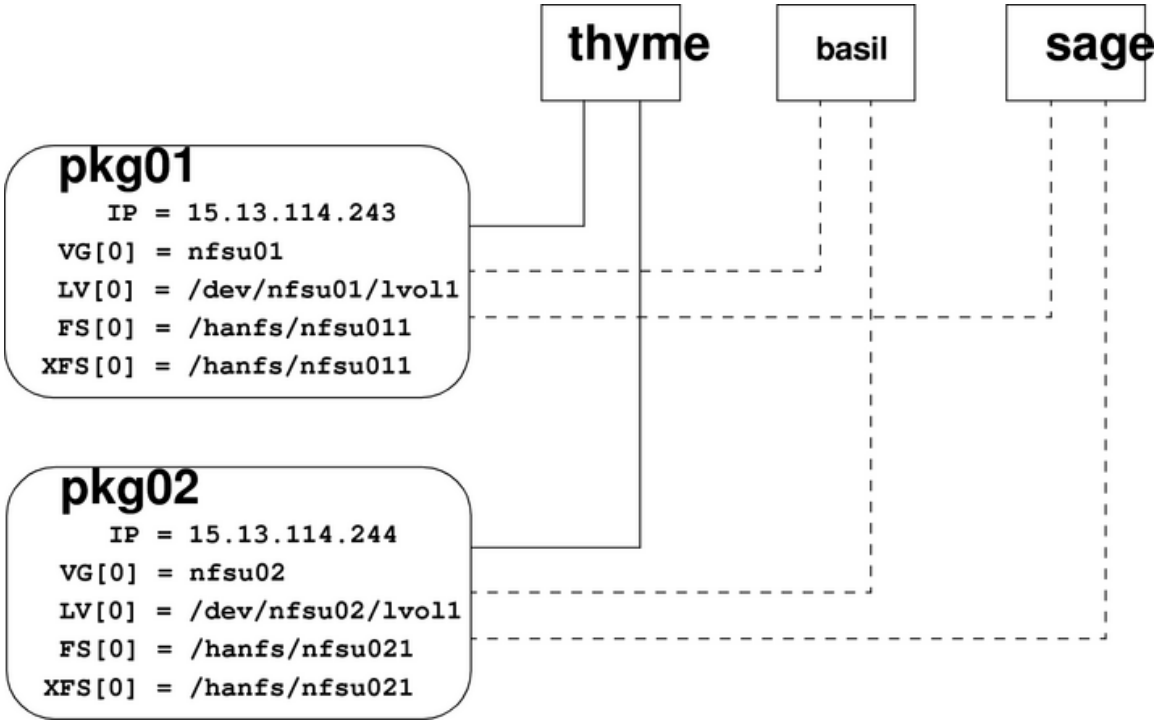
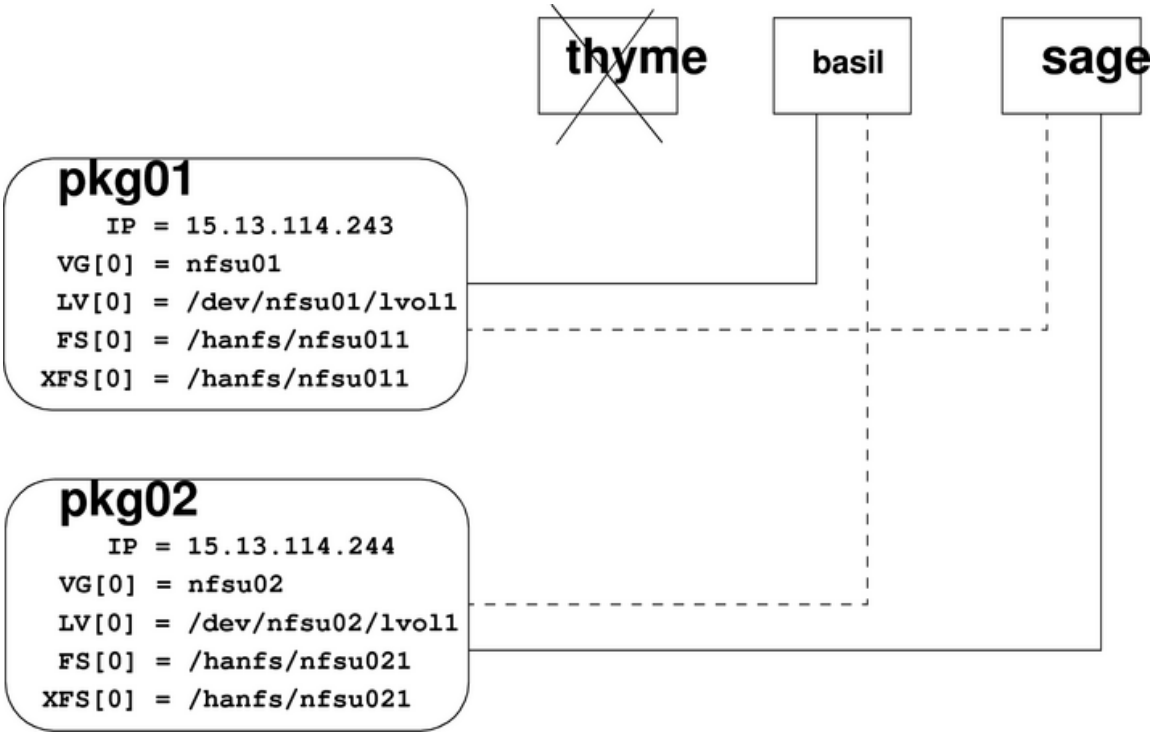


Figure 3-6 shows the cascading failover configuration after host `thyme` has failed. Host `basil` is the first adoptive node configured for `pkg01`, and host `sage` is the first adoptive node configured for `pkg02`.

Figure 3-6 Cascading Failover with Three Servers after One Server Fails



Cluster Configuration File for Three-Server Cascading Failover

This section shows the cluster configuration file (`cluster.conf`) for this configuration example. The comments are not shown.

```
CLUSTER_NAME             Cascading

FIRST_CLUSTER_LOCK_VG    /dev/nfsu01

NODE_NAME                thyme
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP           15.13.119.146
 NETWORK_INTERFACE       lan1
 FIRST_CLUSTER_LOCK_PV   /dev/dsk/c0t1d0

NODE_NAME                basil
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP           15.13.113.168
 FIRST_CLUSTER_LOCK_PV   /dev/dsk/c1t1d0

NODE_NAME                sage
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP           15.13.115.184
 NETWORK_INTERFACE       lan1
```

```
 NETWORK_INTERFACE      lan2
 NETWORK_INTERFACE      lan3
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c0t1d0

HEARTBEAT_INTERVAL       1000000
NODE_TIMEOUT             2000000

AUTO_START_TIMEOUT       600000000
NETWORK_POLLING_INTERVAL 2000000

MAX_CONFIGURED_PACKAGES  2
VOLUME_GROUP             /dev/nfsu01
VOLUME_GROUP             /dev/nfsu02
```

Package Configuration File for pkg01

This section shows the package configuration file (`nfs1.conf`) for the package `pkg01` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME               pkg01
PACKAGE_TYPE               FAILOVER

FAILOVER_POLICY            CONFIGURED_NODE
FAILBACK_POLICY            MANUAL

NODE_NAME                  thyme
NODE_NAME                  basil
NODE_NAME                  sage

AUTO_RUN                   YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED     NO

RUN_SCRIPT                 /etc/cmcluster/nfs/nfs1.cntl
RUN_SCRIPT_TIMEOUT         NO_TIMEOUT
HALT_SCRIPT                /etc/cmcluster/nfs/nfs1.cntl
HALT_SCRIPT_TIMEOUT        NO_TIMEOUT

SERVICE_NAME               nfs1.monitor
SERVICE_FAIL_FAST_ENABLED  NO
SERVICE_HALT_TIMEOUT       300

SUBNET                     15.13.112.0
```

NFS Control Scripts for pkg01

The nfs.cntl Control Script

This section shows the NFS control script (`nfs1.cntl`) for the pkg01 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu01

LV[0]=/dev/nfsu01/lvol1; FS[0]=/hanfs/nfsu011; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.114.243
SUBNET[0]=15.13.112.0
```

The hanfs.sh Control Script

This section shows the NFS control script (`hanfs1.sh`) for the `pkg01` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu011

NFS_SERVICE_NAME[0]="nfs1.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"

NFS_FILE_LOCK_MIGRATION=0
NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

Package Configuration File for pkg02

This section shows the package configuration file (`nfs2.conf`) for the package `pkg02` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME                pkg02
PACKAGE_TYPE                FAILOVER

FAILOVER_POLICY             CONFIGURED_NODE
FAILBACK_POLICY             MANUAL

NODE_NAME                   thyme
NODE_NAME                   sage
```

```
NODE_NAME                   basil

AUTO_RUN                    YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED     NO

RUN_SCRIPT                  /etc/cmcluster/nfs/nfs2.cntl
RUN_SCRIPT_TIMEOUT          NO_TIMEOUT
HALT_SCRIPT                 /etc/cmcluster/nfs/nfs2.cntl
HALT_SCRIPT_TIMEOUT         NO_TIMEOUT

SERVICE_NAME                nfs2.monitor
SERVICE_FAIL_FAST_ENABLED NO
SERVICE_HALT_TIMEOUT       300

SUBNET                      15.13.112.0
```

NFS Control Scripts for pkg02

The nfs.cntl Control Script

This section shows the NFS control script (`nfs2.cntl`) for the pkg02 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu02  LV[0]=/dev/nfsu02/lvol1; FS[0]=/hanfs/nfsu021; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0
IP[0]=15.13.114.244
SUBNET[0]=15.13.112.0
```

The hanfs.sh Control Script

This section shows the NFS control script (hanfs2.sh) for the `pkg02` package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu021

NFS_SERVICE_NAME[0]="nfs2.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"
```

```
NFS_FILE_LOCK_MIGRATION=0
NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

Example Four - Two Servers with NFS Cross-Mounts

This configuration has two servers and two packages. The primary node for each package NFS-mounts the file systems from its own package and the other package. Figure 3-7 illustrates this configuration. If one server fails, the other server adopts its package. The NFS mounts are not interrupted when a package fails over.

Figure 3-7 Two Servers with NFS Cross-Mounts

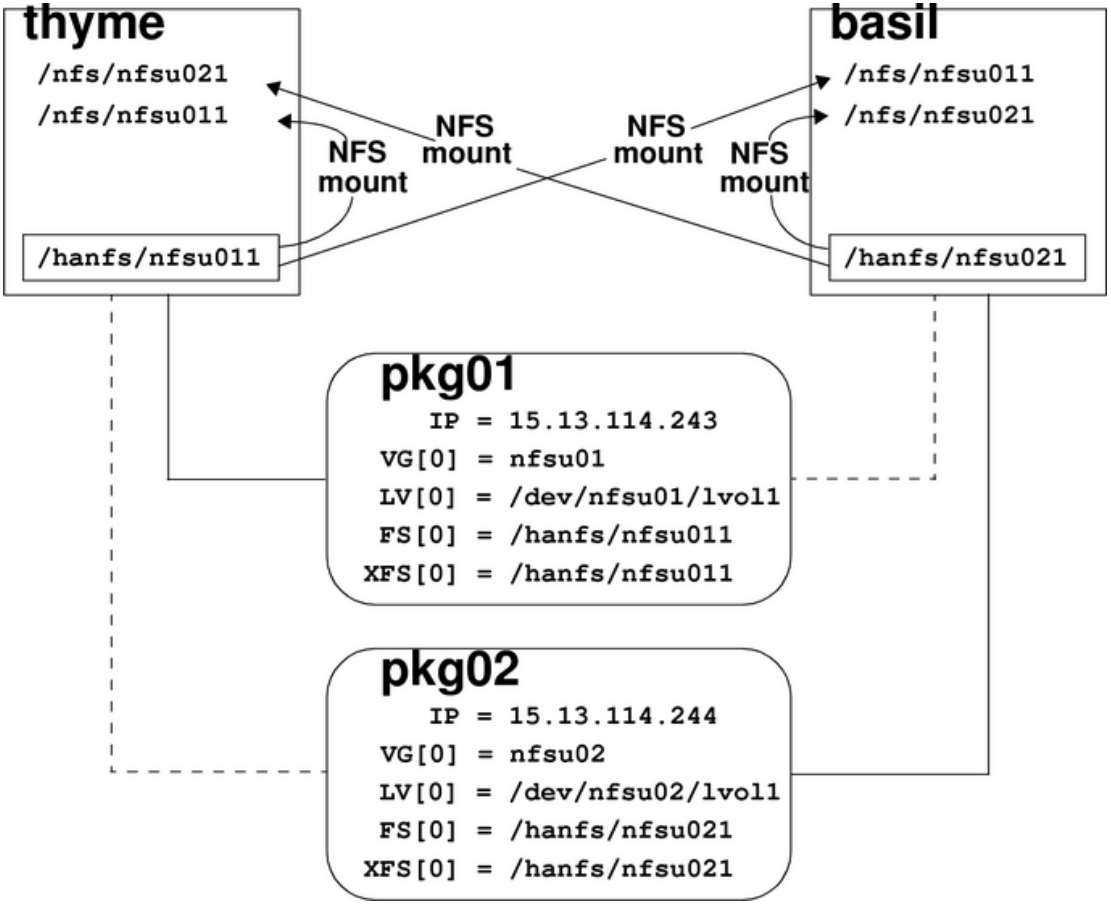
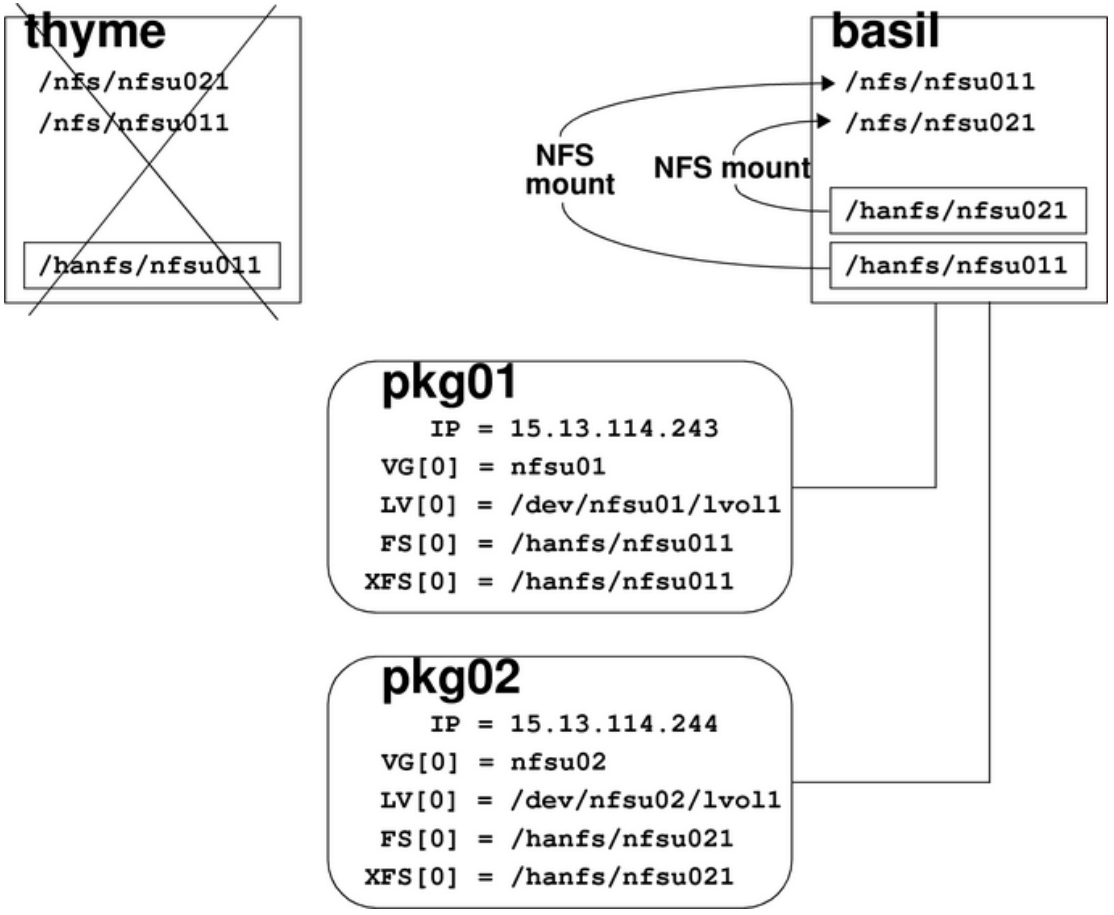


Figure 3-8 shows two servers with NFS cross-mounted file systems after server `thyme` has failed. The NFS mounts on server `basil` are not interrupted.

Figure 3-8 Two Servers with NFS Cross-Mounts after One Server Fails



Cluster Configuration File for Two-Server NFS Cross-Mount

This section shows the cluster configuration file (`cluster.conf`) for this configuration example. The comments are not shown.

```
CLUSTER_NAME              XMnt

FIRST_CLUSTER_LOCK_VG     /dev/nfsu01

NODE_NAME                 thyme
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP          15.13.119.146
 NETWORK_INTERFACE       lan1
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c0t1d0

NODE_NAME                 basil
 NETWORK_INTERFACE       lan0
  HEARTBEAT_IP          15.13.113.168
```

```
 FIRST_CLUSTER_LOCK_PV  /dev/dsk/c1t1d0

HEARTBEAT_INTERVAL       1000000
NODE_TIMEOUT             2000000

AUTO_START_TIMEOUT       600000000
NETWORK_POLLING_INTERVAL 2000000

MAX_CONFIGURED_PACKAGES  2

VOLUME_GROUP             /dev/nfsu01
VOLUME_GROUP             /dev/nfsu02
```

Package Configuration File for pkg01

This section shows the package configuration file (`nfs1.conf`) for the package `pkg01` in this sample configuration. The comments are not shown.

```
PACKAGE_NAME               pkg01
PACKAGE_TYPE               FAILOVER

FAILOVER_POLICY            CONFIGURED_NODE
FAILBACK_POLICY            MANUAL

NODE_NAME                  thyme
NODE_NAME                  basil

AUTO_RUN                   YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED     NO

RUN_SCRIPT                 /etc/cmcluster/nfs/nfs1.cntl
RUN_SCRIPT_TIMEOUT         NO_TIMEOUT
HALT_SCRIPT                /etc/cmcluster/nfs/nfs1.cntl
HALT_SCRIPT_TIMEOUT        NO_TIMEOUT

SERVICE_NAME               nfs1.monitor
SERVICE_FAIL_FAST_ENABLED  NO
SERVICE_HALT_TIMEOUT       300

SUBNET                     15.13.112.0
```

NFS Control Scripts for pkg01

The nfs.cntl Control Script

This section shows the NFS control script (`nfs1.cntl`) for the pkg01 package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                  # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu01

LV[0]=/dev/nfsu01/lvol1; FS[0]=/hanfs/nfsu011; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall"   #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.114.243
SUBNET[0]=15.13.112.0

function customer_defined_run_cmds
{
 /etc/cmcluster/nfs/nfs1_xmnt start
 remsh basil /etc/cmcluster/nfs/nfs1_xmnt start
}
```

The function `customer_defined_run_cmds` calls a script called `nfs1_xmnt`. This script NFS-mounts the file system exported by the package `pkg01`. If you configured the file system in the `/etc/fstab` file, the package might not be active yet when the servers tried to mount the file system at system boot. By configuring the NFS control script to NFS-mount the file system, you ensure that the package is active before the `mount` command is invoked.

The first line in the `customer_defined_run_cmds` function executes the `nfs1_xmnt` script locally on host `thyme` (the primary node for `pkg01`). The second line, beginning with `remsh`, executes the `nfs1_xmnt` script remotely on host `basil`.

If `pkg01` fails to come up, or if the `remsh` to host `basil` fails, the file system will not be mounted, and no error will be returned. The only way to be sure the file system was mounted successfully is to run the `nfs1_xmnt` script manually on both host `thyme` and host `basil`.

The only user-configurable values in the `nfs1_xmnt` script are the `SNFS[`*n*`]` and `CNFS[`*n*`]` variables. These specify the server location of the file system and the client mount point for the file system. The following line is the from the `nfs1_xmnt` script in this example configuration:

```
SNFS[0]="nfs1:/hanfs/nfsu011"; CNFS[0]="/nfs/nfsu011"
```

In the `SNFS[0]` variable, "`nfs1`" is the name that maps to the relocatable IP address of `pkg01`. It must be configured in the name service the host is using (DNS, NIS, or the `/etc/hosts` file). If you do not want to configure a name for the package, you can just specify the IP address in the `SNFS[0]` variable, as follows:

```
SNFS[0]="15.13.114.243:/hanfs/nfsu011";
CNFS[0]="/nfs/nfsu011"
```

The client mount point, specified in the CNFS[0] variable, *must* be different from the location of the file system on the server (SNFS[0]).

The hanfs.sh Control Script

This section shows the NFS control script (hanfs1.sh) for the pkg01 package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu011

NFS_SERVICE_NAME[0]="nfs1.monitor
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"

NFS_FILE_LOCK_MIGRATION=0

NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

Package Configuration File for pkg02

This section shows the package configuration file (nfs2.conf) for the package pkg02 in this sample configuration. The comments are not shown.

```
PACKAGE_NAME                pkg02
PACKAGE_TYPE                FAILOVER

FAILOVER_POLICY             CONFIGURED_NODE
FAILBACK_POLICY             MANUAL

NODE_NAME                   basil
NODE_NAME                   thyme

AUTO_RUN                    YES

LOCAL_LAN_FAILOVER_ALLOWED YES

NODE_FAIL_FAST_ENABLED      NO

RUN_SCRIPT                  /etc/cmcluster/nfs/nfs2.cntl
RUN_SCRIPT_TIMEOUT          NO_TIMEOUT
HALT_SCRIPT                 /etc/cmcluster/nfs/nfs2.cntl
HALT_SCRIPT_TIMEOUT         NO_TIMEOUT

SERVICE_NAME                nfs2.monitor
SERVICE_FAIL_FAST_ENABLED NO
SERVICE_HALT_TIMEOUT        300

SUBNET                      15.13.112.0
```

NFS Control Scripts for pkg02

The nfs.cntl Control Script

This section shows the NFS control script (`nfs2.cntl`) for the `pkg02` package in this sample configuration. Only the user-configured part of the script is shown; the executable part of the script and most of the comments are omitted.

```
PATH=/sbin:/usr/bin:/usr/sbin:/etc:/bin

VGCHANGE="vgchange -a e"                # Default

CVM_ACTIVATION_CMD="vxdg -g \$DiskGroup set activation=exclusivewrite"

VG[0]=nfsu02  LV[0]=/dev/nfsu02/lvol1; FS[0]=/hanfs/nfsu021; FS_MOUNT_OPT[0]="-o rw"

VXVOL="vxvol -g \$DiskGroup startall" #Default

FS_UMOUNT_COUNT=1
FS_MOUNT_RETRY_COUNT=0

IP[0]=15.13.114.244
SUBNET[0]=15.13.112.0

function customer_defined_run_cmds
{
 /etc/cmcluster/nfs/nfs2_xmnt start
 remsh thyme /etc/cmcluster/nfs/nfs2_xmnt start
}
```

The function `customer_defined_run_cmds` calls a script called `nfs2_xmnt`. This script NFS-mounts the file system exported by the package `pkg02`. If you configured the file system in the `/etc/fstab` file, the package might not be active yet when the servers tried to mount the file system at system boot. By configuring the NFS control script to NFS-mount the file system, you ensure that the package is active before the `mount` command is invoked.

The first line in the `customer_defined_run_cmds` function executes the `nfs2_xmnt` script locally on host `basil` (the primary node for `pkg02`). The second line, beginning with `remsh`, executes the `nfs2_xmnt` script remotely on host `thyme`.

If `pkg02` fails to come up, or if the `remsh` to host `thyme` fails, the file system will not be mounted, and no error will be returned. The only way to be sure the file system was mounted successfully is to run the `nfs2_xmnt` script manually on both host `basil` and host `thyme`.

The only user-configurable values in the `nfs2_xmnt` script are the `SNFS[`*n*`]` and `CNFS[`*n*`]` variables. These specify the server location of the file system and the client mount point for the file system. The following line is the from the `nfs2_xmnt` script in this example configuration:

```
SNFS[0]="nfs2:/hanfs/nfsu021"; CNFS[0]="/nfs/nfsu021"
```

In the `SNFS[0]` variable, "`nfs2`" is the name that maps to the relocatable IP address of `pkg02`. It must be configured in the name service the host is using (DNS, NIS, or

the /etc/hosts file). If you do not want to configure a name for the package, you can just specify the IP address in the SNFS[0] variable, as follows:

```
SNFS[0]="15.13.114.244:/hanfs/nfsu021"; CNFS[0]="/nfs/nfsu021"
```

The client mount point, specified in the CNFS[0] variable, *must* be different from the location of the file system on the server (SNFS[0]).

The hanfs.sh Control Script

This section shows the NFS control script (hanfs2.sh) for the pkg02 package in this sample configuration. This example includes only the user-configured part of the script; the executable part of the script and most of the comments are omitted. This example does not enable the File Lock Migration feature.

```
XFS[0]=/hanfs/nfsu021

NFS_SERVICE_NAME[0]="nfs2.monitor"
NFS_SERVICE_CMD[0]="/etc/cmcluster/nfs/nfs.mon"

NFS_FILE_LOCK_MIGRATION=0
NFS_FLM_SCRIPT="${0%/*}/nfs.flm"
```

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