

Veritas Storage Foundation[™] Cluster File System Release Notes

Linux

5.0 Maintenance Pack 2



Veritas Storage Foundation Cluster File System Release Notes

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Storage Foundation Cluster File System 5.0 Maintenance Pack 2

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Veritas Storage Foundation Cluster File System is a licensed product. See the *Veritas Storage Foundation Cluster File System Installation Guide* for license installation instructions.

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For technical assistance, visit

http://www.symantec.com/enterprise/support/assistance_care.jsp and select phone or email support. Use the Knowledge Base search feature to access resources such as TechNotes, product alerts, software downloads, hardware compatibility lists, and our customer email notification service.

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Storage Foundation Cluster File System Release Notes

This document provides information specific to the Maintenance Pack 2 (MP2) for Veritas Storage Foundation Cluster File System (SFCFS) 5.0. It also includes information for Veritas Storage Foundation Cluster File System for Oracle RAC.

- For information on topics not covered in this document, such as SFCFS-specific software fixes and limitations, see the *Veritas Storage Foundation Cluster File System 5.0 Release Notes*.
- For information on Storage Foundation, including software fixes and limitations for Veritas File System, Veritas Volume Replicator, and Veritas Volume Manager, see the *Veritas Storage Foundation 5.0 MP2 Release Notes*.
- For information on installing and configuring Oracle RAC, see the Oracle RAC documentation.

Note: Read the following Veritas Technical Support TechNote for the latest information on updates, patches, and software issues for this release:

<http://entsupport.symantec.com/docs/281993>

New features

Veritas Storage Foundation Cluster File System provides the following new features:

Support for Oracle Enterprise Linux

Oracle Enterprise Linux is a redistribution by Oracle of Red Hat Enterprise Linux 4 Update 4 that has been customized for the Oracle product.

Storage Foundation Cluster File System for Oracle RAC

Maintenance Pack 2 (MP2) for Storage Foundation Cluster File System (SFCFS) 5.0 includes support for Oracle RAC.

As is the case for the Storage Foundation for Oracle RAC product, Storage Foundation Cluster File System for Oracle RAC supports dynamic multipathing (DMP), Oracle Disk Manager (ODM) and Group Membership Services.

Storage Foundation Cluster File System for Oracle RAC does not support the integration of Veritas Cluster Server (VCS) with the Oracle Clusterware APIs.

In addition, although I/O Fencing may be enabled, it is not supported for use with SFCFS for Oracle RAC.

About Storage Foundation Cluster File System for Oracle RAC

Storage Foundation Cluster File System for Oracle RAC is a storage management and clustering solution that provides the following features:

- Enhanced scalability and availability with access to multiple RAC instances per database in a cluster.
- Back up and recovery of databases using volume-level and file system-level snapshot technologies. SFCFS for Oracle RAC enables full volume-level snapshots for off-host processing that reduce load on production systems, and file system-level snapshots that involve efficient backup and rollback processes.
- Sharing of all types of files, in addition to Oracle database files, across nodes.
- Increased availability and performance with dynamic multipathing (DMP), which provides wide storage array support for protection from failures and performance bottlenecks in the HBAs and SAN switches.
- Optimized I/O performance and memory foot-prints through storage mapping technologies, such as ODM, and tunable attributes.

How SFCFS for Oracle RAC works (high-level perspective)

Real Application Clusters (RAC) is a parallel database environment that takes advantage of the processing power of multiple computers. The Oracle database is the physical data stored in table spaces on disk, while the Oracle instance is a set of processes and shared memory that provide access to the physical database. Specifically, the instance involves server processes acting on behalf of clients to read data into shared memory and make modifications to it, and background processes to write changed data to disk.

In traditional environments, only one instance accesses a database at a specific time. SFCFS for Oracle RAC enables all nodes to concurrently run Oracle instances and execute transactions against the same database. This software coordinates access to the shared data for each node to provide consistency and integrity.

Each node adds its processing power to the cluster as a whole and can increase overall throughput or performance.

At a conceptual level, SFCFS for Oracle RAC is a cluster that manages applications (instances), networking, and storage components using resources contained in service groups. SFCFS for Oracle RAC clusters have many of the same properties as Veritas Cluster Server (VCS) clusters, such as:

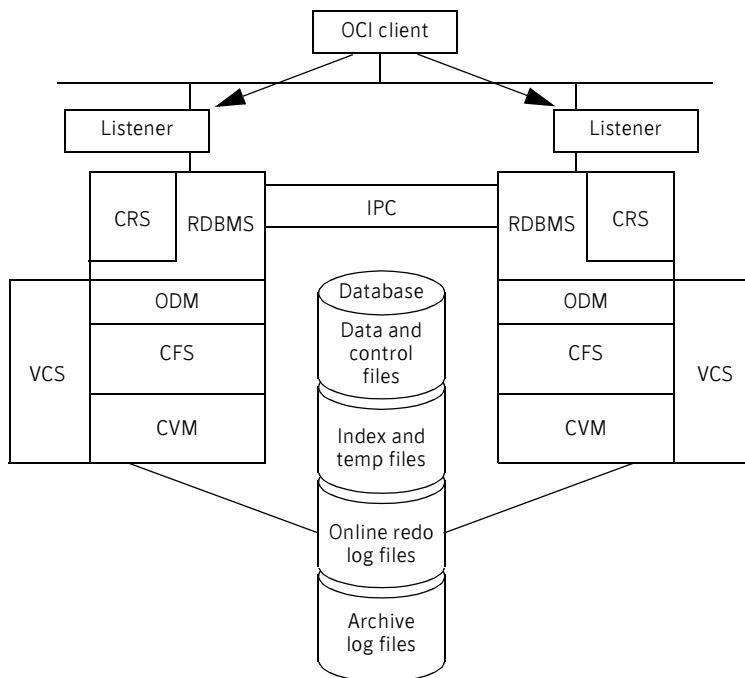
- Each node runs its own operating system.
- A cluster interconnect enables cluster communications.
- A public network connects each node to a LAN for client access.
- Shared storage is accessible by each node that needs to run the application.

SFCFS for Oracle RAC adds the following technologies, engineered specifically to improve performance, availability, and manageability of Oracle RAC environments, to a failover cluster environment:

- Cluster File System (CFS) and Cluster Volume Manager (CVM) technologies to manage multi-instance database access to shared storage.
- An Oracle Disk Manager (ODM) library to maximize Oracle disk I/O performance.

SFCFS for Oracle RAC provides an environment that can tolerate failures with minimal downtime and interruption to users. If a node fails as clients access the same database on multiple nodes, clients attached to the failed node can reconnect to a surviving node and resume access. Recovery after failure in the SFCFS for Oracle RAC environment is far quicker than recovery for a failover database because another Oracle instance is already up and running. The recovery process involves applying outstanding redo log entries from the failed node.

Figure 1-1 SFCFS for Oracle RAC architecture



Component products and processes of SFCFS for Oracle RAC

To understand how SFCFS for Oracle RAC manages database instances running in parallel on multiple nodes, review the architecture and communication mechanisms that provide the infrastructure for Oracle RAC. General highlights of the component products include:

Cluster Volume Manager (CVM)	Enables simultaneous access to shared volumes based on technology from Veritas Volume Manager (VxVM).
Cluster File System (CFS)	Enables simultaneous access to shared file systems based on technology from Veritas File System (VxFS).
Database Accelerator	Provides the interface with the Oracle Disk Manager (ODM) API.
Cluster Server (VCS)	Provides cluster membership, a messaging layer and management of CVM and CFS service groups and resources.

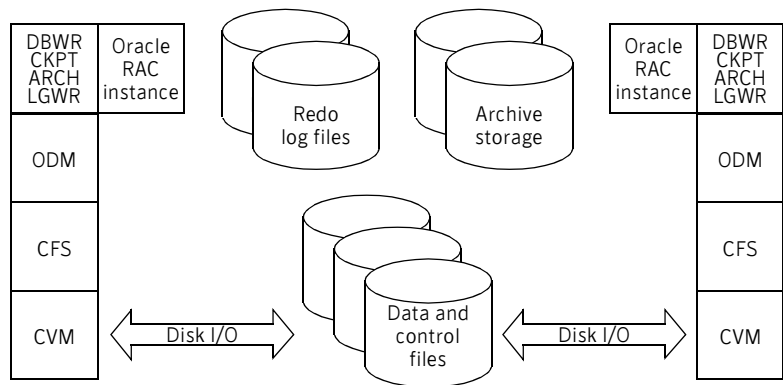
Communication infrastructure

To understand the communication infrastructure, it is necessary to review the data flow and communications requirements.

Data flow

The CVM, CFS, ODM, and Oracle RAC elements reflect the overall data flow, or data stack, from an instance running on a server to the shared storage. The various Oracle processes that compose an instance (such as DB Writers, Checkpoint, Archiver, Log Writer, and Server) read and write data to the storage through the I/O stack. Oracle communicates through the ODM interface to CFS, which in turn accesses the storage through CVM.

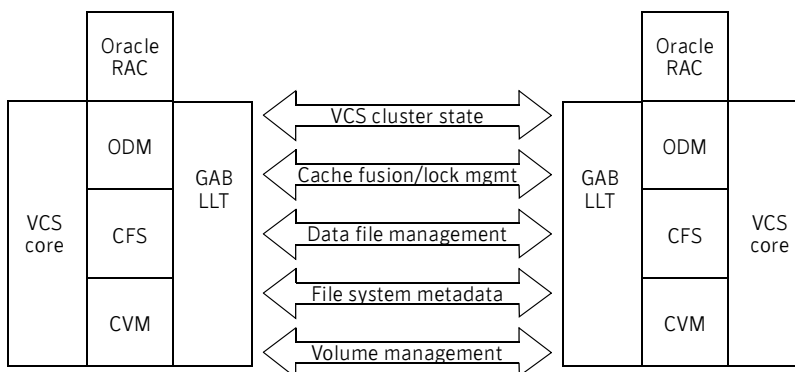
Figure 1-2 Data flow in SFCFS for Oracle RAC



Communication requirements

End-users on a client system are unaware that they are accessing a database hosted by multiple instances. The key to performing I/O to a database accessed by multiple instances is communication between the processes. Each layer or component in the data stack must reliably communicate with its peer on other nodes to function properly. RAC instances communicate to coordinate the protection of data blocks in the database. ODM processes communicate to coordinate the protection of data files and access across the cluster. CFS coordinates metadata updates for file systems, and CVM coordinates the status of logical volumes and maps.

Figure 1-3 Communication requirements in SFCFS for Oracle RAC



Cluster Volume Manager

CVM is an extension of Veritas Volume Manager, the industry standard storage virtualization platform. CVM extends the concepts of VxVM across multiple nodes. Each node recognizes the same logical volume layout, and more importantly, the same state of all volume resources.

CVM supports performance-enhancing capabilities, such as striping, mirroring, and mirror break-off (snapshot) for off-host backup. You can use standard VxVM commands from one node in the cluster to manage all storage. All other nodes immediately recognize any changes in disk group and volume configuration with no interaction.

CVM architecture

CVM is designed with a “master and slave” architecture. One node in the cluster acts as the configuration master for logical volume management, and all other nodes are slaves. Any node can take over as master if the existing master fails.

The CVM master exists on a per-cluster basis and uses GAB and LLT to transport its configuration data.

Just as with VxVM, the Volume Manager configuration daemon, `vxconfigd`, maintains the configuration of logical volumes. This daemon handles changes to the volumes by updating the operating system at the kernel level. For example, if a mirror of a volume fails, the mirror detaches from the volume and `vxconfigd` determines the proper course of action, updates the new volume layout, and informs the kernel of a new volume layout. CVM extends this behaviour across multiple nodes and propagates volume changes to the master `vxconfigd`. (You must perform operator-initiated changes on the master node.)

The `vxconfigd` process on the master pushes these changes out to slave `vxconfigd` processes, each of which updates the local kernel.

CVM does not impose any write locking between nodes. Each node is free to update any area of the storage. All data integrity is the responsibility of the upper application. From an application perspective, standalone systems access logical volumes in the same way as CVM systems. CVM imposes a "Uniform Shared Storage" model. All nodes must connect to the same disk sets for a given disk group. Any node unable to detect the entire set of physical disks for a given disk group cannot import the group. If a node loses contact with a specific disk, CVM excludes the node from participating in the use of that disk.

Cluster File System

CFS enables you to simultaneously mount the same file system on multiple nodes and is an extension of the industry-standard Veritas File System. Unlike some other file systems that send data through another node to the storage, CFS is a true SAN file system. All data traffic takes place over the storage area network (SAN), and only the metadata traverses the cluster interconnect.

In addition to using the SAN fabric for reading and writing data, CFS offers storage checkpoints and rollback for backup and recovery.

CFS architecture

SFCFS for Oracle RAC uses CFS to manage a file system in a large database environment. Since CFS is an extension of VxFS, it operates in a similar fashion and caches metadata and data in memory (typically called buffer cache or vnode cache). CFS uses a distributed locking mechanism called Global Lock Manager (GLM) to ensure all nodes have a consistent view of the file system. GLM provides metadata and cache coherency across multiple nodes by coordinating access to file system metadata, such as inodes and free lists. The role of GLM is set on a per-file system basis to enable load balancing.

CFS involves a primary/secondary architecture. Though any node can initiate an operation to create, delete, or resize data, the GLM master node carries out the actual operation. After creating a file, the GLM master node grants locks for data coherency across nodes. For example, if a node tries to modify a row of a block in a file, it must obtain an exclusive lock to ensure other nodes that may have the same file cached have this cached copy invalidated.

SFCFS for Oracle RAC configurations minimize the use of GLM locking. Oracle RAC accesses the file system through the ODM interface and handles its own locking; only Oracle (and not GLM) buffers data and coordinates write operations to files.

A single point of locking and buffering ensures maximum performance. GLM locking is only involved when metadata for a file changes, such as during create and resize operations.

Oracle Disk Manager

SFCFS for Oracle RAC requires Oracle Disk Manager (ODM), a standard API published by Oracle for support of database I/O. SFCFS for Oracle RAC provides a library for Oracle to use as its I/O library.

ODM architecture

When the Veritas ODM library is linked, Oracle is able to bypass all caching and locks at the file system layer and to communicate directly with raw volumes.

The SFCFS for Oracle RAC implementation of ODM generates performance equivalent to performance with raw devices while the storage uses easy-to-manage file systems.

All ODM features can operate in a cluster environment. Nodes communicate with each other before performing any operation that could potentially affect another node. For example, before creating a new data file with a specific name, ODM checks with other nodes to see if the file name is already in use.

Veritas ODM performance enhancements

Veritas ODM enables the following performance benefits that are provided by Oracle Disk Manager:

- Locking for data integrity.
- Few system calls and context switches.
- Increased I/O parallelism.
- Efficient file creation and disk allocation.

Databases using file systems typically incur the following additional overhead:

- Extra CPU and memory usage to read data from underlying disks to the file system cache. This scenario requires copying data from the file system cache to the Oracle cache.
- File locking that allows for only a single writer at a time. Allowing Oracle to perform locking allows for finer granularity of locking at the row level.
- File systems generally go through a standard Sync I/O library when performing I/O. Oracle can make use of Kernel Async I/O libraries (KAIO) with raw devices to improve performance.

Veritas Cluster Server

Veritas Cluster Server provides the following functionality for SFCFS for Oracle RAC:

- Management of cluster node membership, including the monitoring of node health by using heart-beat technology.
- A messaging layer between cluster nodes.
- Management of CVM and CFS service groups and resources and their interdependencies.

VCS architecture

The High Availability Daemon (HAD) is the main VCS daemon running on each node. HAD tracks changes in the cluster configuration and monitors resource status by communicating with GAB and LLT. HAD manages all application services using agents, which are installed programs to manage resources (specific hardware or software entities).

The VCS architecture is modular for extensibility and efficiency. HAD does not need to know how to start up Oracle or any other application under VCS control. Instead, you can add agents to manage different resources with no effect on the engine (HAD). Agents only communicate with HAD on the local node, and HAD communicates status with HAD processes on other nodes. Because agents do not need to communicate across systems, VCS is able to minimize traffic on the cluster interconnect.

SFCFS for Oracle RAC provides specific agents for VCS to manage CVM and CFS.

Cluster configuration files

VCS uses the following configuration files in a default configuration:

<code>main.cf</code>	Defines the entire cluster, including the cluster name, systems in the cluster, and definitions of service groups and resources, in addition to service group and resource dependencies.
<code>types.cf</code>	Defines the resource types

Additional files similar to `types.cf` may be present if you add agents.

Installing and configuring SFCFS for Oracle RAC

You can install SFCFS for Oracle RAC on clusters of up to 16 nodes. You can also upgrade an existing SFCFS cluster to SFCFS for Oracle RAC.

The Veritas product installer or the `installsfcsrac` script may be used to perform a fresh installation of SFCFS for Oracle RAC. The following packages are installed on each cluster node:

- Veritas Cluster Server (VCS)
- Veritas Volume Manager (VxVM)
- Veritas File System (VxFS)
- Oracle Disk Manager

To perform system checks and configure SFCFS for Oracle RAC, you can use the Veritas product installer or the `-configure` option of the `installsfcsrac` script. You can configure the following components of SFCFS for Oracle RAC:

- VCS
- CVM (Veritas Volume Manager enabled for clusters)
- CFS (Veritas File System enabled for clusters)

The installer and `installsfcsrac` script also start the SFCFS for Oracle RAC processes.

Block device support in Veritas File System

VxFS 5.0 supports the creation of file systems directly on raw devices without requiring a VxVM volume. However, this feature is limited to local mount file systems only and is not supported for CFS mounts. Both partitioned and non-partitioned block devices may now be used directly with VxFS.

For example:

```
# mkfs -t vxfs /dev/sdc1
# mount -t vxfs /dev/sdc1 /mnt
# fsck -t vxfs /dev/sdc1
```

Similarly, all local mount features of VxFS, such as clones and file system snapshots, do not require the creation of a VxVM volume.

Concurrent I/O support

This feature extends current support for concurrent I/O to cluster file systems. Semantics for concurrent read/write access on a file in a cluster file system matches those for a local mount.

Delaylog supported

The `-o delaylog` mount option is supported with cluster mounts.

Disk layout version supported

Disk layout version 7 is now supported on SFCFS.

Nested mount support

This allows mounts of a VxFS file system on any VxFS mount point. There is no requirement to allow mounts of non-VxFS file system on a shared VxFS mount point. A directory on a shared VxFS file system may be used as a mount point for a VxFS file system, enabling nested mounts of shared file systems. The SFCFS and Veritas Cluster Server (VCS) administration interface is enhanced to support nested mounts.

Multiple transaction servers

With this feature, SFCFS moves from a primary/secondary architecture, where only one node in the cluster processes metadata operations (file creation, deletion, resizing, and so on) to a symmetrical architecture, where all nodes in the cluster can simultaneously process metadata operations. This allows SFCFS to handle significantly higher metadata loads.

System requirements

This section describes the system requirement for this release.

Supported Linux operating systems

Storage Foundation Cluster File System operates on the following Linux operating systems and kernel binaries distributed by Red Hat and SUSE:

- Oracle Enterprise Linux, which is based on, and which has binary compatibility with, Red Hat Enterprise Linux 4 Update 4 (2.6.9-42 kernel) or higher on AMD Opteron or Intel Xeon EM64T (x86_64).
- Red Hat Enterprise Linux 4 (RHEL 4) with Update 3 (2.6.9-34 kernel) or higher on AMD Opteron or Intel Xeon EM64T (x86_64).
- SUSE Linux Enterprise Server 9 (SLES 9) with SP3 (2.6.5-7.244 kernels) or higher on AMD Opteron or Intel Xeon EM64T (x86_64).

Note: If your system is running an older version of either Red Hat Enterprise Linux or SUSE Linux Enterprise Server, you must upgrade it before attempting to install the Veritas Storage Foundation Cluster File System software. Consult the Red Hat or SUSE documentation for more information on upgrading your system.

Supported Linux Operating System Updates

Veritas products will operate on subsequent kernel and patch releases provided the operating systems maintain kernel application binary interface (ABI) compatibility.

Information about the latest supported Red Hat erratas and updates and SUSE service packs is available in the following TechNote. Read this TechNote before installing any Veritas product.

<http://entsupport.symantec.com/docs/281993>

Storage Foundation Cluster File System node requirements

All nodes in a cluster file system must have the same operating system version and update level.

Hardware compatibility

For information on servers, network controllers, and disk subsystems that support SFCFS, see the hardware compatibility list available at <http://entsupport.symantec.com/docs/283161>

Memory requirements

2 GB of memory is required.

Oracle software

Oracle 10g Release 2 (10.2.0.2) is supported for use with Storage Foundation Cluster File System for Oracle RAC.

Component product release notes

In addition to reading these Release Notes, review all component product release notes before installing the product. The following component product release notes are included as PDF files on the Veritas software disc:

Veritas Storage Foundation Release Notes (sf_notes.pdf)

Because release notes are not installed by any packages and are not on the documentation disc, it is recommended that you copy them from the software disc to the `/opt/VRTS/docs` directory so they are available on your system for reference.

Installing for the first time

For new installations of Veritas Storage Foundation Cluster File System, follow the installation procedures that are described in the *Veritas Storage Foundation Cluster File System 5.0 Installation Guide*.

The Veritas Storage Foundation Cluster File System for Oracle RAC software is available as an additional product on the installation menu.

See “[Installing SFCFS for Oracle RAC.](#)”

For the procedures to upgrade Storage Foundation Cluster File System to 5.0 MP2, see the following sections:

- “[Preparing to upgrade to 5.0 MP2](#)” on page 24
- “[Upgrading a cluster system to 5.0 MP2](#)” on page 25
- “[Upgrading an entire cluster to 5.0 MP2](#)” on page 30

Installing SFCFS for Oracle RAC

The product installer is the recommended method to install and license the SFCFS for Oracle RAC software. The installer also enables you to verify preinstallation requirements, to view the description of a product, and to configure a product.

At most points during an installation, you can type **b** (“back”) to return to a previous section of the installation procedure. The back feature of the installation scripts is context-sensitive, so it returns to the beginning of a grouped section of questions. If an installation procedure hangs, use **Control-c** to stop and exit the program. There is a short delay before the script exits.

The following sample procedure is based on the installation of a Veritas Storage Foundation Cluster File System for Oracle RAC cluster with two nodes: “system01” and “system02.” Default responses are enclosed by parentheses. Press **Return** to accept defaults.

If you have obtained a Veritas product from an electronic download site, the single product download files do not contain the installer installation script, so you must use the product installation script, `installsfcsrac`, to install the product.

To install the product

- 1 Log in as superuser.
- 2 Insert the appropriate media disc into your system’s DVD-ROM drive connected to your system.

- 3 After inserting the software disc, type the following command:

```
# mount -o ro /dev/cdrom /mnt/cdrom
```
- 4 Change directory to /mnt/cdrom:

```
# cd /mnt/cdrom
```
- 5 Run the `installer` script to install SFCFS for Oracle RAC. The installer script uses SSH to communicate with remote nodes by default:

```
# ./installer
```

If you want to use RSH, you must specify this on the command line:

```
# ./installer -rsh
```
- 6 From the Installation menu, choose the I option for Install and select the Veritas Storage Foundation Cluster File System for Oracle RAC. You are prompted to continue with the installation.
- 7 Enter **y** to continue with the installation.

```
Do you wish to continue with the installation? [y,n,q] (y)
```
- 8 Enter one or more system names to install SFCFS for Oracle RAC.

```
Enter the system names separated by spaces on which to install SFCFS: system01 system02
```
- 9 Enter the license key for system01.

```
Enter a SFCFS license key for system01?
```
- 10 Enter **y** to accept another license key or enter **n** to proceed.

```
Do you want to enter another license key for system02? [y,n,q] (n)
```
- 11 Enter 1, 2 or 3 to be installed on all systems.

```
Select the rpms to be installed on all systems? [1-3,q,?] (2)
```
- 12 Press **Return** to continue.

```
Press [Return] to continue:
```
- 13 Enter **y** to configure SFCFS for Oracle RAC.

```
Are you ready to configure SFCFS? [y,n,q] (y)
```
- 14 Enter information about the cluster configuration:

```
Enter the unique cluster name: [?]  
Enter the unique Cluster ID number between 0-65535: [b,?]  
  
Discovering NICs on system01 ..... discovered eth0  
inet6 eth1 inet6 sit0  
Enter the NIC for the first private heartbeat link on system01: [b,?]  
Would you like to configure a second private heartbeat link? [y,n,q,b,?] (y)  
Enter the NIC for the second private heartbeat link on system01: [b,?]  
Are you using the same NICs for private heartbeat links on all systems? [y,n,q,b,?] (y)
```

```
.  
. .  
. .  
Is this information correct? [y,n,q] (y)
```

Note that it is recommended that you configure a second heartbeat link. See [“Avoiding the Serial Split Brain condition”](#) on page 37.

- 15** Enter **y** or **n** to configure SFCFS to use Veritas Security Services.

```
Would you like to configure SFCFS to use Veritas Security  
Services? [y,n,q] (n)
```

- 16** Enter **y** or **n** to set the user name and password for the Cluster Monitor.

```
Do you want to set the username and/or password for the Admin  
user (default username = 'admin', password= 'password')?  
[y,n,q] (n)
```

- 17** Enter **y** or **n** to add another user to the cluster.

```
Do you want to add another user to the cluster? [y,n,q] (y)
```

- 18** Enter **y** if the information is correct.

```
Is this information correct? [y,n,q] (y)
```

- 19** Enter **y** or **n** to configure SMTP notification.

```
Do you want to configure SMTP notification? [y,n,q] (y)
```

- 20** Enter **y** or **n** to configure SNMP notification.

```
Do you want to configure SNMP notification? [y,n,q] (y)
```

- 21** Enter **y** to set up a default disk group or **n** to continue.

```
Do you want to set up a default disk group for each system?  
[y,n,q,?] (y)
```

- 22** Enter **y** to accept the fully qualified domain name.

```
Is the fully qualified hostname of system "system01" =  
system01.veritas.com"? [y,n,q]
```

- 23** Enter **y** to accept the fully qualified domain name.

```
Is the fully qualified hostname of sytem "system02" =  
system02.veritas.com"? [y,n,q]
```

- 24** Enter **y** or **n** to configure Storage Foundation Management Server Management.

```
Enable Storage Foundation management Server Mangement?  
[y,n,q] (y)
```

```
.  
. .  
. .
```

```
Starting SFCFS: 100%
```

```
Configuring CFS agents for SFCFSHA:
```

```
Confirming VxVM configuration daemons startup....All  
systems Enabled
```

```
Starting CFS agents.....Started  
You declined to set up the name of the default disk group  
for system01.  
You declined to set up the name of the default disk group for  
system02.
```

Installation log files, summary file, and response file are saved at:

```
/opt/VRTS/install/logs/installer-30ibjC
```

See the Storage Foundation Cluster File System Administrator's Guide for more information.

Using the log files

After product installation, the installation scripts create three text files in the `/opt/VRTS/install/logs` directory. Do not remove the log files until the Veritas products are working properly on your system. Technical Support will need these log files for debugging purposes.

Installation log file

The installation log file contains commands executed during the procedure, the output, and any errors generated by the commands. This file is for debugging installation problems and can be used by Veritas Technical Services.

Response file

The response file contains the configuration information entered during the procedure. The response file can be used for future installations by invoking an installation script with the `responsefile` option. The response file passes arguments to the script to automate the installation. This file can be edited to automate the installation of additional systems.

Summary file

The summary file contains output of the Veritas product installation scripts. This file shows which products were installed, where the log and response files are for a particular installation, and the messages displayed at the end of the installation.

Preparing to upgrade to 5.0 MP2

If you are upgrading an installed Veritas Storage Foundation 5.0 or 5.0 RP1 system, read the *Veritas Storage Foundation Installation Guide* or *Veritas Storage Foundation Cluster File System Installation Guide* for instructions on how to preserve the existing configuration information.

In particular, perform the following actions:

- Make a record of the mount points for VxFS file systems and VxVM volumes that are defined in the `/etc/fstab` file. You will need to recreate these entries in the `/etc/fstab` file on the freshly installed system.
- Before upgrading, ensure that you have made backups of all data that you want to preserve. In particular, you will need the information in files such as `/boot/grub/menu.lst`, `/etc/grub.conf`, `/etc/elilo.conf`, or `/etc/lilo.conf` (as appropriate), and `/etc/fstab`. You should also run the `vxlicrep`, `vxdisk list`, and `vxprint -ht` commands, and record the output from these. You may need this information to reconfigure your system after the upgrade.
- Use the `vxlicrep` command to make a record of the currently installed Veritas licenses.
- Verify that `/opt/VRTS/bin` is in your PATH so you can execute all product commands.

You should also review the *Veritas Storage Foundation Release Notes* or *Veritas Storage Foundation Cluster File System Release Notes*, and all documents in the `release_notes` directory for important release information.

Upgrading a cluster system to 5.0 MP2

An upgrade requires stopping cluster failover functionality during the entire procedure. The upgrade is performed in a number of stages depending on the type of upgrade you are performing. The supported upgrade paths are:

- SFCFS 5.0 to 5.0 MP2
- SFCFS 5.0 RP1 to 5.0 MP2

Note: Upgrading from Storage Foundation Cluster File System or Storage Foundation for Oracle RAC to Storage Foundation Cluster File System for Oracle RAC is not supported.

Caution: Phased upgrade procedure results in system PANIC on configurations where LLT is configured over UDP and this known issue is fixed in 5.0 MP2. This issue is specific to configurations where LLT is configured over UDP and not present in usual LLT Ethernet configurations.

Full upgrade procedure should be used for upgrading from SFCFS 5.0 or SFCFS 5.0 RP1 on configurations where LLT is configured over UDP.

Phased upgrade stages

A phased upgrade minimizes downtime by upgrading portions of the cluster, one at a time. Although the entire cluster is offline for a shorter period than a full upgrade, this method requires command-line interaction and some manual configuration.

Stages of a phased upgrade

- 1 Freeze service group operations and stop VCS on the cluster.
- 2 Select a group of one or more cluster nodes to upgrade, and leave a group of one or more nodes running.
- 3 Take the first group offline and install the software patches.
- 4 Take the second group offline **before** bringing the first group online.
- 5 Bring the first group (with the newly installed patches) online to restart cluster failover services.
- 6 Upgrade the remaining nodes in the second group and bring them online. The cluster is fully restored.

Proceed to “[Performing a phased upgrade of a cluster to 5.0 MP2](#)” on page 26.

Full upgrade stages

A full upgrade upgrades the product on the entire cluster and the cluster remains offline for the duration of the procedure. Minimal command-line interaction and some manual configuration are required.

Stages of a full upgrade

- 1 Freeze service group operations and stop VCS on the cluster.
- 2 Take all nodes in the cluster offline and install the software patches.
- 3 Bring all the nodes (with the newly installed patches) online to restart cluster failover services. The cluster is fully restored.

Proceed to “[Upgrading an entire cluster to 5.0 MP2](#)” on page 30.

Performing a phased upgrade of a cluster to 5.0 MP2

This section describes how to perform a phased upgrade of a cluster to 5.0 MP2.

Caution: Existing data could be destroyed on any disks that are touched by upgrading the operating system. While upgrading, do not reconfigure any disks other than the root disk. To ensure the integrity of your data, it is recommended that you back it up before starting the upgrade.

To upgrade to 5.0 MP2

- 1 Log in as superuser.
- 2 From any node in the cluster, make the VCS configuration writable:

```
# haconf -makerw
```
- 3 Enter the following command to freeze HA service group operations on each node:

```
# hasys -freeze -persistent node_name
```
- 4 Make the configuration read-only:

```
# haconf -dump -makero
```
- 5 Select the group of nodes that are to be upgraded first, and follow [step 6](#) through [step 32](#) for these nodes.
- 6 Stop VCS by entering the following command on each node in the group being upgraded:

```
# hastop -local
```

Note: Do not use the `-force` option when executing `hastop`. This will leave all service groups online and shut down Veritas Cluster Server (VCS), causing undesired results while upgrading the packages.

All nodes in a cluster must currently be running the Veritas Storage Foundation Cluster File System 5.0 software, and the correct licenses must be present on these system.

- 7 Check if each node's root disk is under VxVM control by running this command:

```
# df -v /
```

The root disk is under VxVM control if `/dev/vx/dsk/rootvol` is listed as being mounted as the root (`/`) file system. If so, `unmirror` and `unencapsulate` the root disk as described in the following steps:

- a Use the `vxplex` command to remove all the plexes of the volumes `rootvol`, `swapvol`, `usr`, `var`, `opt` and `home` that are on disks other than the root disk.

For example, the following command removes the plexes `mirrootvol-01`, and `mirswapvol-01` that are configured on a disk other than the root disk:

```
# vxplex -o rm dis mirrootvol-01 mirswapvol-01
```

Do not remove the plexes on the root disk that correspond to the original disk partitions.

- b Enter the following command to convert all the encapsulated volumes in the root disk back to being accessible directly through disk partitions instead of through volume devices. There must be at least one other disk in the `rootdg` disk group in addition to the root disk for `vxunroot` to succeed.

```
# /etc/vx/bin/vxunroot
```

Following the removal of encapsulation, the system is rebooted from the unencapsulated root disk.

- 8 If required, upgrade the nodes, and patch them to a supported kernel version. For more information on supported operating systems and kernel versions, see "[System requirements](#)" on page 18.
- 9 On each node, use the following command to check if any VxFS file systems or Storage Checkpoints are mounted:

```
# df -T | grep vxfs
```

- 10 On each node in the cluster, unmount all Storage Checkpoints and file systems:

```
# umount /checkpoint_name  
# umount /filesystem
```

- 11 Stop activity to all VxVM volumes. For example, stop any applications such as databases that access the volumes, and unmount any file systems that have been created on the volumes.
- 12 On each node, stop all VxVM volumes by entering the following command for each disk group:

```
# vxvol -g diskgroup stopall
```
- 13 Comment out any mount points in the `/etc/fstab` file for Veritas File Systems, or for any file systems that are configured on VxVM volumes.
- 14 Check if the VEA service is running:

```
# /opt/VRTS/bin/vxsvcctl status
```

If the VEA service is running, stop it:

```
# /opt/VRTS/bin/vxsvcctl stop
```
- 15 Insert the disc containing the Veritas software into the DVD-ROM drive, and mount the disc on a suitable mount point, for example:

```
# mount -o ro /dev/cdrom /mnt/cdrom
```
- 16 Move to the top-level directory on the DVD:

```
# cd /mnt/cdrom
```
- 17 To upgrade the Storage Foundation Cluster File System, you must invoke the `installmp` command from one of your cluster nodes using the option that corresponds to your configuration:
 - To install on the local system only, enter the following command:

```
# ./installmp
```
 - To install on more than one system using secure shell (SSH) utilities, enter the following command:

```
# ./installmp node_name1 node_name2 ...
```
 - To install on more than one system using remote shell (RSH) utilities, enter the following command:

```
# ./installmp node_name1 node_name2 ... -rsh
```
- 18 After the initial system checks are complete, press **Return** to start the requirements checks.
- 19 After the requirements checks are complete, press **Return** to start upgrading the packages. If you are upgrading multiple nodes, you have the option of upgrading them simultaneously. You will be prompted after the upgrade is complete.
- 20 When installation is complete, note the locations of the summary, log, and response files indicated by the installer.
- 21 Stop VCS on each of the second group of nodes:

```
# hastop -local
```

- 22 Reboot the upgraded nodes. Assuming the reboot was successful, application failover is now available for the first group of nodes.
- 23 If you need to re-encapsulate and mirror the root disk on each of the nodes, follow the procedures in the “Administering disks” chapter of the *Veritas Volume Manager Administrator’s Guide*.
- 24 If necessary, reinstate any missing mount points in the `/etc/fstab` file on each node.
- 25 If any VCS configuration files need to be restored, stop the cluster, restore the files to the `/etc/VRTSvcs/conf/config` directory, and restart the cluster.
- 26 Make the VCS configuration writable again from any node in the upgraded group:

```
# haconf -makerw
```
- 27 Enter the following command on each node in the upgraded group to unfreeze HA service group operations:

```
# hasys -unfreeze -persistent node_name
```
- 28 Make the configuration read-only:

```
# haconf -dump -makero
```
- 29 Bring the CVM service group online on each node in the upgraded group:

```
# hagrps -online cvm -sys node_name
```
- 30 Restart all the volumes by entering the following command for each disk group:

```
# vxvol -g diskgroup startall
```
- 31 Remount all VxFS file systems and Storage Checkpoints on all nodes:

```
# mount /filesystem
# mount /checkpoint_name
```
- 32 Check if the VEA service was restarted:

```
# /opt/VRTS/bin/vxsvcctrl status
```

If the VEA service is not running, restart it:

```
# /opt/VRTS/bin/vxsvcctrl start
```
- 33 Repeat [step 6](#) through [step 32](#) for the second group of nodes.

Upgrading an entire cluster to 5.0 MP2

The following procedure describes upgrading an entire cluster to 5.0 MP2.

Caution: Existing data could be destroyed on any disks that are touched by upgrading the operating system. While upgrading, do not reconfigure any disks other than the root disk. To ensure the integrity of your data, it is recommended that you back it up before starting the upgrade.

To upgrade the Storage Foundation software on an entire cluster

- 1 Log in as superuser.
- 2 Run the following command on any node in the cluster:

```
# hastop -all
```

This stops VCS on all nodes in the cluster.
- 3 Check if each node's root disk is under VxVM control by running this command:

```
# df -v /
```

The root disk is under VxVM control if `/dev/vx/dsk/rootvol` is listed as being mounted as the root (`/`) file system. If so, unmirror and unencapsulate the root disk as described in the following steps:
 - a Use the `vxplex` command to remove all the plexes of the volumes `rootvol`, `swapvol`, `usr`, `var`, `opt` and `home` that are on disks other than the root disk.
For example, the following command removes the plexes `mirrootvol-01`, and `mirswapvol-01` that are configured on a disk other than the root disk:

```
# vxplex -o rm dis mirrootvol-01 mirswapvol-01
```

Do not remove the plexes on the root disk that correspond to the original disk partitions.
 - b Enter the following command to convert all the encapsulated volumes in the root disk back to being accessible directly through disk partitions instead of through volume devices. There must be at least one other disk in the `rootdg` disk group in addition to the root disk for `vxunroot` to succeed.

```
# /etc/vx/bin/vxunroot
```

Following the removal of encapsulation, the system is rebooted from the unencapsulated root disk.
- 4 If required, upgrade your system, and patch it to a supported kernel version. For more information on supported operating systems and kernel versions, see “[System requirements](#)” on page 18.

- 5 Use the following command to check if any VxFS file systems or Storage Checkpoints are mounted:

```
# df -T | grep vxfs
```
- 6 Unmount all Storage Checkpoints and file systems:

```
# umount /checkpoint_name  
# umount /filesystem
```
- 7 Stop activity to all VxVM volumes. For example, stop any applications such as databases that access the volumes, and unmount any file systems that have been created on the volumes.
- 8 Stop all VxVM volumes by entering the following command for each disk group:

```
# vxvol -g diskgroup stopall
```

To verify that no volumes remain open, use the following command:

```
# vxprint -Aht -e v_open
```
- 9 Check if the VEA service is running:

```
# /opt/VRTS/bin/vxsvcctl status
```

If the VEA service is running, stop it:

```
# /opt/VRTS/bin/vxsvcctl stop
```
- 10 Insert the disc containing the Veritas software into the DVD-ROM drive, and mount the disc on a suitable mount point, for example:

```
# mount -o ro /dev/cdrom /mnt/cdrom
```
- 11 Move to the top-level directory on the DVD:

```
# cd /mnt/cdrom
```
- 12 To upgrade the Storage Foundation Cluster File System, you must invoke the `installmp` command from one of your cluster nodes using the option that corresponds to your configuration:
 - To install on the local system only, enter the following command:

```
# ./installmp
```
 - To install on more than one system using secure shell (SSH) utilities, enter the following command:

```
# ./installmp node_name1 node_name2 ...
```
 - To install on more than one system using remote shell (RSH) utilities, enter the following command:

```
# ./installmp node_name1 node_name2 ... -rsh
```
- 13 After the initial system checks are complete, press **Return** to start the requirements checks.
- 14 After the requirements checks are complete, press **Return** to start upgrading the packages. You have the option of upgrading all the cluster nodes simultaneously. You will be prompted after the upgrade is complete.

- 15 When installation is complete, note the locations of the summary, log, and response files indicated by the installer.
- 16 After the upgrade of the packages is complete, use the following command to shut down the system:

```
# shutdown -r now
```
- 17 Reboot the system.
- 18 If you need to re-encapsulate and mirror the root disk on each of the nodes, follow the procedures in the “Administering disks” chapter of the *Veritas Volume Manager Administrator’s Guide*.
- 19 Reinstate any missing mount points in the `/etc/fstab` file.
- 20 If any VCS configuration files need to be restored, stop the cluster, restore the files to the `/etc/VRTSvcs/conf/config` directory, and restart the cluster.
- 21 Restart all the volumes by entering the following command for each disk group:

```
# vxvol -g diskgroup startall
```
- 22 Remount all VxFS file systems and Storage Checkpoints:

```
# mount /filesystem
# mount /checkpoint_name
```
- 23 Check if the VEA service was restarted:

```
# /opt/VRTS/bin/vxsvcctl status
```

If the VEA service is not running, restart it:

```
# /opt/VRTS/bin/vxsvcctl start
```

Verifying software versions

To list the Veritas packages installed on your system, enter the following command:

```
# rpm -qa | grep VRTS
```


Removing 5.0 MP2

Roll back of the 5.0 MP2 packages to a previous version of the packages is not supported. To restore release 5.0 on your system, you must completely remove 5.0 MP2, then reinstall Veritas Storage Foundation Cluster File System 5.0.

To uninstall the Veritas software

- 1 Log in as superuser.
- 2 Verify that `/opt/VRTS/bin` is in your `PATH` so you can execute all product commands.
- 3 Run the `hastop -all` command to take all service groups offline, and shut down VCS:

```
# /opt/VRTSvc/bin/hastop -all
```

Note: Do not use the `-force` option when executing `hastop`. This will leave all service groups online and shut down VCS, causing undesired results during uninstallation of the packages.

- 4 Use the following command to check if any VxFS file systems or Storage Checkpoints are mounted:

```
# df -T | grep vxfs
```
- 5 Unmount all Storage Checkpoints and file systems:

```
# umount /checkpoint_name  
# umount /filesystem
```
- 6 Stop activity to all VxVM volumes. For example, stop any applications such as databases that access the volumes, and unmount any file systems that have been created on the volumes.
- 7 Stop all VxVM volumes by entering the following command for each disk group:

```
# vxvol -g diskgroup stopall
```

To verify that no volumes remain open, use the following command:

```
# vxprint -Aht -e v_open
```

Software limitations

Veritas Storage Foundation Cluster File System software limitations in the 5.0 release are listed in the *Veritas Storage Foundation Cluster File System 5.0 Release Notes*.

The *Veritas Storage Foundation Cluster File System 5.0 Release Notes* can be viewed at the following URL:

<http://entsupport.symantec.com/docs/283857>

The Veritas Storage Foundation, Veritas Volume Manager, Veritas File System, Veritas Volume Replicator, and Veritas Storage Foundation for Databases software limitations are listed in the *Veritas Storage Foundation 5.0 MP2 Release Notes*.

The Storage Foundation Cluster File System for Oracle RAC software has the following limitations in this MP2 release:

- Storage Foundation Management Server is only supported for managed hosts; it is not supported for centralized servers.
- Although I/O Fencing may be enabled, it is not supported for use with SFCFS for Oracle RAC.

Security-enhanced Linux

Security-enhanced Linux (SELinux) support is provided for evaluation purposes only. Security policy files are not currently available for the Veritas product stack.

To disable SELinux at boot time on both SLES9 and RHEL4, set the kernel boot parameter `selinux` to 0 (`selinux=0`) and reboot the machine.

Assuming the system has been configured for booting from the machine *machine_name*, edit the file `/boot/machine_name/menu.lst` to include `selinux=0` on the kernel line. Then reboot the machine to ensure the setting takes effect.

Fixed issues

Veritas Storage Foundation Cluster File System fixed issues in the 5.0 release are listed in the *Veritas Storage Foundation Cluster File System 5.0 Release Notes*.

The *Veritas Storage Foundation Cluster File System 5.0 Release Notes* can be viewed at the following URL:

<http://entsupport.symantec.com/docs/283857>

The Veritas Storage Foundation, Veritas Volume Manager, Veritas File System, Veritas Volume Replicator, and Veritas Storage Foundation for Databases fixed issues are listed in the *Veritas Storage Foundation 5.0 MP2 Release Notes*.

The following are new Veritas Storage Foundation Cluster File System fixed issues in the MP1 and MP2 releases:

Incident	Description
612406	Push the entire extent for an iList hole. This will prevent multi-entry holes.
645227	The file system was hanging due to a rare race between the merge and activation of File Change Log (FCL) which led to a deadlock. The problem has been resolved by ensuring that the merge threads try for the FCL global lock and proceed only if the lock is available.
770917	In some code paths related to large directory support, the cluster member (node) was not taking and holding the ownership of the inode for which the extents are to be re-organized. So, an assertion was being triggered when another member node of the cluster tried to revoke ownership of the inode. The problem has been resolved by correcting the ownership issues in large directory related code paths.
771892	A deadlock was occurring during CFS recovery. Log replay, which is performed as the first step during CFS recovery when a node crashes, was found to block in certain scenarios on an inode that the replay is trying to process. The problem has been resolved by freeing all inodes in the chunk one at a time without marking other inodes as busy.

Incident	Description
771970	When a file is truncated, the truncate request is shipped to the cluster member that has the current ownership of the inode. There were certain inconsistencies in pre-splitting a buffer in the presence of clones, when the truncate request was shipped to another node of the cluster leading to an assertion. The problem has been resolved by changing the truncation code paths to handle the pre-splitting of buffers at a later stage during truncation, for both locally mounted and cluster mounted file systems.
771999	A node in a cluster was hanging under heavy CFS activity in the cluster. When all the worker threads servicing callbacks from a queue were blocked, the callbacks that were still lying in the same queue faced a deadlock. The problem has been resolved by queuing the callbacks that need to be processed to unblock other callbacks into a different queue, and processing them at a higher priority.
775611	Upon encountering an I/O error, the file system is correctly disabled but an internal inconsistency check fails. The check failure in this instance is quite benign and cannot cause customer data corruption since the file system is safely disabled upon encountering an I/O error of this nature. To further diagnose this condition, a new consistency check has been added.
782024	Under heavy inode cache stress, file system recovery on a cluster file system was hanging after an I/O error. The problem has been resolved by ensuring that the code paths that attempt to reuse an inode do not wait for a dirty/bad/inactive inode to become free if recovery initiated by a disabled file system is currently in progress. If there are no inodes available for re-use, a new inode will be allocated to ensure that the recovery proceeds to completion.
793030	The vxfsutil.h was using 'struct timeval' in one of the function declarations without including time.h resulting in a warning message during compilation. The problem has been resolved by including time.h in vxfsutil.h.

For a list of additional issues fixed in this release, see the following TechNote:
<http://entsupport.symantec.com/docs/285869>

Known issues

Veritas Storage Foundation Cluster File System known issues in the 5.0 release are listed in the *Veritas Storage Foundation Cluster File System 5.0 Release Notes*.

The *Veritas Storage Foundation Cluster File System 5.0 Release Notes* can be viewed at the following URL:

<http://entsupport.symantec.com/docs/283857>

The Veritas Storage Foundation, Veritas Volume Manager, Veritas File System, Veritas Volume Replicator, and Veritas Storage Foundation for Databases known issues are listed in the *Veritas Storage Foundation 5.0 MP2 Release Notes*.

The following are new known issues in the MP1 and MP2 releases:

I/O Fencing

Veritas Storage Foundation Cluster File System for Oracle RAC is not licensed to support the I/O Fencing feature. If you use the product installer or installation scripts, you are not given the option during installation to enable I/O Fencing, and the I/O Fencing driver will be disabled. If you install the product manually, use the file `/etc/vxfen.d/vxfenmode_disabled` as a template for the `/etc/vxfenmode` configuration file.

If you subsequently enable I/O Fencing, importing a shared disk group will fail with the following error message:

```
VxVM vxvg ERROR V-5-1-10978 Disk group shared_dg: import failed:  
License has expired or is not available for operation
```

To verify the state of the I/O Fencing driver, use the `/sbin/vxfenadm -d` command.

Avoiding the Serial Split Brain condition

SFCFS for Oracle RAC does not include support for the I/O Fencing feature. As a result, SFCFS requires that two heartbeat links be configured during installation. When a node is reduced to a single heartbeat connection, SFCFS can no longer discriminate between the loss of a system and the loss of the final network connection. This “jeopardy” state affects all applications that use the cluster file system mount points. (Jeopardy cannot be avoided as the I/O Fencing feature is not available.)

If a node fails after the jeopardy state has been notified, all the cluster nodes cease to be members of the shared disk group, and the mounted cluster file systems are disabled on all the nodes in the cluster. This action is taken to prevent potential data corruption as SFCFS is neither aware of, nor can it coordinate with, the native fencing support feature of Oracle.

See the *Veritas Storage Foundation Cluster File System Administrator's Guide*.

Also note that if one of the following events occurs, Oracle's native fencing will evict the problem node from the cluster:

- Simultaneous failure of both heartbeat links to a node.
- A node hangs and is unable to respond to heartbeat messages.

The surviving cluster nodes will be unaffected and continue to operate.

ODM is incompatible with auditing on SLES9

Oracle Disk Manager (ODM) is incompatible with the auditing subsystem on SUSE Linux Enterprise Server 9 systems.

Uninstallation and upgrade issues

If Veritas Storage Foundation for Oracle and Veritas Storage Foundation Cluster File System are installed on the same machine, do not use the installer to uninstall if you are planning to uninstall only one product.

If you want to uninstall the product, you must uninstall the Veritas Storage Foundation for Oracle packages manually.

To uninstall the Veritas Storage Foundation for Oracle packages

- 1 Review the uninstallation requirements in the *Veritas Storage Foundation Installation Guide*.
- 2 Stop the repository database and unmount the repository volume.

In a stand-alone configuration:

Stop the database repository:

```
# /opt/VRTSdbcom/bin/sfua_db_config -o stopdb
```

Unmount the database repository:

```
# /opt/VRTSdbcom/config/sfua_rep_mount stop
```

In an HA configuration: Stop VCS processes on either the local system or all systems.

To stop VCS processes on the local system:

```
# hstop -local
```

To stop VCS processes on all systems:

```
# hstop -all
```

- 3 Remove the Veritas Storage Foundation for Oracle packages by using the `rpm -e` command:

```
# rpm -e VRTSorgui-common VRTSdbed-common VRTSdbcom-common \ VRTSdbdoc
```

If Veritas Storage Foundation for Oracle and Veritas Storage Foundation Cluster File System are installed on the same machine and you are upgrading both products, use the installer to upgrade Veritas Storage Foundation Cluster File System first. Then, use the installer to upgrade Veritas Storage Foundation for Oracle.

If the second upgrade fails, remove the Veritas Storage Foundation for Oracle packages as described above, then run the installer to upgrade Veritas Storage Foundation for Oracle. [840486]

Documentation errata

Veritas Storage Foundation Cluster File System Administrator's Guide errata

On page 45, the procedure in “Setting up the disk group for coordinator disks” is incorrect. The following procedure should be used instead:

Setting up the disk group for coordinator disks

The disk group for the coordinator disks must contain an odd number of disk devices with a minimum of three devices. It is recommended that you use only three coordinator disks, and that you use small LUNs to conserve disk space. The default size of the private region is 32 megabytes, but a smaller size can be specified.

If you have already added and initialized disks that you intend to use as coordinator disks, you can begin the following procedure at step 5.

To set up the disk group for coordinator disks

- 1 Add the three disks or create the three LUNs that are to be used as coordinator disks. All cluster nodes must be able to access these devices. (This procedure assumes that the disks have the device names `sdz`, `sdaa`, and `sdab`.)
- 2 Use the `vxdisk scandisks` command to scan the disks and their attributes. This command updates the VxVM device list and reconfigures DMP with the new devices.

```
# vxdisk scandisks
```

- 3 Use the `vxdisksetup` command to initialize each disk as a VxVM disk. In the following example, the CDS format is specified for the disk `sdz`, and the size of the private region is set to 512 kilobytes:

```
# vxdisksetup -i sdz format=cdsdisk privlen=512k
```

- 4 Test the disks for SCSI-3 persistent reservation support. If the size of a LUN is 1 megabyte or greater, you can use the `vxfcntlsthaw` command.
- 5 On the master node of the cluster, create the disk group for the disks, such as `vxfcntlsg`, specifying the device names of all three coordinator disks:

```
# vxvg -o coordinator=on init vxfcntlsg sdz sdaa sdab
```