VERITAS™

VERITAS Storage Foundation 4.1 *for Oracle RAC*

Release Notes

Linux

Maintenance Pack 1

December 2005

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Release Notes: VERITAS Storage Foundation *for Oracle RAC* 4.1 Maintenance Pack 1

This document provides important information regarding Storage Foundation *for Oracle RAC* (SFRAC) version 4.1 for Red Hat Enterprise Linux 4.0 (on x86 architecture) and SUSE Linux Enterprise Server 9 (on x86_64 and IA 64 architectures). Please review this entire document before installing Storage Foundation *for Oracle RAC*.

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

http://support.veritas.com/docs/277033

The VERITAS Storage Foundation *for Oracle RAC* software is an integrated set of software products. It enables administrators of Oracle Real Application Clusters (RAC) to operate a database in an environment of cluster systems running VERITAS Cluster Server (VCS) and the cluster features of VERITAS Volume Manager™ and VERITAS File System™, also known as CVM and CFS, respectively.

Acronyms used for VERITAS Storage Foundation *for Oracle RAC* component products:

CVM	VERITAS Volume Manager cluster functionality
CFS	VERITAS File System cluster functionality
VCS	VERITAS Cluster Server
VEA	VERITAS Enterprise Administrator graphical user interface
VxFS	VERITAS File System
VxVM	VERITAS Volume Manager

Product components are described in the VERITAS Storage Foundation *for Oracle RAC Installation and Configuration Guide*.

New Features

This release of Storage Foundation *for Oracle RAC* adds support for:

◆ Red Hat Enterprise Linux 4 Update 2

◆ SUSE Linux Enterprise Server 9 Service Pack 2 with patch 201

◆ SUSE Linux Enterprise Server 9 Service Pack 3

To verify the latest information on support for Oracle database versions, see the VERITAS Technical Support TechNote:

http://support.veritas.com/docs/277033

Not supported in this release:

◆ Red Hat Enterprise Linux 3

End of Support

This is the last release of VERITAS Storage Foundation *for Oracle RAC* to support 32-bit operating systems on Linux.

Installation Notes

◆ "Supported Hardware" on page 2

◆ "Supported Software" on page 3

◆ "System Requirements" on page 4

◆ "Storage Foundation for Oracle RAC Packages" on page 5

◆ "Installing 4.1 Maintenance Pack 1 (MP1) on Clean Systems" on page 6

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Supported Hardware

Before installing or upgrading SFRAC, review the current compatibility list to confirm the compatibility of your hardware and software. See http://support.veritas.com.

Supported Software

Storage Foundation *for Oracle RAC* operates on the following Linux operating systems and kernel binaries distributed by Red Hat and SUSE:

Operating System	Architecture	Kernel
Red Hat Enterprise Linux 4 Update 1	x86 (32-bit)	2.6.9-11EL 2.6.9-11ELsmp 2.6.9-11ELhugemem
Red Hat Enterprise Linux 4 Update 2	x86 (32-bit)	2.6.9-22EL 2.6.9-22ELsmp 2.6.9-22ELhugemem
	x86_64 (Intel Xeon, AMD Opteron)	2.6.9-22EL 2.6.9-22ELsmp
SUSE Linux Enterprise Server 9 Service Pack 2 with Patch 201	IA64 (Intel)	2.6.5-7.201-default
	x86_64 (Intel Xeon, AMD Opteron)	2.6.5-7.201-smp 2.6.5-7.201-default
SUSE Linux Enterprise Server 9 Service Pack 3	IA64 (Intel)	2.6.5-7.241-default or higher
	x86_64 (Intel Xeon, AMD Opteron)	2.6.5-7.241-smp or higher 2.6.5-7.241-default or higher

For SLES9 SP2 installations, kernel version 2.6.5-7.201 or greater is required because versions 2.6.5-7.191 (SP2) and 2.6.5-7.193 have a bug (Incident 425945) that stops dynamic multipathing (DMP) failover from working. This is fixed in the 2.6.5-7-201 kernel version, which is available from the SUSE Linux maintenance web site. A SUSE Portal login and password are required to access this URL.

On IA64 systems, upgrading SLES 9 to SP2 removes the `sfdisk` binary, which is required by VERITAS Volume Manager. See TechNote 278873 for instructions on how to install this binary:

http://support.veritas.com/docs/278873

Installing Linux patches: No specific patches are required for Storage Foundation *for Oracle RAC*. However, Oracle9*i* Release 2 software on Red Hat Enterprise Linux 4.0 requires a number of patches. These patches, and other manual steps that need to be executed before installing Oracle, are available at Oracle's metalink site.

For RHEL4, disable SELinux or Security Enhanced Linux during OS installation.

For RHEL4, disable Firewall during OS installation.

For SLES9, do not use the auditing subsystem. ODM is not compatible with the auditing subsystem on SLES 9.

VERITAS Software: Only versions of VCS, VxVM, and VxFS provided on the software CD are supported. Other versions must be removed before the software from the VERITAS Storage Foundation for Oracle RAC CD is installed.

Software combinations are supported for VERITAS Storage Foundation for Oracle RAC:

Oracle Version	RHEL 4.0 Update 2			SLES9 SP2 or SP3		
	x86_32	x86_64	IA 64	x86_32	x86_64	IA64
9.2.0.7	Yes	N/A	N/A	N/A	N/A	N/A
10.1.0.4	Yes	No	No	No	Yes	Yes
10.2.0.1	Yes	Yes	No	No	Yes	Yes

SUSE Linux Enterprise Server 9 on IA64 architecture requires Oracle patch #3875155.

To verify the latest information on support for Oracle database versions, see the VERITAS Technical Support TechNote:

http://support.veritas.com/docs/277033

System Requirements

- VERITAS Storage Foundation *for Oracle RAC* supports RAC clusters of up to eight nodes. We recommend that each system have two or more CPUs at 2GHz or higher.

- Disk space, locally: approximately 500 MB; review the installation requirements in the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

- 1 GB or more of physical memory is recommended.

- Shared storage: The storage units used by Storage Foundation for Oracle RAC 4.1 must support and be enabled for SCSI-3 Persistent Reservations (PR), a requirement for I/O fencing. Refer to "Supported Hardware" on page 2 for additional information.

- Required information for Oracle 10*g* installation:

  - One public base IP address (in DNS) per node

  - One public virtual IP address (in DNS) per node

  - One private IP address per node

Storage Foundation *for Oracle RAC* Packages

VERITAS Storage Foundation *for Oracle RAC* is a licensed product. The *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide* describes how to obtain a license that applies for VERITAS Storage Foundation for Oracle RAC, VERITAS Volume Manager, VERITAS File System, and VERITAS Cluster Server.

Infrastructure Packages Installed

The installer checks for the presence of the infrastructure packages, VRTSvlic (VERITAS Licensing) and VRTScpi (VERITAS Product Installer). If they are not present, or if they are present but not the correct version, they will be installed.

Software Installed for Storage Foundation *for Oracle RAC*

The software components installed by the VERITAS Storage Foundation for Oracle RAC 4.1 installation utility, installsfrac, include:

- ◆ VERITAS Storage Foundation for Oracle RAC 4.1
- ◆ VERITAS Cluster Server (VCS)
- ◆ VERITAS Volume Manager (VxVM)
- ◆ VERITAS Group Lock Manager
- ◆ VERITAS File System (VxFS)
- ◆ VERITAS extension for Oracle Disk Manager (ODM)
- ◆ VERITAS Cluster Server enterprise agent for Oracle

See "Packages Upgraded for Storage Foundation for Oracle RAC 4.1 Maintenance Pack 1" on page 5 for a list of the specific software packages.

Packages Upgraded for Storage Foundation *for Oracle RAC* 4.1 Maintenance Pack 1

```
VRTScpi - VERITAS Product Installer
VRTSvxvmcommon - VERITAS Volume Manager Common Package
VRTSvxvmplatform - VERITAS Volume Manager Platform Specific Package
VRTSvmpro - VERITAS Volume Manager Management Services Provider
VRTSfspro - VERITAS File System Management Services Provider
VRTSalloc - VERITAS Volume Manager Intelligent Storage Provisioning
VRTSddlpr - VERITAS Device Discovery Layer Services Provider
VRTSvxfscommon - VERITAS File System Common Package
VRTSvxfsplatform - VERITAS File System Platform Specific Package
VRTSfsman - VERITAS File System Manual Pages
```

```
VRTSfsdoc - VERITAS File System Documentation
VRTSfssdk - VERITAS File System Software Developer Kit
VRTSfsmnd - VERITAS File System Software Developer Kit Manual Pages
VRTSllt - VERITAS Low Latency Transport
VRTSgab - VERITAS Group Membership and Atomic Broadcast
VRTSvxfen - VERITAS I/O Fencing
VRTSvcs - VERITAS Cluster Server
VRTSvcsdr - VERITAS Cluster Server Disk Reservation Modules and
Utilities
VRTScavf - VERITAS Cluster Server Agents for Cluster File System
VRTSglm - VERITAS Group Lock Manager
VRTSdbac - VERITAS Oracle Real Application Cluster Support Package
VRTSvcsor - VERITAS Cluster Server Oracle Enterprise Extension
VRTScsocw - VERITAS Oracle and RAC Configuration Wizards for Linux
VRTSgms - VERITAS Group Messaging Services
VRTSodmcommon - VERITAS Oracle Disk Manager Common Package
VRTSodmplatform - VERITAS Oracle Disk Manager Platform Specific
Package
```

Installing 4.1 Maintenance Pack 1 (MP1) on Clean Systems

If you are installing the Storage Foundation *for Oracle RAC* 4.1 MP1 software for the first time and not upgrading an existing system, read the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide* for pre-installation instructions.

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, back it up before starting the upgrade.

▼ **To install Storage Foundation *for Oracle RAC* 4.1 MP1 on a clean system**

1. Log in as root on one of the systems for installation.

2. Install the VERITAS Storage Foundation *for Oracle RAC* 4.1 GA software from the release CD as described in the *Storage Foundation for Oracle RAC Installation and Configuration Guide*, Chapters 2 and 3, but run the product installation script instead of the generic installer script. Enter the following command from the top-level directory of the mounted CD:

    # **./installsfrac -installonly** [**-usersh**]

The -installonly option is required to perform the installation without configuring the software. The -usersh option is required if you are using the remote shell (RSH) rather than the secure shell (SSH) to install the software simultaneously on several systems.

> **Note** Provided that the remote shell (RSH) or secure shell (SSH) has been configured correctly, this command can be run on a single node of the cluster to install the software on all the cluster nodes.

3. Download Storage Foundation *for Oracle RAC* 4.1 MP1.

4. Extract the Storage Foundation *for Oracle RAC* installation files.

5. Change to the directory containing the installation program.

6. To install Storage Foundation *for Oracle RAC* 4.1 MP1, you must invoke installmp from one of your cluster nodes using the option that corresponds to your configuration:

   ◆ To install on the local system only:

     # **./installmp**

   ◆ To install on more than one system using secure shell (SSH) utilities:

     # **./installmp *galaxy nebula ...***

   ◆ To install on more than one system using remote shell (RSH) utilities:

     # **./installmp *galaxy nebula ...* -usersh**

7. After the initial system checks are complete, press **Return** to start the requirements checks.

> **Note** All the Storage Foundation for Oracle RAC processes are stopped before uninstalling the rpms. This includes VCS, VM, FS and VEA. While stopping these processes, you may see messages such as: "GAB /sbin/gabconfig ERROR V-15-2-25022 unknown error." These messages can be ignored safely.

8. 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.

9. When installation is complete, note the locations of the summary, log, and response files indicated by the installer.

10. Change directories to: /opt/VRTS/install/

11. Run the same installation script that you used in step 2, this time specifying the
-configure option to configure the software, for example:

> # **./installsfrac -configure** [**-usersh**] **<galaxy> <nebula>**

Configure using the *Storage Foundation for Oracle RAC Installation and Configuration
Guide 4.1*, Chapter 3, beginning on page 39.

12. Install and configure the correct version of Oracle.

▼ **To install and configure Oracle 10***g* **Release 2 on clean systems on all
archictectures**

1. Install Oracle using "Installing Oracle 10g Release 2" on page 33.

2. Configure service groups for Oracle using "Configuring VCS Service Groups for
Oracle 10g Release 2" on page 77.

▼ **To install and configure Oracle 10***g* **Release 1 (10.1.0.4) for clean SLES9 x86_64
systems**

1. Install Oracle 10*g* R1 (10.1.0.3) using Chapter 15, "Installing Oracle 10g Software on
SLES9." on page 265 of the *Storage Foundation for Oracle RAC 4.1 Installation and
Configuration Guide*.

Do not reboot the nodes after installation. Do not create the database or configure
resources using hawizard until you have applied the 10.1.0.4 patchset.

2. Apply the patchset using "Applying Oracle Patchsets" on page 29.

3. Configure service groups for Oracle using Chapter 16, "Configuring VCS Service
Groups for Oracle 10g on SLES9" on page 299 of the *Storage Foundation for Oracle RAC
4.1 Installation and Configuration Guide*.

▼ **To install and configure Oracle 10***g* **Release 1 (10.1.0.4) for clean RHEL4 x86
systems**

1. Install Oracle 10*g* R1 (10.1.0.3) using Chapter 6, "Installing Oracle 10g Software on
Red Hat" on page 95 of the *Storage Foundation for Oracle RAC 4.1 Installation and
Configuration Guide*.

Do not reboot the nodes after installation. Do not create the database or configure
resources using hawizard until you have applied 10.1.0.4 patchset.

2. Apply the patchset using "Applying Oracle Patchsets" on page 29.

3. Configure service groups for Oracle, using Chapter 8, "Configuring VCS Service Groups for Oracle 10g on Red Hat" on page 137 of the *Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

▼ **To install and configure Oracle9*i* Release 2 (9.2.0.7) for clean RHEL4 x86 systems**

1. Install Oracle9*i* R2 using Chapter 11, "Installing Oracle9*i* Software on Red Hat" on page 181, of the *Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

   Do not reboot the nodes after installation. Do not create the database or configure resources using hawizard until you have applied 10.1.0.4 patchset.

2. Apply the patchset using "Applying Oracle Patchsets" on page 29.

3. Configure service groups for Oracle using Chapter 12, "Configuring VCS Service Groups for Oracle9*i* on Red Hat" on page 203 of the *Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

Upgrading to 4.1 Maintenance Pack 1

Upgrading is supported from Storage Foundation *for Oracle RAC* 4.1 to 4.1 MP1. Upgrading from Storage Foundation *for Oracle RAC* 4.0, 4.0 MP1, or 4.0 MP2 is not supported due to the difference in operating systems.

Caution   To uninstall Storage Foundation *for Oracle RAC* 4.1 MP1, you must remove all VERITAS Storage Foundation *for Oracle RAC* software packages. You cannot roll back Maintenance Pack 1 to the previously installed release.

To restore VERITAS Storage Foundation *for Oracle RAC* 4.1 on your system, you must completely remove maintenance pack 1, then reinstall 4.1. Before uninstalling maintenance pack 1, certain configuration files must be backed up to enable rollback of maintenance pack. See "Rolling Back Storage Foundation for Oracle RAC from 4.1 MP1 to 4.1" on page 14.

▼ **To upgrade from 4.1 to 4.1 MP1**

1. Upgrade the OS on all cluster nodes:

   ◆ For SLES9, upgrade to SLES9 SP2 with 201 kernel or upgrade to SLES9 SP3.

   ◆ For RHEL4, upgrade to RHEL4 Update 2.

2. After the OS install reboot the nodes.

For SLES9, none of the VERITAS modules will load. For RHEL4 all the modules will load and Oracle resources will come up.

3. Stop all Oracle resources including the database on all nodes.

For Oracle 10*g*, stop CRS on all nodes:

/etc/init.d/init.crs stop

4. Make sure that no processes are running which make use of mounted shared file system or shared volumes.

5. With Storage Foundation *for Oracle RAC* 4.1 installed and configured, run the following command on all nodes in the Storage Foundation *for Oracle RAC* cluster:

hastop -all

6. Download Storage Foundation *for Oracle RAC* 4.1 MP1.

7. Extract the Storage Foundation *for Oracle RAC* installation files.

8. Log in as root on one of the systems for installation.

9. Change to the directory containing the installation program.

10. Upgrade VRTSperl rpm:

    a. Change to the directory /storage_foundation_for_oracle_rac/rpms.

    b. Copy the VRTSperl rpm on all custer nodes in /tmp including the current node if it is part of the cluster.

    c. Upgrade VRTSperl rpm with following command:

    # **rpm -Uvh /tmp/<VRTSperl rpm>**

11. Create a backup of the existing cluster configuration:

    a. Change to /etc/VRTSvcs/conf/config

    b. Create a backup of main.cf on all cluster nodes:

    # **cp main.cf /etc/main.cf.41**

12. Change to the directory containing the installation program, for instance, installmp.

13. To install Storage Foundation *for Oracle RAC* 4.1 MP1, you must invoke `installmp` from one of your cluster nodes using the option that corresponds to your configuration:

◆ To install using `ssh` (default):

   # **./installmp galaxy nebula**

◆ To install using `rsh`:

   # **./installmp -usersh galaxy nebula**

   The program begins by presenting a copyright message.

14. The installer checks that the systems are ready for installation. At the conclusion of these initial checks, and before installing any rpms, the installer:

◆ Creates a log called `installmp`*date_time* on each system in the directory `/var/tmp`.

◆ Specifies the utilities it uses to communicate with the remote systems; typically this is `ssh -x` and `scp`.

◆ Lists the rpms that it will replace on each system

◆ Backs up the Maintenance Pack 1 (MP1) configuration files

After the installer has all the configuration information, it can replace the rpms on the cluster systems.

Storage Foundation Cluster File System and VERITAS Enterprise Administrator processes must be stopped before adding patches. You are prompted:

```
Do you want to stop these processes and install patches on galaxy?
[y,n,q] (y)
```

Press **Enter** to continue.

Note All the Storage Foundation for Oracle RAC processes are stopped before uninstalling the rpms. This includes VCS, VM, FS and VEA. While stopping these processes, you may see messages such as: "GAB /sbin/gabconfig ERROR V-15-2-25022 unknown error." These messages can be safely ignored.

---

15. Choose whether to replace the rpms consecutively or simultaneously.

16. After you choose the sequence of installing the rpms, the installation process begins to uninstall the rpms that will be replaced, indicating the total number of steps required, based on the number of systems and the chosen configuration options. The installer copies replacement rpms to remote systems before installing them

Press **Enter** to continue.

When replacement of Storage Foundation *for Oracle RAC* rpms is completed successfully, a few more tasks remain before the installation is complete.

17. Press **Enter** to continue when the Cluster Server startup is confirmed as successful. The locations of the installation summary, log and response files:

◆ /opt/VRTS/install/logs/installmpxxxxxxxxxx.summary

◆ /opt/VRTS/install/logs/installmpxxxxxxxxxx.log

◆ /opt/VRTS/install/logs/installmpxxxxxxxxxx.response

The summary, the log, and the response files contain the date as part of their names.

18. Restore the original main.cf on all nodes from the backup created in :

```
# cd /etc/VRTSvcs/conf/config/
# cp /etc/main.cf.41 /etc/VRTSvcs/conf/config
```

19. A reboot is required after installing the Storage Foundation *for Oracle RAC* VERITAS Maintenance Pack 1 for all nodes.

```
# shutdown -r now
```

20. After reboot, all the ports will come up along with Oracle resources. Before you proceed to the Oracle upgrade process, you must shutdown these Oracle resources.

For Oracle 10*g*, CRS should be stopped on all nodes as follows.

```
# /etc/init.d/init.crs stop
```

21. Install and configure the correct version of Oracle.

▼ **To upgrade to Oracle 10*g* Release 2**

1. Install Oracle using "Installing Oracle 10g Release 2" on page 33.

2. Migrate the database using "Migrating Databases to the Latest Installed Version of Oracle" on page 61.

▼ **To upgrade to Oracle 10*g* Release 1 (10.1.0.4) for SLES9 x86_64**

1. Apply the patchset using "Applying Oracle Patchsets" on page 29.

2. Migrate the database using "Migrating Databases to the Latest Installed Version of Oracle" on page 61.

▼ **To upgrade to Oracle 10*g* Release 1 (10.1.0.4) for RHEL4 x86**

   1. Apply the patchset using "Applying Oracle Patchsets" on page 29.

   2. Migrate the database using "Migrating Databases to the Latest Installed Version of Oracle" on page 61.

▼ **To upgrade to Oracle9*i* Release 2 (9.2.0.7) for RHEL4 x86**

   1. Apply the patchset using "Applying Oracle Patchsets" on page 29.

   2. Migrate the database using "Migrating Databases to the Latest Installed Version of Oracle" on page 61.

Operational Notes

See the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide* for complete procedures.

Enabling Fencing

When the installer completes, I/O fencing will be disabled on all nodes of the cluster. I/O fencing must be configured and enabled after the installation of Storage Foundation for Oracle RAC has successfully completed. VERITAS does not support using I/O fencing in disabled mode in a Storage Foundation *for Oracle RAC* environment. See the *VERITAS Storage Foundation for Oracle RACInstallation and Configuration Guide* Chapter 3 for details on configuring I/O fencing in a cluster environment.

Installing and Configuring Oracle 10*g* Release 2

For procedures for installing and configuring Oracle 10*g* Release 2, see:

◆ "Installing Oracle 10g Release 2" on page 33

◆ "Migrating Databases to the Latest Installed Version of Oracle" on page 61

◆ "Configuring VCS Service Groups for Oracle 10g Release 2" on page 77

Adding and Removing a Node on Clusters Using Oracle 10*g* Release 2

For procedures to add or remove a node in a cluster using Oracle 10*g* Release 2, see the VERITAS Technical Support TechNote:

> http://support.veritas.com/docs/280707

Uninstalling Storage Foundation *for Oracle RAC* 4.1 MP1

To uninstall Storage Foundation *for Oracle RAC* 4.1 MP1, you must remove all VERITAS Storage Foundation *for Oracle RAC* software packages. You cannot roll back Maintenance Pack 1 to the previously installed release.

Uninstalling Storage Foundation *for Oracle RAC* 4.1 MP1 without Saving Your Configuration

See "Uninstalling Storage Foundation *for Oracle RAC* on Oracle 10*g* Systems" on page 173 of the *VERITAS Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

Rolling Back Storage Foundation *for Oracle RAC* from 4.1 MP1 to 4.1

Rolling back the Storage Foundation *for Oracle RAC* 4.1 MP1 patch installation is a manual process which involves uninstalling Storage Foundation *for Oracle RAC* completely and reinstalling Storage Foundation *for Oracle RAC* 4.1. You must:

◆ Save your configuration files

◆ Completely remove Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Reinstall VERITAS Storage Foundation *for Oracle RAC* 4.1

◆ Restore your saved configuration files

▼ **To save Storage Foundation *for Oracle RAC* configuration files**

Back up current configuration files on each cluster node. Note that some of the files may not exist.

```
mkdir -p /var/sfrac41mp1-config-save/etc/vx/vras
mkdir -p /var/sfrac41mp1-config-save/etc/VRTSvcs/conf/config

cp -p /etc/llttab /etc/llthosts  /etc/gabtab /etc/vxfendg
/etc/vxfenmode
/var/sfrac41mp1-config-save/etc/ cp -p
/etc/VRTSvcs/conf/config/main.cf
/var/sfrac41mp1-config-save/etc/VRTSvcs/conf/config/
```

```
cp -p /etc/vx/vxddl.exclude /etc/vx/darecs
/etc/vx/disk.info /etc/vx/jbod.info /etc/vx/.aascsi3
/etc/vx/.apscsi3 /etc/vx/volboot
/etc/vx/array.info /etc/vx/ddl.support /etc/vx/disks.exclude
/etc/vx/cntrls.exclude
/etc/vx/enclr.exclude /etc/vx/.newnames /etc/vx/guid.state
/etc/vx/vxvm_tunables
/etc/vx/vxdmp_tunables  /etc/vx/vvrports
/var/sfrac41mp1-config-save/etc/vx

cp -p /etc/vx/vras/.rdg /etc/vx/vras/vras_env
/var/sfrac41mp1-config-save/etc/vx/vras/
```

▼ **To uninstall Storage Foundation for Oracle RAC 4.1 MP1**

1. Stop Oracle and CRS on each cluster node.

```
/etc/init.d/init.crs stop
```

2. Unencapsulate root disk if necessary.

df /

The root disk is under VxVM control if /dev/vx/dsk/rootvol is listed as being mounted as the root (/) file system.

vxplex -o rm dis mirrootvol-01 mirswapvol-01
/etc/vx/bin/vxunroot

3. Unmount all vxfs mounts and all file systems on VxVM volumes.

4. Stop all volumes for each disk group.

vxvol -g diskgroup stopall

5. Stop VCS along with all the resources. Then stop remaining resources manually.

hastop -all

6. Uninstall SFRAC.

cd /opt/VRTS/install
./uninstallsfrac galaxy nebula

7. Uninstall all the remaining VRTS rpms manually on each cluster node.

```
rpm -qa | grep VRTS
rpm -e <remaining VRTS RPMs>
```

For example:

```
rpm -e VRTSob VRTSvlic VRTSobgui VRTSperl VRTSgab VRTScpi
```

▼ **To reinstall Storage Foundation *for Oracle RAC* 4.1**

Install SFRAC 4.1 using the -installonly option.

```
cd <4.1 install
location>/rhel4_i686/storage_foundation_for_oracle_rac
./installsfrac  -installonly galaxy nebula
```

▼ **To restore your configuration**

1. Restore VCS and VxVM configuration on each cluster node.

```
cd /var/sfrac41mp1-config-save/etc/vx
cp disk.info jbod.info .aascsi3 .apscsi3 volboot
array.info ddl.support disks.exclude cntrls.exclude enclr.exclude
newnames guid.state vxvm_tunables
vxdmp_tunables /etc/ vvrports  /etc/vx/
cp vras/.rdg vras/vras_env /etc/vx/vras/
```

If vxfen was originally configured in enabled mode:

```
rm /etc/vxfenmode ... on all nodes
```

2. Install VxVM on each cluster node. Run vxinstall on all nodes.

3. If necessary, re-encapsulate the root disk.

4. Reboot all nodes.

Software Limitations

Software limitations in this release:

Limitations of Volume Manager in a Shared Disk Environment (CVM)

◆ No support for software RAID 5

◆ VVR is not supported in this release

Limitations of Cluster File System (CFS)

◆ CFS will only support disk layout version 6.

◆ No support for mapping or plug-in drivers in VxMS.

◆ No support for QLOG.

- No direct support for QIO or Cached QIO.

- VxFS will not distribute its own versions of file utilities (such as `cpio`, `mv`, etc).

- Large file system and large file support is restricted to the limits imposed by RHEL4. Large file size is limited to 16TB for 32-bit kernel and is approximately 256TB for 64-bit kernel.

- No support for Access Control Lists.

- No support for HSM/DMAPI.

- No support for forced unmount.

- No support for Storage Checkpoint and Rollback.

Known Issues

Known issues in Storage Foundation *for Oracle RAC* 4.1 and methods for resolving them.

Kernel Warnings

The following warning messages may be displayed on the console or in the system log when VERITAS modules are loaded into the kernel.

```
Warning: loading <module name> will taint the kernel: non-GPL
license - Proprietary. Send bug reports to support@veritas.com
See http://www.tux.org/lkml/#export-tainted for information about
tainted modules
Module <module> loaded, with warnings
```

These warning messages are displayed because the VERITAS kernel modules are proprietary. They can safely be ignored.

On RHEL4 Update 2 Systems, the following warning messages may be displayed on the console or in the system log when VERITAS modules are loaded into the kernel.

```
kernel: vxglm : disagrees about version of the symbol struct_module
kernel: vxodm : disagrees about version of the symbol struct_module
```

These messages can safely be ignored.

Stack Overflow on Red Hat

There is a known problem in Red Hat Enterprise Linux 4 Update 1 32-bit systems that is unlikely to occur but which may result in a stack overflow. The issue was reported to Red Hat and is documented in Bugzilla incident 162257.

Installation Fails While Starting the CFS Agents

The installation of Storage Foundation *for Oracle RAC* may fail if the system names provided during installation do not match the actual host names of the cluster systems. The failure occurs while attempting to start the CFS agents.

▼ **To resolve system name mismatch**

1. Uninstall the Storage Foundation *for Oracle RAC* product.

2. Reinstall using the correct host names of the cluster systems.

Restarting Multiple Cluster Nodes

Rebooting multiple cluster nodes simultaneously may cause some or all of the nodes to panic.

Network Interfaces Change Their Names After Restart

On SUSE systems, network interfaces change their names after restarting even with `HOTPLUG_PCI_QUEUE_NIC_EVENTS=yes` and `MANDATORY_DEVICES="..."` set.

Work around: Use `PERSISTENT_NAME= ethX` where X is the interface number for all interfaces. For more details see the *Storage Foundation for Oracle RAC Installation and Configuration Guide*.

Installer Warning about Oracle 10*g* Support

The installer may display a warning similar to:

 "WARNING: Currently Oracle 10g Release 1 is not supported. For latest support matrix, please refer to technical notes before proceeding."

To verify your installation is supported

◆ For Oracle and OS support, see:

"Supported Software" on page 3.

◆ For late breaking news, see:

http://support.veritas.com/docs/277033

Storage Foundation for Oracle RAC Release Notes

RAC Wizard Does Not Detect Pre-configured PrivNIC Resources

The VCS Oracle 10*g* RAC wizard does not properly detect `PrivNIC` resources if they are already set up. If `PrivNIC` is already configured, you must remove the `ora_priv` resource from `main.cf`.

Local Installation of Oracle 10*g* on IA64

Local installation of Oracle 10*g* CRS is not supported on IA64 for SLES 9 SP2.

Installer Warning about Oracle 10*g* Support

The installer may display a warning similar to:

"WARNING: Currently Oracle 10g Release 1 is not supported. For latest support matrix, please refer to technical notes before proceeding. "

▼ To verify your installation is supported

1. For Oracle and OS support at the time of this release, see:

"Supported Software" on page 3.

2. For late breaking news, see:

http://support.veritas.com/docs/277033

CRS Resources Go into UNKNOWN State after Reboot

After reboot, CRS resources (`gsd`, `ons`, instances, listeners) may display UNKNOWN state.

To resolve this issue, do one of the following:

◆ Stop and start CRS with: `/etc/init.d/init.crs`

◆ stop the UNKNOWN resources one by one and start them with:
  `$CRS_HOME/bin/crs_start`

This problem is identified as bug in Oracle. For further information on this bug, contact Oracle support.

CVM Master Node May Require Restart After Upgrading to Oracle 10g

After upgrading Oracle 10g to 10.1.0.3, it may occur that only the CVM master node comes online while the other nodes remain in the STARTING | PARTIAL state. These nodes continue in their attempt to bring the crs_cfsmount resource online.

Workaround: restart the CVM master node. This transfers the master designation to another cluster node. The cluster and all nodes then come online.

Run the following command on any node to determine the CVM master.

```
# vxdctl -c mode
   master: fslnx14
```

Using lltconfig -u in an Oracle 10*g* RAC Environment

Using lltconfig -u in an Oracle 10g RAC environment to unconfigure a link with Oracle's private IP address plumbed on it prevents the PrivNIC agent from failing over this IP address. This usage may result in a machine reboot by the Oracle CRS.

vcsmm unconfigure Fails Due to Leftover Oracle Processes

On occasion, /etc/init.d/init.crs stop leaves some oclsmon.bin processes running. You are not able to unconfigure vcsmm because these processes make use of the VERITAS membership module. Using /etc/init.d/vcsmm stop will not succeed.

In this case, you need to kill all oclsmon processes manually, after which you can unconfigure vcsmm.

Installer Unable to Back up Oracle Membership and IPC Libraries

The installer is unable to make a backup of Oracle's libskgxn2.so and libskgxp10.so libraries situated in CRS_HOME/lib during Oracle 10*g* R2 installations. This occurs because the Oracle Universal Installer sets the permissions of CRS_HOME to root. Although the backup fails in CRS_HOME/lib, the backup for the same libraries is successful in ORACLE_HOME/lib and these libraries are same as CRS_HOME/lib libraries.

vxgms Service Is Disabled When Upgrading OS from Sles9 SP2 to Sles9 SP3

During the upgrade from SLES9 SP2 with Storage Foundation *for Oracle RAC* 4.1 MP1 installed to SLES9 SP3, the vxgms service is disabled. As a result, vxgms does not start after reboot, and port d (vxodm port) does not appear in GAB membership.

▼ **To resolve the problem**

```
# /etc/init.d/vxodm stop
# /etc/init.d/vxgms start
# /etc/init.d/vxodm start
# chkconfig vxgms on
```

Database Startup Fails

A situation may occur where a database startup fails with the message:

"Cluster interconnect IPC library is incompatible with this version of Oracle
Oracle interface version information 2.4
Cluster IPC library version information 2.3"

▼ **To start the database**

1. Stop all database instances.

2. Manually copy the correct version of IPC library in Oracle Home directory on each node:

```
cp /opt/VRTSvcs/rac/lib/skgxp24/64/libskgxp9.so
$ORACLE_HOME/lib/libskgxp10.so
```

Netdump - Network console and crash dump facility

VERITAS advises that netdump to be installed and configured on all Red Hat and SUSE installations. This is not specifically for the VERITAS product stack, but because this is recommended as good systems administration practice.

For information on netdump installations for Red Hat systems, see:

http://www.redhat.com/support/wpapers/redhat/netdump/

For information on netdump installations for SUSE systems, see:

/usr/share/doc/packages/lkcdutils/README.SuSE

Wizards Do Not Start if the /etc/hosts File Contains ipv6 Entries

If the /etc/hosts file contains ipv6 entries, VCS displays the following error when you try to start a VCS wizard:

Error 16-12-6 Could not connect to VCS engine. Cannot proceed

To resolve: Remove the ipv6 entries before running VCS wizards.

SCSI Reservation Errors During Bootup

If you reboot a node of an SFRAC cluster, SCSI reservation errors may be observed during bootup such as:

Nov 23 13:18:28 galaxy kernel: scsi3 (0,0,6) : RESERVATION CONFLICT

This message is printed for each disk that is a member of any shared disk group which is protected by SCSI-3 I/O fencing. The message may be safely ignored.

Uninstall Log Messages

After unistalling Storage Foundation *for Oracle RAC* 4.1, the uninstall log may contain errors that can be safely ignored:

```
ERROR: Module vxodm does not exist in /proc/modules
ERROR: Module vxgms does not exist in /proc/modules
ERROR: Module vcsmm does not exist in /proc/modules
ERROR: Module lmx does not exist in /proc/modules
```

Vxfen Is Not Able to Write the Reservation Keys

If you leave the product installer loop without stopping all the SFRAC components, you may encounter problems with Vxfen.

If Vxfen has problems coming up after the reboot, SCSI3 PR registration keys should be fixed using vxfenclearpre command. See the *Storage Foundation for Oracle RAC Installationand Configuration Guide*, page 86.

Infinite Start Check Loop in init.cssd

Problem: Clsinfo script being called frequently from /etc/init.cssd. This problem was only observed in CRS 10.1.0.4.

To resolve: Read bug 315235.1 in Oracle metalink. Patch 4554792 solves this problem. Before applying the patch, `/etc/init.d/init.cssd` script should be backed up. After the patch is applied, the following lines should be inserted in `/etc/init.d/init.cssd` immediately after definition of `CRS_Process_Volume_Group()` function:

```
# Veritas Cluster Server (Linux)
if [ -d "/opt/VRTSvcs" ]
then
  VC_UP="/opt/VRTSvcs/ops/bin/checkvcs"
  CLINFO="/opt/VRTSvcs/ops/bin/clsinfo"
  SKGXNLIB="/opt/ORCLcluster/lib/libskgxn2.so"
fi
```

Fixed Issues and Enhancements

Fixed issues and software enhancement requests are referenced by VERITAS incident number and described briefly below.

Fixes and Enhancements in Storage Foundation *for Oracle RAC* 4.1

Incident Number	Description
255034	Shared DGs in VCS required manual configuration if split or joined using VEA because the `main.cf` was not getting updated.
	The VCS RAC wizard (`hawizard`) is supported for Oracle 10*g*.
293447	Machine does not reboot after panic with kernel.panic set.
	Oracle slave deregistering twice is fixed. The problem was: under heavy loads, and under rare circumstances, Oracle might deregister its slave processes twice with VCSMM. This caused all nodes of the cluster to panic.

Documentation

Documentation for VERITAS Storage Foundation *for Oracle RAC* is available as Adobe Portable Document Format (PDF) files on the product disc. Documentation is also available in HTML format on the software disc included with your software purchase.

Storage Foundation *for Oracle RAC* Documentation

Storage Foundation *for Oracle RAC* components are described fully in the documents provided on the documentation disc for VERITAS Volume Manager, VERITAS File System, and VERITAS Cluster Server. These documents provide important information on the software components that support CVM, VxFS, and VCS.

VERITAS recommends copying the Storage Foundation *for Oracle RAC* installation and configuration guide and release notes from the software discs containing the product to the `/opt/VRTS/docs` directory so that they are available on your system for reference.

Storage Foundation *for Oracle RAC* Documentation Set

Guide	File Name
VERITAS Storage Foundation *for Oracle RAC*	
VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide	`sfrac_install.pdf`
VERITAS Storage Foundation for Oracle RAC Release Notes	`sfrac_notes.pdf`
VERITAS Cluster Server	
VERITAS Cluster Server User's Guide	`vcs_users.pdf`
VERITAS Cluster Server Installation Guide	`vcs_install.pdf`
VERITAS Cluster Server Agent Developer's Guide	`vcs_agent_dev.pdf`
VERITAS Cluster Server Bundled Agents Reference Guide	`vcs_bundled_agents.pdf`
VERITAS Cluster Server Oracle Enterprise Agent	
VERITAS Cluster Server Enterprise Agent for Oracle Installation and Configuration Guide	`vcs_oracle_install.pdf`
VERITAS Storage Foundation	
VERITAS Storage Foundation Installation Guide	`sf_install.pdf`
VERITAS Volume Manager Intelligent Storage Provisioning Administrator's Guide	`sf_isp_admin.pdf`
VERITAS Volume Manager Cross-platform Data Sharing Administrator's Guide	`sf_cds_admin.pdf`

Guide	File Name
VERITAS FlashSnap Point-in-Time Copy Solutions Administrator's Guide	`flashsnap_admin.pdf`
VERITAS Volume Manager	
VERITAS Volume Manager Administrator's Guide	`vxvm_admin.pdf`
VERITAS Volume Manager 4.0 Hardware Notes	`vxvm_hwnotes.pdf`
VERITAS Volume Manager Troubleshooting Guide	`vxvm_tshoot.pdf`
VERITAS File System	
VERITAS File System Administrator's Guide	`vxfs_admin.pdf`

VERITAS Documentation Disc

Documentation is available in HTML format on the searchable VERITAS Documentation Disc included with your software purchase.

VERITAS Documentation Online

Visit the Web site for VERITAS Storage Foundation *for Oracle RAC*:

> http://support.veritas.com/

to download Storage Foundation *for Oracle RAC* documentation from current and previous releases.

Hard-Copy Documentation Set

Copies of VERITAS software guides are available for purchase through the VERITAS Web Store at http://www.veritas.com/webstore.

For Storage Foundation *for Oracle RAC* 4.1 on Linux, the *Installation and Configuration Guide* and all the component product documents listed in "Storage Foundation for Oracle RAC Documentation" on page 24 are available.

Manual Pages

The manual pages for VRTStd, VRTSllt, VRTSgab, and VRTSvcs are installed in
/opt/VRTS/man. Set the MANPATH environment variable so the man(1) command can point to
the VCS manual pages.

For Bourne or Korn shell (sh or ksh), type

```
# MANPATH=$MANPATH:/opt/VRTS/man
# export MANPATH
# LC_ALL = C export LC_ALL
```

For C shell (csh or tcsh), type:

```
# setenv MANPATH ${MANPATH}:/opt/VRTS/man
# setenv LC_ALL C
```

For more information, refer to the man(1) manual page.

Oracle Documentation

Oracle documents are not shipped with VERITAS Storage Foundation 4.1 *for Oracle RAC*.
Documents that provide necessary related information for Oracle9*i*:

◆ B10110-01 *Oracle Real Application Clusters Cluster File System Release Notes*

◆ A95493-01 *Oracle9i Database Installation Guide*

For Oracle 10*g*:

◆ B14406-01 *Oracle Real Application Clusters Installation and Configuration 10g Release 1*
   (10.1.0.3) (for Linux x86-64)

◆ B10766-08 *Oracle Real Application Clusters Installation and Configuration Guide* (for
   Linux x86 and IA64)

Getting Help

For technical assistance, visit http://support.veritas.com and select phone or email
support. This site also provides information on topics such as TechNotes, product alerts,
software downloads, hardware compatibility lists, and our customer email notification
service. Use the "Knowledge Base Search" feature to access additional product
information, including current and past releases of VERITAS documentation.

Additional Resources

◆ For license information, software updates and sales contacts, visit
https://my.veritas.com/productcenter/ContactVeritas.jsp

◆ For information on purchasing product documentation, visit
http://www.veritas.com/webstore

Unique Message Identifiers

When contacting VERITAS Technical Services, either by telephone or by visiting the
Technical Services website, be sure to provide the unique message identifier preceding the
message. The identifier is an alpha-numeric string that denotes the type of message. Error
messages begin with the letter "V." For example:

```
VCS NOTICE V-16-1-10075 Invalid host name.
```

VERITAS Technical Services uses message identifiers to locate TechNotes and other
information to assist in troubleshooting your case.

Diagnostic Tools

VERITAS Technical Services provides diagnostic tools to assist you in troubleshooting
problems associated with the product. These tools are available on disc or can be
downloaded from the VERITAS FTP site. See the VRTSspt readme file in the /support
directory for details.

Applying Oracle Patchsets   2

Use this chapter to apply Oracle patchsets.

These installation procedures assume you have:

◆ Installed Storage Foundation *for Oracle RAC* 4.1

◆ Used "Installation Notes" on page 2 to install and configure Storage Foundation *for Oracle RAC* 4.1 MP1

To verify the latest information on support for Oracle database versions, see the VERITAS Technical Support TechNote:

http://support.veritas.com/docs/277033

Applying an Oracle 10*g* Patchset

▼ **To apply an Oracle 10*g* patchset**

  1. Stop CRS and all the Oracle processes, if not already stopped.

  2. Log in to oracle user. Go to $ORACLE_HOME/lib.

  3. Restore the original ODM library from the Oracle installation which was replaced by the VERITAS ODM library.

   a. Create a backup of the existing odm library:

   # **mv libodm10.so libodm10.so.vrts**

   b. Restore Oracle's ODM library:

   # **ln -s libodm10.so. libodm10.so**

4. Follow the Oracle patchnote provided with the patchset to upgrade to the intended version of Oracle 10*g*.

If you have a database running with an earlier version, use the database upgrade procedure listed in the patchnote to upgrade your database.

5. After patchset application is complete, run:

/opt/VRTS/install/installsfrac -configure

6. Choose the correct relinking option for your version of Oracle:

◆ **Relink SFRAC for Oracle 10g Release 1**

◆ **Relink SFRAC for Oracle 10g Release 2**

7. If you are using SLES9 on IA64 and installing an Oracle 10.1.0.4 or higher patchset, you must manually copy the correct version of IPC library in Oracle Home directory on each node after relinking is complete.

```
cp /opt/VRTSvcs/rac/lib/skgxp24/64/libskgxp9.so
$ORACLE_HOME/lib/libskgxp10.so
```

8. You can start CRS and CRS resources using:

/etc/init.d/init.crs start

9. Verify that all CRS resources are ONLINE.

10. After a successful application of the Oracle 10*g* patchset, a RAC database can be configured. Use your own tools or see "Creating a Starter Database" on page 351 of the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

11. If you have just installed Storage Foundation *for Oracle RAC* 4.1 MP1 on clean systems, you need to bring CVM and Private NIC under VCS control. This can be achieved by:

◆ Using the VCS Oracle RAC Configuration wizard, see the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*:

"Creating an Oracle Service Group" on page 137 for RHEL4

"Creating an Oracle Service Group" on page 299 for SLES9

◆ Manually editing the VCS configuration file, see the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*:

"Configuring CVM Service Group for Oracle 10g Manually" on page 143 for RHEL4

"Configuring CVM Service Group for Oracle 10g Manually" on page 305 for SLES9

Caution If the nodes are rebooted before configuring the CVM service group, the services will not start on their own.

Applying an Oracle9*i* Patchset

▼ **To apply an Oracle9***i* **patchset**

1. Log in as the oracle user.

   # **su oracle**

2. Restore the original ODM library from the Oracle installation which was replaced by the VERITAS ODM library.

   a. Create a backup of the existing odm library:

   # **mv libodm9.so libodm9.so.vrts**

   b. Restore Oracle's ODM library:

   # **ln -s libodm9.so. libodm9.so**

3. Follow the Oracle patchnote provided with the patchset to upgrade to the intended version of Oracle9*i*.

   If you have a database running with an earlier version, use the database upgrade procedure listed in the patchnote to upgrade your database.

4. After patchset application is complete, run:

   # **/opt/VRTS/install/installsfrac -configure**

5. Choose **Relink SFRAC for Oracle 9i**.

6. After a successful application of the Oracle 10*g* patchset, a RAC database can be configured. Use your own tools or see "Creating a Starter Database" on page 351 of the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

7. If you have just installed Storage Foundation *for Oracle RAC* 4.1 MP1 on clean systems, you need to bring CVM and Private NIC under VCS control. This can be achieved by:

◆ Using the VCS Oracle RAC Configuration wizard, see "Creating an Oracle Service Group Using the Wizard" on page 213 of the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

◆ Manually editing the VCS configuration file, see "Configuring CVM and Oracle Service Groups Manually" on page 206 of the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

Installing Oracle 10*g* Release 2   **3**

Use this chapter to install Oracle 10*g* Release 2 software on clean systems. These procedures apply to all supported Linux distributions and architectures. See "Supported Software" on page 3.

These installation procedures assume:

◆ You have installed Storage Foundation *for Oracle RAC* 4.1

◆ You have used "Installation Notes" on page 2 to install and configure Storage Foundation *for Oracle RAC* 4.1 MP1

To verify the latest information on support for Oracle database versions, see the VERITAS Technical Support TechNote:

http://support.veritas.com/docs/277033

To install Oracle 10*g* Release 2, see:

◆ "Configuring Oracle 10g Release 2 Prerequisites" on page 33

◆ "Installing Oracle 10g Release 2 CRS and Database" on page 39

When you have finished installing Oracle 10*g* Release 2, you can create a database and configure your VCS service groups. See "Configuring VCS Service Groups for Oracle 10g Release 2" on page 77.

Configuring Oracle 10*g* Release 2 Prerequisites

After upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1, configure the Oracle 10*g* prerequisites:

◆ "Creating OS Oracle User and Group" on page 35

◆ "Creating CRS_HOME" on page 35

◆ "Creating Volumes for OCR and Vote Disk" on page 37

◆ "Configuring Private IP Addresses on All Cluster Nodes" on page 37

◆ "Obtaining Public Virtual IP Addresses for Use by Oracle" on page 38

Backing up Files if Upgrading

If you are upgrading from Oracle 10*g* R1, you must make a backup your files. For more on upgrading from Oracle 10*g* R1, see "Migrating from Oracle 10.1.0.3 to Oracle 10.2.0.1 on SLES9 x86_64" on page 70.

▼ **To back up Oracle 10*g* R1 files**

1. As `oracle`, create a dump file for the OCR registry file. This dump is used after the upgrade is completed to use the same service and resource names in Oracle 10.2.0.1 and populate the Oracle 10.2.0.1 OCR registry file.

   ```
   # su - oracle
   $ cd $CRS_HOME/bin
   $ ./ocrdump
   ```

2. As root, CRS should be stopped on all nodes as follows.

   ```
   # su - root
   # /etc/init.d/init.crs stop
   ```

3. Make a backup of Oracle 10.1.0.4 files/folders on all cluster nodes. During Oracle 10.2.0.1 installation, these files will be replaced.

   ```
   # /etc/init.d/init.crs stop
   # mv /etc/oracle /etc/oracle-10gR1
   # mv /etc/oraInst.loc /etc/oraInst.loc-10gR1
   # mv /etc/oratab /etc/oratab-10gR1
   # mv /etc -name "[SK]*init.c?s*" | xargs rm -f
   # mv /etc -name "[SK]*init.evm*" | xargs rm -f
   # mv /etc/init.d/init.crs etc/init.d/init.crs-10gR1
   # mv /etc/init.d/init.crsd etc/init.d/init.crsd-10gR1
   # mv /etc/init.d/init.cssd etc/init.d/init.cssd-10gR1
   # mv /etc/init.d/init.evmd /etc/init.d/init.evmd-10gR1
   # mv /etc/inittab.crs etc/inittab.crs-10gR1
   ```

   Edit `/etc/inittab` and remove the following lines:

   ```
   # h1:35:respawn:/etc/init.d/init.evmd run >/dev/null 2>&1
   </dev/null
   # h2:35:respawn:/etc/init.d/init.cssd fatal >/dev/null 2>&1
   </dev/null
   # h3:35:respawn:/etc/init.d/init.crsd run >/dev/null 2>&1
   </dev/null
   # init q
   ```

4. You must use new Oracle 10.2.0.1 CRS_HOME and ORACLE_HOME for 10.2.0.1 during the installation. You must also use new volumes for shared OCR and Vote disks.

Creating OS Oracle User and Group

On each system, create a local group and local user for Oracle. For example, create the group `oinstall` and the user `oracle`. Be sure to assign the same group ID, user ID, and home directory for the user on each system.

▼ **To create OS Oracle user and group on each system**

1. Create the `oinstall` group on each system:

   ```
   # groupadd -g 1000 oinstall
   # groupadd -g 1001 dba
   ```

2. Create the `oracle` user on each system and the oracle id should resemble the following:

   ```
   useradd -g oinstall -u <User id> -G dba -d /oracle oracle
   ```

3. Enable `rsh` and key-based authentication `ssh` for the `oracle` user on all nodes.

Creating CRS_HOME

On each system in the Storage Foundation *for Oracle RAC* cluster, create a directory for `CRS_HOME`. The disk space required is 0.5 GB minimum.

▼ **To create CRS_HOME on each system**

1. Log in as root user on one system.

   ```
   # su - root
   ```

2. Create groups and users.

   a. Referring to the *Oracle Real Application Clusters Installation and Configuration Guide*, create the groups `oinstall` (the Oracle Inventory group) and `dba`, and the user `oracle`, assigning the primary group for `oracle` to be `oinstall` and the secondary group for `oracle` to be `dba`. Assign a password for `oracle` user.

   b. On the original node determine the user and group IDs and use the identical IDs on each of the other nodes. Assign identical passwords for the user `oracle`.

3. On one node, create a disk group. For example:

   # **vxdg init crsdg sdc**

For shared CRS Home on CVM master:

   # **vxdg -s init crsdg sdc**

4. Create the volume in the group for the CRS_HOME. The volume should be a minimum of 0.5 GB:

   # **vxassist -g crsdg make crsvol 500M**

5. Start the volume:

   # **vxvol -g crsdg startall**

6. Create a VxFS file system on which to install CRS. For example:

   # **mkfs -t vxfs /dev/vx/rdsk/crsdg/crsvol**

7. Create the mount point for the CRS_HOME:

   # **mkdir /oracle/crs**

> **Note** Make sure that CRS_HOME is a subdirectory of ORACLE_BASE.

8. Mount the file system, using the device file for the block device:

   # **mount -t vxfs /dev/vx/dsk/crsdg/crsvol /oracle/crs**

For shared CRS Home on CVM master:

   # **mount -t vxfs -o /dev/vx/dsk/crsdg/crsvol /oracle/crs**

9. For local mount only, edit the /etc/fstab file and list the new file system. For example:

   /dev/vx/dsk/crsdg/crsvol /oracle/crs vxfs defaults 1 1

10. Set the CRS_HOME directory for the oracle user as /oracle/crs.

11. Assign ownership of the directory to oracle and the group oinstall:

   # **chown -R oracle:oinstall /oracle/crs**

12. On each cluster, repeat step 1 through step 11. For shared CRS_HOME repeat step 7 through step 8.

Creating Volumes for OCR and Vote Disk

The OCR and Vote disk must be shared among all nodes in a cluster. You must create shared raw volumes for OCR and Vote disk, as these disks are not recognized if they are on a cluster file system. You can add them in the VCS configuration to make them highly available.

The ORACLE_BASE directory contains CRS_HOME and ORACLE_HOME.Create OCR and Voting disks on shared raw volumes. For Oracle 10*g* Release 2, it is mandatory that OCR and Voting disks are created on shared raw volumes and not on a cluster file system.

▼ **To create OCR and Vote disk on raw volumes**

1. Log in as root user.

2. On the CVM master node, create a shared disk group:

   # **vxdg -s init ocrdg sdz**

3. Create volumes in the shared group for OCR and Vote disk:

   # **vxassist -g ocrdg make ocrvol 100M**
   # **vxassist -g ocrdg make vdvol 100M**

4. Assign ownership of the volumes using the vxedit command:

   # **vxedit -g ocrdg set user=oracle group=oinstall mode=660 ocrvol**
   # **vxedit -g ocrdg set user=oracle group=oinstall mode=660 vdvol**

5. Start the volume:

   # **vxvol -g ocrdg startall**

6. When installing CRS, specify the following for OCR and Vote disk:

   OCR: /dev/vx/rdsk/ocrdg/ocrvol
   VD: /dev/vx/rdsk/ocrdg/vdvol

Configuring Private IP Addresses on All Cluster Nodes

The CRS daemon requires a private IP address on each system to enable communications and heartbeating. Do the following to set up the private IP addresses.

▼ **To configure private IP addresses on all cluster nodes**

1. On each cluster system, determine a private NIC device for which LLT is configured. Look at the file /etc/llttab. For example, if **eth0** is used as an LLT interconnect on one system, you can configure an available IP address for it. Example commands:

   ```
   # ifconfig eth0 down
   # ifconfig eth0 inet 192.168.1.58 netmask 255.255.255.0
   # ifconfig eth0 up
   ```

   Configure one private NIC on each node.

   Note The private IP addresses of all nodes should be on the same physical network in the same IP subnet.

2. On each system, add the configured private IP addresses of all nodes to the /etc/hosts file, mapping them to symbolic names.

   Example:

   ```
   192.168.1.58 galaxy_priv
   192.168.1.59 nebula_priv
   ```

3. From each system, try pinging each of the other nodes, using the symbolic system name associated with the private NIC IP address.

   After configuring the IP addresses, you can edit the CVM service group and add the PrivNIC resource to make the IP addresses highly available. See:

   ◆ "Creating Service Groups for Oracle 10g Release 2 Manually" on page 80

   ◆ "Configuring the PrivNIC Agent" on page 369 of the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

Obtaining Public Virtual IP Addresses for Use by Oracle

Before starting the Oracle installation, you must create virtual IP addresses for each node. An IP address and an associated host name should be registered in the domain name service (DNS) for each public network interface.

▼ **To obtain public virtual IP addresses for use by Oracle**

1. Obtain one virtual IP per node.

2. Add entry for the virtual IP and virtual public name in the /etc/hosts file, for all nodes.

3. Register with DNS.

Example:

```
10.11.12.58 galaxy_pub
10.11.12.59 nebula_pub
```

Installing Oracle 10*g* Release 2 CRS and Database

Supported options for installing:

◆ "Installing Oracle 10g Release 2 Using the Installer" on page 39

◆ "Installing Oracle 10g Release 2 Manually" on page 50

Installing Oracle 10*g* Release 2 Using the Installer

Use the appropriate preparation steps for your configuration. The procedure for installing Oracle 10*g* Release 2 in a VERITAS Storage Foundation 4.1 for Oracle RAC environment is identical for a shared and local disk installation.

▼ **To prepare to install Oracle 10*g* Release 2 on a shared disk**

1. Log into any system of the cluster as the root user.

su - root

2. On the master node create a shared disk group.

a. Enter:

vxdg -s init orabindg sdd

b. Create the volume in the shared group:

vxassist -g orabindg make orabinvol 3000M

For the Oracle 10*g* binaries, make the volume 3 GB.

c. Start the volume:

vxvol -g orabindg startall

d. On the master node, create a VxFS file system on the shared volume on which to install the Oracle 10*g* binaries. For example, create the file system on orabinvol:

mkfs -t vxfs /dev/vx/dsk/orabindg/orabinvol

3. On each system, create the mount point for Oracle binaries and mount the file system.

   a. Create the mount point for the Oracle binaries if it does not already exist:

      `# `**`mkdir /oracle/10g`**

   b. Mount the file system, using the device file for the block device:

      `# `**`mount -t vxfs -o cluster /dev/vx/dsk/orabindg/orabinvol`**
            `/oracle/10g`

4. From the CVM master, execute:

      `# `**`vxedit -g orabindg set user=oracle group=oinstall mode=660`**
        `orabinvol`

5. Set "`oracle`" to be the owner of the file system, and set "`0660`" as the permissions:

      `# `**`chown oracle:oinstall /oracle`**

6. On the first system, set the following variables in root's environment on the node from which `installsfrac -configure` will be executed.

   a. For Bourne shell (`bash`, `sh`, or `ksh`), enter:

      `# `**`export ORACLE_BASE=/oracle`**
      `# `**`export DISPLAY=`*`host`*`:0.0`**

   b. For the C Shell (`csh` or `tcsh`):

      `# `**`setenv ORACLE_BASE /oracle`**
      `# `**`setenv DISPLAY `*`host`*`:0.0`**

7. Set the X server access control:

   `# `**`xhost + <hostname or ip address>`**

Where <hostname or ip address> is the hostname or IP address of the server to which you are displaying.

Note By default, the `installsfrac` utility uses `ssh` for remote communication. However, `rsh` can be used in place of `ssh` by using the `-usersh` option with the `installsfrac` utility. The installation of Oracle 10*g* requires that `rsh` be configured on all nodes. See Oracle 10*g* documentation for details on configuring `rsh`.

▼ **To prepare to install Oracle 10*g* Release 2 locally**

1. Log in as root user on one system.

   # **su - root**

2. On one node, create a disk group.

   a. Enter:

      # **vxdg init orabindg sdz**

   b. Create the volume in the group:

      # **vxassist -g orabindg make orabinvol 5000M**

      For the Oracle 10*g* binaries, make the volume 5,000 MB.

   c. Start the volume:

      # **vxvol -g orabindg startall**

   d. Create a VxFS file system on orabinvol to install the Oracle 10*g* binaries. For example:

      # **mkfs -t vxfs /dev/vx/dsk/orabindg/orabinvol**

3. Create the mount point for the file system.

   a. Enter:

      # **mkdir /oracle**

   b. Mount the file system, using the device file for the block device:

      # **mount -t vxfs /dev/vx/dsk/orabindg/orabinvol /oracle**

   c. To mount the file system automatically across reboot, edit the /etc/fstab file, and add the new file system. For example:

      /dev/vx/dsk/orabindg/orabinvol /oracle vxfs defaults 1 1

4. Create a local group and a local user for Oracle. For example, create the group oinstall and the user oracle. Be sure to assign the same user ID and group ID for the user on each system.

5. Set the home directory for the oracle user as /oracle.

6. Set appropriate permissions:

```
# vxedit -g orabindg set user=oracle group=oinstall mode=660
    orabinvol
```

7. Repeat step 1 through step 6 on the other systems.

8. Set the X server access control:

```
# xhost + <hostname or ip address>
```

Where <hostname or ip address> is the hostname or IP address of the server to which you are displaying.

Example:

```
# xhost + 192.168.1.128
192.168.1.128 being added to access control list
```

9. On the first system, set the following variables in root's environment on the node from which installsfrac -configure will be executed.

   a. For Bourne shell (bash, sh, or ksh), enter:

   ```
   # export ORACLE_BASE=/oracle
   # export DISPLAY=host:0.0
   ```

   b. For the C Shell (csh or tcsh):

   ```
   # setenv ORACLE_BASE /oracle
   # setenv DISPLAY host:0.0
   ```

▼ **To install Oracle 10*g* Release 2 on shared or local disk**

1. Make sure that the Oracle installer is in a directory that is writable. If you are using the CD-ROM, make sure that the Oracle installation files are copied locally.

2. On the same node where you have set the environment variables, execute the following command as root:

```
# cd /opt/VRTS/install
# ./installsfrac –configure
```

The installer will display the copyright message.

3. When the installer prompts, enter the system names separated by spaces on which to configure Storage Foundation *for Oracle RAC*. For the installation example used in this procedure:

```
# galaxy nebula
```

The installer checks both systems for communication and creates a log directory on the second system in /var/tmp/installsfracxxxxxxxxxx, where xxxx is the timestamp.

4. When the initial system check is successfully completed, press **Enter** to continue.

5. The installer proceeds to verify the license keys.

    a. Enter additional licenses at this time if any are needed.

    b. When the licenses are successfully verified, press **Enter** to continue.

6. The installer presents task choices for installing and configuring, depending on the operating system you are running.

Example:

```
    This program enables you to perform one of the following tasks:
1)  Install Oracle 9i.
2)  Install Oracle 10g Release 1.
3)  Install Oracle 10g Release 2.
4)  Relink SFRAC for Oracle 9i.
5)  Relink SFRAC for Oracle 10g Release 1.
6)  Relink SFRAC for Oracle 10g Release 2.
7)  Configure different components of SFRAC.

Enter your choice [1-7]: [?]
```

Select **Install** Oracle 10*g* **Release 2**. The installer proceeds to check environment settings.

7. Set Oracle directories.

    a. When prompted, enter the directory name for CRS_HOME relative to the ORACLE_BASE directory.

    b. When prompted, enter the directory name for ORACLE_HOME relative to the ORACLE_BASE directory. The Installer proceeds to validate ORACLE_HOME and check the node list.

    c. Press **Enter** to continue.

8. Configure user accounts.

a. Enter Oracle Unix User Account when prompted. The installer checks for the user on all systems.

b. Enter Oracle Inventory group when prompted. The installer checks for group existence on all systems

c. Press **Enter** to continue.

9. Enter the Oracle installer path for CRS when prompted. Specify the disk in your Oracle media kit where the CRS binaries reside. The installer validates the CRS installer.

Example:

`/<CRS_Disk>/`

In the example, `<CRS_Disk>` is the disk where the CRS binaries reside.

10. Enter the oracle installer path when prompted. The installer validates the Oracle Installer, copies files, creates directories based on the information provided, and invokes the Oracle CRS Installer.

Example:

`/DB_Disk/`

In the example,`<DB_Disk>` is the disk where the Oracle binaries reside.

11. If you are installing Oracle 10*g* Release 2 on an x86_64 machine, you will see message something like this:

Before proceeding with Oracle 10*g* Release 2 installation, you need to run `/oracle/Oracle10gR2/clusterware/rootpre/rootpre.sh` on all nodes (as root user) as Oracle prerequisite. Please run this script on all the nodes and then proceed.

Press [Enter] to continue:

At this stage, you need to run `rootpre.sh` script (available inside `<CRS_DISK>/rootpre/` folder, where `<CRS_DISK>` is the disk where CRS binaries are located, on all the nodes before proceeding. This script may not be available on other nodes, so copy it from the node where it is available and run it.

12. When the Oracle CRS Installer appears, it prompts for the following:

a. Specify the name for the install and `CRS_HOME` and click **Next**.

b. The host name for the local node is displayed with default string (`-priv` and `-vip`) appended to its private name and virtual name.

- ◆ Modify it as needed to put the correct private and virtual name for the local node.

- ◆ Add other cluster nodes using the **Add** option. While adding new nodes, specify private and virtual names for each. The nodes must be added in the same order in which they are configured for Storage Foundation *for Oracle RAC* (the node order present in `/etc/llthosts`), otherwise after Oracle installation, you may observe that original node ordering (present in `/etc/llthosts`) is missing.

- ◆ After adding all the cluster nodes click **Next**.

c. Specify the OCR shared raw volume name with an absolute path, for example the `/dev/vx/rdsk/ocrdg/ocrvol` raw volume, and click **Next**.

d. Specify CSS (Vote disk) shared raw volume name with an absolute path, for example the `/dev/vx/rdsk/ocrdg/vdvol` raw volume, and click **Next**. The installer proceeds with the CRS installation and sets the CRS parameters.

e. Choose the **external redundancy** option. Specify the OCR shared raw volume name with an absolute path, for example the `/dev/vx/rdsk/ocrdg/ocrvol` raw volume, and click **Next**.

f. Choose the **external redundancy** option. Specify CSS (Vote disk) shared raw volume name with an absolute path, for example the `/dev/vx/rdsk/ocrdg/vdvol` raw volume, and click **Next**. The installer proceeds with the CRS installation and sets the CRS parameters.

g. When prompted at the end of the CRS installation, run the `$CRS_HOME/root.sh` file on each cluster node in the same order as mentioned by Oracle CRS Installer.

Do not click OK in the `$CRS_HOME/root.sh` window until after you run the VIPCA utility.

h. Run the VIPCA utility in `$CRS_HOME/bin` from the first node in the cluster.

i. Click OK in the `$CRS_HOME/root.sh` window after you run the VIPCA utility.

j. Exit the CRS Installer after running `root.sh` and continue with `installsfrac -configure` for the Oracle 10*g* binaries installation.

13. Press **Enter** to continue.

The Oracle 10*g* database installer window displays.

      a. Choose the installation type.

      b. Specify the file locations and click **Next**.

      c. Select all nodes in the cluster and click **Next**. The installer verifies that the requirements are all met.

      d. When prompted to create the database, select the **Install database software only** option.

      e. Install the binaries now.

      f. The installer prompts you to run $ORACLE_HOME/root.sh on each node. The installer confirms when installation is successful. Exit the Oracle 10*g* Installer and return to installsfrac -configure.

14. Before replacing libraries, the CRS must be shutdown to avoid risk of nodes suddenly rebooting. You are prompted "Do you want to continue with stopping CRS? [y,n,q] (y)." If you select y (default value), the installer stops CRS on all nodes:

```
Stopping CRS on node1 using: /etc/init.d/init.crs stop ……….. Done
Stopping CRS on node2 using: /etc/init.d/init.crs stop ……….. Done
Checking files …………………………………………………. Done
Oracle was installed successfully
```

If you select "n," the installer skips this step:

```
Stopping CRS on node1 using: /etc/init.d/init.crs stop ….. Skipped
Stopping CRS on node2 using: /etc/init.d/init.crs stop ….. Skipped
Checking files …………………………………………………. Done
Oracle was installed successfully
```

We recommend that you do not skip this step, because the installer tries to replace oracle libraries after this. There may be some issues with the currently running CRS (which is using these libraries), in which case nodes may be suddenly rebooted. To safeguard against this problem, it is recommended to first stop CRS and then replace the libraries.

15. The installer displays LLT and CRS node numberings:

```
Checking for node numbering differences ..................... Done
NODE NAME                 LLT NODE ID            CRS NODE ID

galaxy                       0                        1

nebula                       1                        2
   Node numbering of LLT and CRS is different. It will be fixed. This step is
mandatory for SFRAC to function.

   Press [Enter] to continue.
```

If LLT and CRS node numberings are not same, then Oracle may not detect some nodes and may detect some nodes in a wrong manner. This step ensures that the two numberings are same.

Press **Enter**. The installer continues:

```
   Replacing node membership pattern in /etc/VRTSvcs/conf/config/main.cf on
all the nodes ... Done

   NodeId attribute has been changed only for CVMCluster resource in
/etc/VRTSvcs/conf/config/main.cf to conform to Oracle's node numbering scheme,
but if you have any other resource which uses NodeId as an attribute, you must
change that manually in /etc/VRTSvcs/conf/config/main.cf file before starting
vcs.

   Replacing node membership pattern in /etc/llthosts on all the nodes .. Done

   Press [Enter] to continue:
```

16. The installer prompts you to stop the whole Storage Foundation *for Oracle RAC* stack and provides the required commands. Use the commands to stop the Storage Foundation *for Oracle RAC* stack.

```
Before finishing Oracle 10g Release 2 installation, the SFRAC stack needs
    to be shutdown on all the nodes using the following steps.

Commands to shutdown the stack :
    1) Stop database, crs.
    2) Unmount all VxFS mounts, stop volumes and deport diskgroups.
    3) Stop DBAC with commands :
        /etc/init.d/vcsmm stop (Do not use vcsmmconfig -U);
        /etc/init.d/lmx stop
    4) Stop ODM and GMS with commands :
        /etc/init.d/vxodm stop; /etc/init.d/vxgms stop
    5) Stop VCS with command :
        /opt/VRTSvcs/bin/hastop -local
     6) /opt/VRTS/bin/fsclustadm cfsdeinit
     7) Stop GLM with command :
        /etc/init.d/vxglm stop
     8) Stop/Kill the following processes if they are running :
        had, hashadow, CmdServer
     9) Stop VXFEN with command :
        /etc/init.d/vxfen stop (Do not use vxfenconfig -U)
    10) Stop GAB with command :
        /etc/init.d/gab stop
    11) Stop LLT with command :
        /etc/init.d/llt stop

Press [Enter] to continue:

Please remember that you should not use "vcsmmconfig -U" and "vxfenconfig -U"
for unconfiguring vcsmm and vxfen respectively. For stopping vcsmm and vxfen,
please use:

$ /etc/init.d/vcsmm stop
$ /etc/init.d/vxfen stop
```

If the Storage Foundation *for Oracle RAC* stack does not stop, messages appear checking the status, confirming that Storage Foundation *for Oracle RAC* is not down and some components are still up. You are prompted to bring the stack down or to reboot. The required commands to bring the stack down are provided again. You are prompted:

```
Do you want to continue to bring down SFRAC components? [y,n,q] (y)
```

You can enter **N** and safely ignore the step of stopping Storage Foundation *for Oracle RAC* stack. On selecting **N**,the installer displays the following message:

```
You must manually reboot all the nodes at the same time for the new
membership to take effect. To achieve simultaneous reboot of nodes,
please shutdown all the nodes at the same time. Now start them only
```

```
after all are in shutdown state. This step is critical for avoiding
those situations where some nodes are running with old membership
and the rest with new membership.

WARNING: If VxFEN has problems coming up after the reboot, SCSI3
PGR registration keys should be fixed using
/opt/VRTSvcs/vxfen/bin/vxfenclearpre command. Refer to SFRAC
Installation and configuration guide page # 86 for more
information.

Press [Enter] to continue:
```

This step ensures that all the cluster nodes start with new node IDs on next boot.

```
If you were able to stop SFRAC stack successfully, then you do not need to
reboot the nodes to start SFRAC stack. Start the SFRAC stack on all the nodes
using the following steps:
    1) Start LLT with command :
        /etc/init.d/llt start
    2) Start GAB with command :
        /etc/init.d/gab start
    3) Start VXFEN with command :
        /etc/init.d/vxfen start
    4) Start DBAC with commands :
        /etc/init.d/vcsmm start; /etc/init.d/lmx start
    5) Start GMS and ODM with commands :
        /etc/init.d/vxgms start; /etc/init.d/vxodm start
    6) Start vcs with command:
        /etc/init.d/vcs start
    7) Import all previously imported diskgroups and start all volumes.
        Mount all VxFS mounts that were previously mounted.
    8) Start crs and then start database (If any).
```

17. In `installsfrac -configure`, press **Enter** to continue. The success of the
configuration is reported. The configuration summary is saved at:
`/opt/VRTS/install/logs/installsfracxxxxxxxxxx.summary`

The installsfrac log is saved at:
`/opt/VRTS/install/logs/installsfracxxxxxxxxxx.log`

18. After successful installation of CRS and Oracle 10*g*, a RAC database can be configured
if it is not already created. Use your own tools or see "Creating a Starter Database" on
page 351.

19. If this is a clean install, you will need to bring CVM and Private NIC under VCS
control. This step may not be needed, if you are upgrading from Oracle 10g Release 1
and if you have already brought these resources under VCS control during
installation of Oracle 10g Release 1. Bringing CVM and Private NIC under VCS
control can be achieved by:

♦ Using the VCS Oracle RAC Configuration wizard. See "Creating Service Groups for Oracle 10g Release 2 Using the Wizard" on page 77.

♦ Manually editing the VCS configuration file. See "Creating Service Groups for Oracle 10g Release 2 Manually" on page 80, and "Configuring the PrivNIC Agent" on page 369 of the *VERITAS Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

♦ If the nodes are rebooted before configuring the CVM service group, the services will not start on their own.

Installing Oracle 10*g* Release 2 Manually

VERITAS recommends using installsfrac -configure to install the Oracle 10*g* RAC binaries. However, some situations may require manual installation of the Oracle 10*g* RAC binaries. The following steps are required to install Oracle 10*g* manually:

♦ Patching the CRS OUI

♦ Pre-installation tasks

♦ OUI-based installation for CRS

♦ OUI-based installation for the database

♦ Post installation relinking

♦ Post installation configuration

▼ **To patch the CRS OUI**

1. Log in as oracle.

su - oracle

The Oracle CRS installer must be patched so that it will detect the presence of VCS and use the correct cluster membership. If the OUI has been patched previously using this procedure, then proceed to the next section.

2. Search for the ClusterQueries.jar file inside the CRS OUI directory structure. With the current release of OUI, it may be at the following location:

**cp
<installer_directory>/stage/Queries/ClusterQueries/10.2.0.1.0/1
/tmp/jar**

3. Unzip this file in some temporary location such as /tmp/jar. This directory should contain coe.tar under /tmp/jar/bin/linux/ directory.

cp /tmp/jar/bin/linux/coe.tar /tmp/tar

4. Extract this file at another temporary location such as /tmp/tar.

```
# tar -xvf /tmp/tar/coe.tar
```

5. Backup the original lsnodes.sh script.

```
# cp lsnodes.sh lsnodes.sh.orig
```

6. Patch the lsnodes.sh file as follows which will create a new file lsnodes_new.sh:

```
# cat lsnodes.sh | sed  -e '/CM / i #Patch to Check if something is
present in central location \
   if [ -d /opt/ORCLcluster/lib ]; then \
   CL="/opt/ORCLcluster/lib" \
   export LD_LIBRARY_PATH=\$CL:\$LD_LIBRARY_PATH \
      cd $base \
      ret=`./lsnodes` \
      if [ $? = 0 ]; then \
          echo "CL"; \
          exit; \
      fi \
   fi \
          ' > lsnodes_new.sh
```

The lsnodes.sh file determines whether to use existing cluster membership or ask the user to input a new set of nodes that will form the cluster. This script will acknowledge existence of a cluster only if Oracle's Cluster Manager (oracm) is running. The above patch changes this behavior such that the lsnodes.sh script will acknowledge a presence of cluster if /opt/ORCLcluster/lib directory is present and lsnodes.sh executes correctly.

7. Overwrite the existing lsnodes.sh by the new lsnodes_new.sh file.

```
# cp lsnodes_new.sh lsnodes.sh
```

8. Ensure that lsnodes.sh file has permissions set to 755.

```
# chmod 755 lsnodes.sh
```

9. Backup the lsnodes_get.sh file

```
# cp lsnodes_get.sh lsnodes_get.sh.orig
```

10. Patch the `lsnodes_get.sh` as follows which will create a new file `lsnodes_get_new.sh`:

```
# cat lsnodes_get.sh | sed -e ' s_CL="/etc/ORCLcluster/oracm/lib"_\
        if [ -d /opt/ORCLcluster/lib ]; then \
                CL="/opt/ORCLcluster/lib" \
        else \
                CL="/etc/ORCLcluster/oracm/lib" \
        fi _ '> lsnodes_get_new.sh
```

The `lsnodes_get.sh` script is the one that actually queries `lsnodes` command for the cluster members. This patch sets the CL variable to `/opt/ORCLcluster/lib` which is exported as the `LD_LIBRARY_PATH` value. This allows our `vcsmm` to be used while determining the cluster membership.

11. Overwrite the existing `lsnodes_get.sh` by the new `lsnodes_get_new.sh` file.

```
# cp lsnodes_get_new.sh lsnodes_get.sh
```

12. Ensure that `lsnodes_get.sh` file has permissions set to 755.

```
# chmod 755 lsnodes_get.sh
```

13. Delete `lsnodes_new.sh` and `lsnodes_get_new.sh` files.

```
# rm -f lsnodes_new.sh lsnodes_get_new.sh
```

14. Re-create the `coe.tar` from the `/tmp/tar` location as follows:

```
# tar cvf /tmp/coe.tar -C /tmp/tar/ .
```

15. Overwrite the old `coe.tar present under /tmp/jar/bin/linux/` directory.

16. Create the jar file as follows:

```
# jar -cMf /tmp/ClusterQueries.jar -C /tmp/jar .
```

Make sure that the `-M` option is passed while creating the jar. The jar files do not require manifest file.

17. Copy this patched jar file back into the OUI location.

▼ **To complete the pre-installation tasks**

1. Log in as root.

```
# su - root
```

2. Execute on any one node of the cluster:

```
# $CRS_HOME/bin/crsctl set css miscount 900
```

3. Make sure the LLT and CRS node numbering agree. If LLT and CRS node numberings are not the same, then Oracle will not detect some nodes and it may detect nodes in a wrong manner.

Run the following command to get Oracle's node (CRS) numbering:

```
# $CRS_HOME/bin/olsnodes -n
```

Output may resemble:

```
nodeA    1
nodeB    2
nodeC    3
nodeD    4
```

Node names and their corresponding numberings are shown; if this node numbering is same as that of /etc/llthosts, you may skip step 4 through step 8.

4. If the node numberings differ, then you must change the node numbering (in /etc/llthosts and /etc/VRTSvcs/conf/config/main.cf) to the Oracle node numbering. Before replacing node numbering, you must stop the entire Storage Foundation *for Oracle RAC* stack.

    a. Stop database and CRS.

    b. To stop the Storage Foundation *for Oracle RAC* stack on x86, perform the following as oracle on all cluster nodes:

```
$ cp $ORACLE_HOME/lib/libskgxp10.so $ORACLE_HOME/lib/libskgxp10.so.orig
$ cp /opt/VRTSvcs/rac/lib/skgxp25/32/libskgxp10.so
        $ORACLE_HOME/lib/libskgxp10.so
$ cp $ORACLE_HOME/lib/libskgxn2.so $ORACLE_HOME/lib/libskgxn2.so.orig
$ cp /usr/lib/libvcsmm.so $ORACLE_HOME/lib/libskgxn2.so
$ cp $ORACLE_HOME/lib/libodm10.so $ORACLE_HOME/lib/libodm10.so.orig
$ cp /usr/lib/libodm10.so $ORACLE_HOME/lib/libodm10.so
$ cp $CRS_HOME/lib/libskgxp10.so $CRS_HOME/lib/libskgxp10.so.orig
$ cp /opt/VRTSvcs/rac/lib/skgxp25/32/libskgxp10.so
        $CRS_HOME/lib/libskgxp10.so
$ cp $CRS_HOME/lib/libskgxn2.so $CRS_HOME/lib/libskgxn2.so.orig
$ cp /usr/lib/libvcsmm.so $CRS_HOME/lib/libskgxn2.so
```

    c. To stop the Storage Foundation *for Oracle RAC* stack on x86_64, perform the following as oracle on all cluster nodes:

```
$ cp $ORACLE_HOME/lib/libskgxp10.so $ORACLE_HOME/lib/libskgxp10.so.orig
$ cp /opt/VRTSvcs/rac/lib/skgxp25/64/libskgxp10.so
        $ORACLE_HOME/lib/libskgxp10.so
$ cp $ORACLE_HOME/lib/libskgxn2.so $ORACLE_HOME/lib/libskgxn2.so.orig
```

```
$ cp /usr/lib64/libvcsmm.so $ORACLE_HOME/lib/libskgxn2.so
$ cp $ORACLE_HOME/lib/libodm10.so $ORACLE_HOME/lib/libodm10.so.orig
$ cp /usr/lib64/libodm10.so $ORACLE_HOME/lib/libodm10.so
$ cp $ORACLE_HOME/lib32/libskgxn2.so $ORACLE_HOME/lib32/libskgxn2.so.orig
$ cp /usr/lib/libvcsmm.so $CRS_HOME/lib32/libskgxn2.so
$ cp $CRS_HOME/lib/libskgxp10.so $CRS_HOME/lib/libskgxp10.so.orig
$ cp /opt/VRTSvcs/rac/lib/skgxp25/64/libskgxp10.so
       $CRS_HOME/lib/libskgxp10.so
$ cp $CRS_HOME/lib/libskgxn2.so $CRS_HOME/lib/libskgxn2.so.orig
$ cp /usr/lib64/libvcsmm.so $CRS_HOME/lib/libskgxn2.so
$ cp $CRS_HOME/lib32/libskgxn2.so $CRS_HOME/lib32/libskgxn2.so.orig
$ cp /usr/lib/libvcsmm.so $CRS_HOME/lib32/libskgxn2.so
```

d. Unmount all VxFS mounts, stop volumes and deport diskgroups.

e. Stop DBAC:

```
/etc/init.d/vcsmm stop (Do not use vcsmmconfig -U.)
/etc/init.d/lmx stop
```

f. Stop ODM and GMS:

```
/etc/init.d/vxodm stop; /etc/init.d/vxgms stop
```

g. Stop VCS: `/opt/VRTSvcs/bin/hastop -local`

h. Enter: `/opt/VRTS/bin/fsclustadm cfsdeinit`

i. Stop GLM: `/etc/init.d/vxglm stop`

j. Stop/Kill these processes if they are running: `had`, `hashadow`, `CmdServer`.

k. Stop VXFEN: `/etc/init.d/vxfen stop` (Do not use `vxfenconfig -U`.)

l. Stop GAB: `/etc/init.d/gab stop`

m. Stop LLT: `/etc/init.d/llt stop`

n. Do not use `vcsmmconfig -U` and `vxfenconfig -U` for unconfiguring `vcsmm` and `vxfen respectively`. To stop vcsmm and vxfen, use:

```
$ /etc/init.d/vcsmm stop
$ /etc/init.d/vxfen stop
```

5. Replace the node numberings manually, in `/etc/llthosts` and `/etc/VRTSvcs/conf/config/main.cf`, even if you could not stop the Storage Foundation *for Oracle RAC* stack successfully.

6. If you could not stop the Storage Foundation *for Oracle RAC* stack successfully before replacing node numberings, you must reboot all the nodes at the same time. All the cluster nodes must be shutdown at the same time and restarted. If one node reboots and comes back while other node has not rebooted and is still running with the old membership, there may be issues while starting the Storage Foundation for Oracle RAC stack on the rebooted node.

7. If `vxfen` has problems coming up after the reboot, fix the SCSI3 PR registration keys using `/opt/VRTSvcs/vxfen/bin/vxfenclearpre` command. See "Using vxfenclearpre Command to Clear Keys after Split Brain" on page 86 of the *VERITAS Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

8. If you were able to stop Storage Foundation *for Oracle RAC* stack successfully, then you do not need to reboot the nodes to start Storage Foundation *for Oracle RAC* stack. Start the Storage Foundation *for Oracle RAC* stack on all the nodes using the following steps:

   a. Start LLT: `/etc/init.d/llt start`

   b. Start GAB: `/etc/init.d/gab start`

   c. Start VXFEN: `/etc/init.d/vxfen start`

   d. Start DBAC: `/etc/init.d/vcsmm start; /etc/init.d/lmx start`

   e. Start GMS and ODM: `/etc/init.d/vxgms start; /etc/init.d/vxodm start`

   f. Start VCS with command: `/etc/init.d/vcs start`

   g. Import all previously imported diskgroups.

   h. Start all volumes.

   i. Mount all VxFS mounts that were previously mounted.

   j. Start CRS.

   k. Start the database (if you have any).

▼ **To use OUI-based Installation for CRS**

Execute the `./runinstaller` and follow the instructions as given in Oracle's 10*g* Installation guide.

> **Note** If the cluster node names are not displayed on the "Specify the host names" page of the OUI, verify that the CRS OUI has been patched, the pre-installation steps have been completed correctly, and `vcsmm` is configured on that cluster.

▼ To install OUI-based Installation for the Database

Install the 10g database using the OUI. No special steps are needed for an Oracle 10*g* database installation.

▼ To perform post-install re-linking

1. Before replacing libraries, the CRS must be shutdown to avoid risk of nodes suddenly rebooting. Run the following command:

    ```
    # /etc/init.d/crs stop
    ```

    Do not skip this step. Issues with the currently running CRS (which is using these libraries), may cause nodes to suddenly reboot. To prevent this problem, stop CRS before replacing the libraries.

2. Perform the following steps as oracle user on all of the cluster nodes:

    ```
    # cp $ORACLE_HOME/lib/libskgxp10.so
    $ORACLE_HOME/lib/libskgxp10.so.orig
    # cp /usr/lib/libskgxp10.so $ORACLE_HOME/lib/libskgxp10.so
    # cp $ORACLE_HOME/lib/libskgxn2.so
    $ORACLE_HOME/lib/libskgxn2.so.orig
    # cp /usr/lib/libvcsmm.so $ORACLE_HOME/lib/libskgxn2.so
    # cp $ORACLE_HOME/lib/libodm10.so
    $ORACLE_HOME/lib/libodm10.so.orig
    # cp /usr/lib/libodm10.so $ORACLE_HOME/lib/libodm10.so
    # cp $CRS_HOME/lib/libskgxn2.so $CRS_HOME/lib/libskgxn2.so.orig
    # cp /usr/lib/libvcsmm.so $CRS_HOME/lib/libskgxn2.so
    ```

    These steps must be repeated on all cluster nodes and must be done as oracle user. The libraries must not be copied as root: doing so will break Oracle.

▼ To complete post-install configuration

1. Log in as root.

    ```
    # su - root
    ```

2. Start CRS with the following command:

    ```
    # /etc/init.d/crs start
    ```

3. Make sure the LLT and CRS node numbering agree. If LLT and CRS node numberings are not the same, then Oracle will not detect some nodes and it may detect nodes in a wrong manner.

Run the following command to get Oracle's node (CRS) numbering:

$CRS_HOME/bin/olsnodes -n

Output may resemble:

```
nodeA    1
nodeB    2
nodeC    3
nodeD    4
```

Node names and their corresponding numberings are shown; if this node numbering is same as that of /etc/llthosts, you may skip step 4 through step 8.

4. If the node numberings differ, then you must change the node numbering (in /etc/llthosts and /etc/VRTSvcs/conf/config/main.cf) to the Oracle node numbering. Before replacing node numbering, you must stop the entire Storage Foundation *for Oracle RAC* stack.

a. Stop database and CRS.

b. Unmount all VxFS mounts, stop volumes and deport diskgroups.

c. Stop DBAC:

```
/etc/init.d/vcsmm stop (Do not use vcsmmconfig -U.)
/etc/init.d/lmx stop
```

d. Stop ODM and GMS:

```
/etc/init.d/vxodm stop; /etc/init.d/vxgms stop
```

e. Stop VCS: /opt/VRTSvcs/bin/hastop -local

f. Enter: /opt/VRTS/bin/fsclustadm cfsdeinit

g. Stop GLM: /etc/init.d/vxglm stop

h. Stop/Kill these processes if they are running: had, hashadow, CmdServer.

i. Stop VXFEN: /etc/init.d/vxfen stop (Do not use vxfenconfig –U.)

j. Stop GAB: /etc/init.d/gab stop

k. Stop LLT: `/etc/init.d/llt stop`

l. Do not use `vcsmmconfig -U` and `vxfenconfig -U` for unconfiguring `vcsmm` and `vxfen` respectively. To stop vcsmm and vxfen, use:

```
$ /etc/init.d/vcsmm stop
$ /etc/init.d/vxfen stop
```

5. Replace the node numberings manually, in `/etc/llthosts` and `/etc/VRTSvcs/conf/config/main.cf`, even if you could not stop the Storage Foundation *for Oracle RAC* stack successfully.

6. If you could not stop the Storage Foundation *for Oracle RAC* stack successfully before replacing node numberings, you must reboot all the nodes at the same time. All the cluster nodes must be shutdown at the same time and restarted. If one node reboots while another node has not rebooted and is still running with the old membership, there may be issues while starting the Storage Foundation *for Oracle RAC* stack on the rebooted node.

7. If `vxfen` has problems coming up after the reboot, fix the SCSI3 PR registration keys using `/opt/VRTSvcs/vxfen/bin/vxfenclearpre` command. See "Using vxfenclearpre Command to Clear Keys after Split Brain" on page 86 of the *VERITAS Storage Foundation for Oracle RAC 4.1 Installation and Configuration Guide*.

8. If you were able to stop Storage Foundation *for Oracle RAC* stack successfully, then you do not need to reboot the nodes to start Storage Foundation *for Oracle RAC* stack. Start the Storage Foundation *for Oracle RAC* stack on all the nodes using the following steps:

a. Start LLT: `/etc/init.d/llt start`

b. Start GAB: `/etc/init.d/gab start`

c. Start VXFEN: `/etc/init.d/vxfen start`

d. Start DBAC: `/etc/init.d/vcsmm start; /etc/init.d/lmx start`

e. Start GMS and ODM: `/etc/init.d/vxgms start; /etc/init.d/vxodm start`

f. Start VCS with command: `/etc/init.d/vcs start`

g. Import all previously imported diskgroups.

h. Start all volumes.

   i.   Mount all VxFS mounts that were previously mounted.

   j.   Start CRS.

   k.   Start the database (if you have any).

9. Execute on any one node of the cluster:

   $ **$CRS_HOME/bin/crsctl set css misscount 900**

10. Stop CRS on all nodes:

   # **/etc/init.d/init/init.crs stop**

11. Verify that CRS is stopped on all nodes:

   # **ps -ef | grep ocssd**

12. After successful installation of CRS and Oracle 10*g*, a RAC database can be configured if it is not already created. Use your own tools or see "Creating a Starter Database" on page 351 of the *VERITAS Storage Foundation for Oracle RAC Installation and Configuration Guide*.

13. If this is a clean install, you will need to bring CVM and Private NIC under VCS control. This step may not be needed, if you are upgrading from Oracle 10g Release 1 and if you have already brought these resources under VCS control during installation of Oracle 10g Release 1. Bringing CVM and Private NIC under VCS control can be achieved by:

   ◆   Using the VCS Oracle RAC Configuration wizard. See "Creating Service Groups for Oracle 10g Release 2 Using the Wizard" on page 77.

   ◆   Manually editing the VCS configuration file. See "Creating Service Groups for Oracle 10g Release 2 Manually" on page 80.

   ◆   If the nodes are rebooted before configuring the CVM service group, the services will not start on their own.

Migrating Databases to the Latest Installed Version of Oracle 4

Use this chapter for upgrading Oracle databases:

These installation procedures assume you have installed Storage Foundation *for Oracle RAC* 4.1. If you have not already used "Installation Notes" on page 2 to install and configure Storage Foundation *for Oracle RAC* 4.1 MP1, you will need to do so during the preparation for migration procedures.

To verify the latest information on support for Oracle database versions, see the VERITAS Technical Support TechNote:

http://support.veritas.com/docs/277033

Migrating from Oracle9*i* to Oracle 10.1.0.4 on RHEL4 32-bit

The migration procedure assumes that the beginning configuration includes the following are up and running on the cluster nodes:

◆ RHEL4 Update 1

◆ Storage Foundation *for Oracle RAC* 4.1

◆ Oracle9*i*

Tasks for migration:

✔ Upgrade the OS to RHEL4 Update 2

✔ Upgrade Storage Foundation *for Oracle RAC* 4.1 to 4.1 MP1

✔ Installing Oracle 10.1.0.4

✔ Migrate the database to Oracle 10.1.0.4

Upgrading the OS on RHEL4

To migrate to Oracle 10.1.0.4, you must update the OS from RHEL4 Update 1 (U1) to RHEL4 Update 2 (U2).

▼ **To upgrade the OS on RHEL4**

1. Upgrade OS release from RHEL4 U1 to RHEL4 U2.

2. Start up with RHEL4 U2. Storage Foundation *for Oracle RAC* processes will start as usual, because RHEL4 U1 and RHEL4 U2 are ABI compatible, hence old Storage Foundation *for Oracle RAC* modules work on RHEL4 U2 also.

   You now have the following up and running:

   ◆ RHEL4 Update 2

   ◆ Storage Foundation *for Oracle RAC* 4.1

   ◆ Oracle9*i* database

Upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1

To upgrade to Oracle 10.1.0.4, you must upgrade to Storage Foundation *for Oracle RAC* 4.1 MP1.

▼ **To upgrade Storage Foundation *for Oracle RAC* from 4.1 to 4.1 MP1**

Follow the steps for upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1:

See "Upgrading to 4.1 Maintenance Pack 1" on page 9.

You now have the following up and running:

◆ RHEL4 Update 2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle9*i* database

Installing Oracle 10.1.0.4 on RHEL4 32-bit

After installing the correct OS and Storage Foundation *for Oracle RAC* 4.1 MP1,you can install Oracle 10.1.0.4.

▼ **To install Oracle 10.1.0.4**

1. Make backups of your Oracle9*i* files.

2. Configure the Oracle 10.0.1.3 prerequisites. See "Configuring Oracle 10g Release 1 Prerequisites" on page 95 of the VERITAS Storage Foundation *for Oracle RAC* Installation and Configuration Guide, 4.1.

3. As root, run `installsfrac -configure` to install Oracle 10.0.1.3. See "Installing Oracle 10g CRS and Database" on page 101 of the VERITAS Storage Foundation *for Oracle RAC* Installation and Configuration Guide, 4.1.

4. Apply the Oracle 10.1.0.4 patchset. See "Applying an Oracle 10g Patchset" on page 29.

You now have the following up and running:

◆ RHEL4 U2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.1.0.4 binaries

◆ Oracle9*i* database

Migrating the Database from Oracle9*i* to Oracle 10.1.0.4 on RHEL4 32-bit

After installing the correct OS, Storage Foundation *for Oracle RAC* 4.1 MP1,and Oracle 10.1.0.4 binaries, you can migrate the database.

▼ **To migrate a database from Oracle9*i* to Oracle 10.1.0.4**

1. Start the Oracle9*i* instances on all the nodes.

2. Verify that CRS is running on all the nodes.

3. Verify the Oracle 10*g* Listeners on all the nodes are up and running.

4. Verify that the `/etc/oratab` file has all entries for the instances on all nodes.

5. Log in as the `oracle` user.

6. Export the display.

7. Run the `dbua` utility for the migration and refer to Oracle metalink Doc ID: Note:263809.1 for a complete checklist for manual upgrades to Oracle 10*g*.

You now have the following up and running:

◆ RHEL4 Update 2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.1.0.4 database

Migrating from Oracle9*i* to Oracle 10.2.0.1 on RHEL4 32-bit

The migration procedure assumes that the beginning configuration includes the following are up and running on the cluster nodes:

◆ RHEL4 Update 1

◆ Storage Foundation *for Oracle RAC* 4.1

◆ Oracle9*i*

Tasks for migration:

✔ Upgrade the OS

✔ Upgrade Storage Foundation *for Oracle RAC* 4.1 to 4.1 MP1

✔ Install Oracle 10.2.0.1

✔ Migrate the database to Oracle 10.2.0.1

Upgrading the OS on RHEL4

To migrate to Oracle 10.2.0.1, you must update the OS from RHEL4 Update 1 (U1) to RHEL4 Update 2 (U2).

▼ **To upgrade the OS on RHEL4**

1. Upgrade OS release from RHEL4 U1 to RHEL4 U2.

2. Start up with RHEL4 U2. Storage Foundation *for Oracle RAC* processes will start as usual, because RHEL4 U1 and RHEL4 U2 are ABI compatible, hence old Storage Foundation *for Oracle RAC* modules work on RHEL4 U2 also.

You now have the following up and running:

◆ RHEL4 Update 2

◆ Storage Foundation *for Oracle RAC* 4.1

◆ Oracle9*i* database

Upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1

To migrate to Oracle 10.2.0.1, you must upgrade to Storage Foundation *for Oracle RAC* 4.1 MP1.

▼ **To upgrade Storage Foundation *for Oracle RAC* from 4.1 to 4.1 MP1**

Follow the steps for upgrading to 4.1 MP1. See "Upgrading to 4.1 Maintenance Pack 1" on page 9.

You now have the following up and running:

◆ RHEL4 Update 2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle9*i* database

Installing Oracle 10.2.0.1

After installing the correct OS and Storage Foundation *for Oracle RAC* 4.1 MP1, you can install Oracle 10.2.0.1.

▼ **To install Oracle 10.2.0.1**

1. Make backups of your Oracle9*i* files. See "Backing up Files if Upgrading" on page 34.

2. Configure the Oracle 10.2.0.1 prerequisites. See "Configuring Oracle 10g Release 2 Prerequisites" on page 33.

3. As root, run `installsfrac -configure` to install Oracle 10.2.0.1. See "Installing Oracle 10g Release 2 CRS and Database" on page 39.

You now have the following up and running:

◆ RHEL4 U2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.2.0.1 binaries

◆ Oracle9*i* database

Migrating the Database from Oracle9*i* to Oracle 10.2.0.1 on RHEL4 32-bit

After installing the correct OS, Storage Foundation *for Oracle RAC* 4.1 MP1,and Oracle 10.2.0.1 binaries, you can migrate the database.

▼ **To migrate the database from Oracle9*i* to Oracle 10.2.0.1**

1. Start the Oracle9*i* instances on all the nodes.

2. Verify that CRS is running on all the nodes.

3. Verify the Oracle 10*g* Listeners on all the nodes are up and running.

4. Verify that the /etc/oratab file has all entries for the instances on all nodes.

5. Log in as the oracle user.

   # **su oracle**

6. Export the display.

7. Follow Oracle Metalink Note #263809.1 to manually upgrade Oracle 10.1.0.4 databases to Oracle 10.2.0.1 or use dbua upgrade utility.

   You now have the following up and running:

   ◆ RHEL4 U2

   ◆ Storage Foundation *for Oracle RAC* 4.1 MP1

   ◆ Oracle 10.2.0.1 database

Migrating from Oracle 10.1.0.3 to Oracle 10.1.0.4 on SLES9 64-bit

The migration procedure assumes that the beginning configuration includes the following are up and running on the cluster nodes:

◆ SLES9 SP1

◆ Storage Foundation *for Oracle RAC* 4.1

◆ Oracle 10.1.0.3

Tasks for migration:

✔ Upgrade the OS

✔ Upgrade Storage Foundation *for Oracle RAC* 4.1 to 4.1 MP1

✔ Upgrade to Oracle 10.1.0.4

✔ Relink after upgrading to Oracle 10.1.0.4

Upgrading the OS on SLES9

To migrate to Oracle 10.1.0.4, you must update the OS from SLES9 Service Pack 1 (SP1) to SLES9 Service Pack 2 (SP2) or SLES9 Service Pack 3 (SP3).

▼ **To upgrade the OS on SLES9**

1. Upgrade the OS from SLES9 SP1to SLES9 SP2.

2. Start up with SLES9 SP2 or SLES9 SP3. No Storage Foundation *for Oracle RAC* processes will start, because SLES9 SP1, SP2, and SP3 are not ABI compatible, hence old Storage Foundation *for Oracle RAC* modules will not load on SLES9 SP2 or SP3. The Storage Foundation *for Oracle RAC* stack is down, but the CRS processes are waiting in loop for their dependencies (shared mount points) to become available.

Upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1

To migrate to Oracle 10.1.0.4, you must upgrade to Storage Foundation *for Oracle RAC* 4.1 MP1.

▼ **To upgrade Storage Foundation *for Oracle RAC* from 4.1 to 4.1 MP1**

Follow the steps for upgrading to 4.1 MP. See "Upgrading to 4.1 Maintenance Pack 1" on page 9.

As soon as Storage Foundation *for Oracle RAC* stack becomes available, CRS dependencies are satisfied and CRS processes start.

You now have the following up and running:

◆ SLES9 SP2 or SLES9 SP3

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.1.0.3 database

Upgrading to Oracle 10.1.0.4 on SLES9 64-bit

After installing the correct OS and Storage Foundation *for Oracle RAC* 4.1 MP1,you can upgrade to Oracle 10.1.0.4.

▼ **To upgrade to Oracle 10.1.0.4**

Follow Oracle's metalink procedure to upgrade from 10.1.0.3 to 10.1.0.4.

Relinking after Upgrading from Oracle 10.1.0.3 to 10.1.0.4

Running `installsfrac -configure` to relink Storage Foundation *for Oracle RAC* libraries with Oracle 10*g* R1 (10.1.0.4) accomplishes the following:

◆ Replaces Oracle's libraries with Veritas libraries.

◆ Patches init.cssd, if it's not already patched.

▼ **To relink the VERITAS libraries**

1. Log in as root user.

   # **su - root**

2. Export the `ORACLE_BASE` and `ORACLE_HOME` environment variables.

3. Change directory to `/opt/VRTS/install`.

   # **cd /opt/VRTS/install**

4. Start the installer to relink:

   # **./installsfrac -configure**

5. The installer checks systems:

   a. When the installer prompts, enter the system names separated by spaces on which to configure Storage Foundation *for Oracle RAC*. For the installation example used in this procedure:

   `galaxy nebula`

   The installer checks both systems for communication and creates a log directory on the second system in /var/tmp/installsfracxxxxxxxxxx.

   b. When the initial system check is successfully completed, press **Enter** to continue.

6. The installer proceeds to verify the license keys.

   a. Enter additional licenses now if any are needed.

   b. When the licenses are successfully verified, press **Enter** to continue.

7. The installer presents task choices for installing and configuring, depending on the operating system you are running.

Example:

```
     This program enables you to perform one of the following tasks:
1)  Install Oracle 9i.
2)  Install Oracle 10g Release 1.
3)  Install Oracle 10g Release 2.
4)  Relink SFRAC for Oracle 9i.
5)  Relink SFRAC for Oracle 10g Release 1.
6)  Relink SFRAC for Oracle 10g Release 2.
7)  Configure different components of SFRAC.

Enter your choice [1-7]: [?]
```

Select **Relink SFRAC for** Oracle 10*g* **Release 1**. The installer proceeds to check environment settings.

8. Set Oracle directories.

   a. When prompted, enter the directory name for CRS_HOME relative to /oracle. It will be used relative to the ORACLE_BASE directory.

   b. When prompted, enter the directory name for ORACLE_HOME relative to /oracle. It will be used relative to the ORACLE_BASE directory. The Installer proceeds to validate ORACLE_HOME and check the node list.

   c. Press **Enter** to continue.

9. Set user accounts.

   a. Enter Oracle Unix User Account when prompted. The installer checks for the user on all systems.

   b. Enter Oracle Inventory group when prompted. The installer checks for group existence on all systems

   c. Press **Enter** to continue.

10. The success of the configuration is reported. Press **Enter** to continue.

The configuration summary is saved at:
/opt/VRTS/install/logs/installsfracxxxxxxxxxx.summary

The installsfrac log is saved at: /opt/VRTS/install/logs/installsfracxxxxxxxxxx.log

11. At this point, CRS is not running. Manually start CRS.

You now have the following up and running:

◆ SLES9 SP2 or SLES9 SP3

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.1.0.4 database

Migrating from Oracle 10.1.0.3 to Oracle 10.2.0.1 on SLES9 x86_64

The migration procedure assumes that the beginning configuration includes the following are up and running on the cluster nodes:

◆ SLES9 SP1

◆ Storage Foundation *for Oracle RAC* 4.1

◆ Oracle 10.1.0.3 database

Tasks for migration:

✔ Upgrade Storage Foundation *for Oracle RAC* 4.1 to MP1

✔ Install Oracle 10.2.0.1

✔ Migrate the database to Oracle 10.2.0.1

Upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1

This procedure includes a required upgrade of the OS from SLES9 SP1 to SLES9 SP2 or SLES9 SP3.

▼ **To upgrade Storage Foundation *for Oracle RAC* from 4.1 to 4.1 MP1**

Follow the steps for upgrading to 4.1 MP1. See "Upgrading to 4.1 Maintenance Pack 1" on page 9.

You now have the following up and running:

◆ SLES9 SP2 or SLES9 SP3

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.1.0.3 database

Installing Oracle 10.2.0.1

After installing the correct OS and Storage Foundation *for Oracle RAC* 4.1 MP1, you can install Oracle 10.2.0.1.

▼ **To install Oracle 10.2.0.1**

1. Make backups of your Oracle 10.1.0.4 files. See "Backing up Files if Upgrading" on page 34.

2. You must use new Oracle 10.2.0.1 CRS_HOME and ORACLE_HOME for 10.2.0.1 during the installation. You must also use new volumes for shared OCR and Vote disks. See "Configuring Oracle 10g Release 2 Prerequisites" on page 33.

3. As root, run installsfrac -configure to install Oracle 10.2.0.1. See "Installing Oracle 10g Release 2 CRS and Database" on page 39.

You now have the following up and running:

- ◆ SLES9 SP2 or SLES9 SP3
- ◆ Storage Foundation *for Oracle RAC* 4.1 MP1
- ◆ Oracle 10.2.0.1 binaries
- ◆ Oracle 10.1.0.3 database

Migrating the Database from Oracle 10.1.0.3 to Oracle 10.2.0.1 on SLES9 x86_64

After installing the correct OS, Storage Foundation *for Oracle RAC* 4.1 MP1,and Oracle 10.2.0.1 binaries, you can migrate the database.

▼ **To migrate from Oracle 10.1.0.3 to Oracle 10.2.0.1**

1. Start the Oracle 10*g* instances on all the nodes using Oracle 10.1.0.3 environment variables.

```
# su - oracle
```

2. Verify that CRS are online on all the nodes.

```
# $CRS_HOME/bin/crs_stat -t
```

3. Follow Oracle Metalink Note #316889.1 to manually upgrade Oracle 10.1.0.4 databases to Oracle 10.2.0.1 or use dbua upgrade utility.

4. The Oracle 10.2.0.1 OCR will not have listener and database resources. After migration of databases is complete, perform the following actions:

a. Stop the Oracle 10.1.0.3 listener if it is running.

b. Create a new listener in Oracle 10.2.0.1 using `netca`.

c. Register the database and instance resources in OCR using `crs_register`.

5. After upgrading the database, make sure the following are up and running:

◆ Oracle 10.2.0.1 CRS

◆ Oracle 10.2.0.1 database

◆ Oracle 10.2.0.1 listeners

You now have the following up and running:

◆ SLES9 SP2 or SLES9 SP3

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.2.0.1 database

Migrating from Oracle 10.1.0.4 to Oracle 10.2.0.1 on RHEL4 32-bit

The migration procedure assumes that the beginning configuration includes the following are up and running on the cluster nodes:

◆ RHEL4 Update 1

◆ Storage Foundation *for Oracle RAC* 4.1

◆ Oracle 10.1.0.4 database

Tasks for migration:

✔ Upgrade the OS

✔ Upgrade Storage Foundation *for Oracle RAC* 4.1 to MP1

✔ Install Oracle 10.2.0.1

✔ Migrate the database to Oracle 10.2.0.1

Upgrading the OS on RHEL4

To migrate to Oracle 10.2.0.1, you must update the OS from RHEL4 Update 1 (U1) to RHEL4 Update 2 (U2).

▼ **To upgrade the OS on RHEL4**

1. Upgrade OS release from RHEL4 U1 to RHEL4 U2.

2. Start up with RHEL4 U2. Storage Foundation *for Oracle RAC* processes will start as usual, because RHEL4 U1 and RHEL4 U2 are ABI compatible, hence old Storage Foundation *for Oracle RAC* modules work on RHEL4 U2 also.

   You now have the following up and running:

   ◆ RHEL4 Update 2

   ◆ Storage Foundation *for Oracle RAC* 4.1

   ◆ Oracle 10.1.0.4 database

Upgrading to Storage Foundation *for Oracle RAC* 4.1 MP1

To migrate to Oracle 10.1.0.4, you must upgrade to Storage Foundation *for Oracle RAC* 4.1 MP1.

▼ **To upgrade Storage Foundation *for Oracle RAC* from 4.1 to 4.1 MP1**

Follow the steps for upgrading to 4.1 MP. See "Upgrading to 4.1 Maintenance Pack 1" on page 9.

You now have the following up and running:

◆ RHEL4 Update 2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.1.0.4 database

Installing Oracle 10.2.0.1

After installing the correct OS and Storage Foundation *for Oracle RAC* 4.1 MP1, you can install Oracle 10.2.0.1.

▼ **To install Oracle 10.2.0.1**

1. Make backups of your Oracle 10.1.0.4 files. See "Backing up Files if Upgrading" on page 34.

2. You must use new Oracle 10.2.0.1 CRS_HOME and ORACLE_HOME for 10.2.0.1 during the installation. You must also use new volumes for shared OCR and Vote disks. See "Configuring Oracle 10g Release 2 Prerequisites" on page 33.

3. As root, run `installsfrac -configure` to install Oracle 10.2.0.1. See "Installing Oracle 10g Release 2 CRS and Database" on page 39.

   You now have the following up and running:

   ◆ RHEL4 U2

   ◆ Storage Foundation *for Oracle RAC* 4.1 MP1

   ◆ Oracle 10.2.0.1 binaries

   ◆ Oracle 10.1.0.4 database

Migrating the Database from Oracle 10.1.0.4 to Oracle 10.2.0.1 on RHEL4 32-bit

After installing the correct OS, Storage Foundation *for Oracle RAC* 4.1 MP1, and Oracle 10.2.0.1 binaries, you can migrate the database.

▼ **To migrate from Oracle 10.1.0.4 to Oracle 10.2.0.1**

1. Start the Oracle 10*g* instances on all the nodes using Oracle 10.1.0.4 environment variables.

   # **su - oracle**

2. Verify that CRS are online on all the nodes.

   $ **$CRS_HOME/bin/crs_stat -t**

3. Follow Oracle Metalink Note #316889.1 to manually upgrade Oracle 10.1.0.4 databases to Oracle 10.2.0.1 or use `dbua` upgrade utility.

4. The Oracle 10.2.0.1 OCR will not have listener and database resources. After migration of databases is complete, perform the following actions:

   a. Stop the Oracle 10.1.0.3 listener if it is running.

   b. Create a new listener in Oracle 10.2.0.1 using `netca`.

   c. Register the database and instance resources in OCR using `crs_register`.

5. After upgrading the database, make sure the following are up and running:

   ◆ Oracle 10.2.0.1 CRS

   ◆ Oracle 10.2.0.1 database

◆ Oracle 10.2.0.1 listeners

You now have the following up and running:

◆ RHEL4 U2

◆ Storage Foundation *for Oracle RAC* 4.1 MP1

◆ Oracle 10.2.0.1 database

Configuring VCS Service Groups for Oracle 10*g* Release 2   **5**

After you have installed Oracle and created your database, you can set up VCS to automate the Oracle RAC environment:

◆ "Creating Service Groups for Oracle 10g Release 2 Using the Wizard" on page 77

◆ "Creating Service Groups for Oracle 10g Release 2 Manually" on page 80

◆ "Location of VCS Log Files" on page 83

To verify the latest information on support for Oracle database versions, see the VERITAS Technical Support TechNote:

http://support.veritas.com/docs/277033

Creating Service Groups for Oracle 10*g* Release 2 Using the Wizard

The Oracle 10g RAC configuration wizard guides you through the modification of the existing CVM group to include CRS Application, `PrivNIC`, `CFSMount` and `CVMVolDg` resources.

Before starting the wizard, verify that your Oracle installation can be configured:

✔ Oracle 10g CRS must be running

✔ Oracle RAC instances and listeners must be running on all cluster nodes

✔ The database files of all instances must be on shared storage, in a cluster file system or shared raw volumes

Make sure you have available the information the wizard needs as it proceeds:

✔ Names of the database instances to be configured

✔ Private IP addresses used by Oracle 10g CRS

✔ 10g CRS OCR location

✔ Vote disk location

Establishing Graphical Access for the Wizard

The configuration wizard requires graphical access to the VCS systems where you want to configure service groups. If your VCS systems do not have monitors, or if you want to run the wizards from a remote UNIX system, use the procedure for establishing graphical access for a remote system.

▼ To establish graphical access from a remote system

1. From the remote system, (jupiter, for example), run:

   ```
   # xhost +
   ```

2. Do one of the following, depending on your shell:

   ◆ For Bourne shell (bash, sh, or ksh), run this step on one of the systems where the wizard is to run, for example galaxy:

   ```
   # export DISPLAY=jupiter:0.0
   ```

   ◆ For C shell (csh), run this step

   ```
   # setenv DISPLAY jupiter:0.0
   ```

3. Verify that the DISPLAY environment variable has been updated:

   ```
   # echo $DISPLAY
   jupiter:0.0
   ```

Creating Service Groups Using the Configuration Wizard

The configuration wizard for Oracle 10g RAC is started at the command line.

▼ To create service groups using the configuration wizard

1. Log on to one of your VCS systems as root.

2. Start the configuration wizard.

   ```
   # /opt/VRTSvcs/bin/hawizard rac10g
   ```

   The VCS RAC Oracle 10g Configuration wizard starts with a Welcome window that highlights the prerequisites for configuration and the information you will need to complete the configuration.

   If your configuration does not meet the configuration requirements, you can stop the wizard by pressing Cancel. Take the necessary steps to meet the requirements and start the wizard again. See

3. To discover the RAC configuration, press **Next** on the Welcome screen when you are ready to configure Oracle service group. The wizard begins discovering the current Oracle RAC information before proceeding to the next screen.

   If the wizard does not find all databases in the cluster, it halts with an error, indicating the problem. Press Cancel, and start the wizard again after you correct the problem.

4. In the Database Selection screen, databases and their instances running on the cluster are listed are displayed. Select only one and click **Next**.

5. In the Private NIC Configuration screen, specify information for all the cluster nodes:

   a. Configure the Private IP address that is used by Oracle 10g CRS.

   b. Select the NIC's that should be used by the Private NIC agent to make this IP address highly available.

6. In the CRS Configuration screen, specify the OCR and Voting Disk locations (created on raw volumes).

7. In the Database Configuration screen, the wizard discovers the mount point of the database, if it is installed on a cluster file system, and displays it. If the database exists on raw volumes, the wizard discovers the volumes. If the OCR and Voting disk are on raw volumes, the wizard discovers the volumes.

   Confirm or modify the mount options displayed.

8. In the Service Group Summary screen, the wizard displays the configuration after you have configured the database and listener resources. Click **Finish** to complete the configuration.

9. In the Completing the RAC 10g Configuration screen:

   a. Click the **Bring the service groups online** check-box to start the newly added resources after exiting the wizard.

   b. Click **Close** to exit the wizard.

▼ To verify the state of newly added resources

1. Use `hargrp -state` to check status of the `cvm` group.

2. Use `hargrp -state` to check status of resources.

▼ **To restart the cluster nodes**

A restart is required at this stage so that CRS and Oracle RAC database instances use VERITAS libraries.

1. Stop CRS using `/etc/init.d/init.crs stop` on all nodes.

2. Stop VCS using `/opt/VRTSvcs/bin/hastop -local` on all nodes.

3. Restart all nodes.

Creating Service Groups for Oracle 10*g* Release 2 Manually

This section describes how to manually edit the `main.cf` file to configure the CVM and Oracle service groups.

▼ **To configure CVM service group for Oracle 10*g* manually**

1. Log in to one system as `root`.

2. Save your existing configuration to prevent any changes while you modify `main.cf`:

   # **haconf -dump -makero**

3. Make sure VCS is not running while you edit `main.cf` by using the `hastop` command to stop the VCS engine on all systems and leave the resources available:

   # **hastop -all -force**

4. Make a backup copy of the main.cf file:

   # **cd /etc/VRTSvcs/conf/config**
   # **cp main.cf main.orig**

5. Using `vi` or another text editor, edit the `main.cf` file, modifying the `cvm` service group and creating `Oracle` service groups using the sample main.cf as a guideline.

Sample main.cf for Oracle 10*g*

```
include "vcsApacheTypes.cf"
include "types.cf"
include "CFSTypes.cf"
include "CVMTypes.cf"
include "OracleTypes.cf"
include "PrivNIC.cf"
```

```
cluster ora_cluster (
        UserNames = { admin = dOPhOJoLPkPPnXPjOM }
        Administrators = { admin }
        HacliUserLevel = COMMANDROOT
        CounterInterval = 5
        UseFence = SCSI3
        )

system galaxy (
        )

system nebula (
        )

group cvm (
        SystemList = { galaxy = 0, nebula = 1 }
        AutoFailOver = 0
        Parallel = 1
        AutoStartList = { galaxy, nebula }
        )

        CFSMount orabin_mnt (
                Critical = 0
                MountPoint = "/orabin"
                BlockDevice = "/dev/vx/dsk/orabindg/orabinvol"
                )

        CFSMount oradata_mnt (
                Critical = 0
                MountPoint = "/oradata"
                BlockDevice = "/dev/vx/dsk/oradatadg/oradatavol"
                )

        CVMVolDg oradata_voldg (
                Critical = 0
                CVMDiskGroup = oradatadg
                CVMVolume = { oradatavol }
                CVMActivation = sw
                )

        CVMVolDg orabin_voldg (
                Critical = 0
                CVMDiskGroup = orabindg
                CVMVolume = { orabinvol }
                CVMActivation = sw
                )

        CVMVolDg ocrvote_voldg (
                Critical = 0
                CVMDiskGroup = ocrvotedg
                CVMVolume = { ocrvotevol }
                CVMActivation = sw
                )
```

```
                        CFSfsckd vxfsckd (
                                )

        CVMCluster cvm_clus (
                        CVMClustName = ora_cluster
                        CVMNodeId = { galaxy = 0, nebula = 1 }
                        CVMTransport = gab
                        CVMTimeout = 200
                        )

                CVMVxconfigd cvm_vxconfigd (
                        Critical = 0
                        CVMVxconfigdArgs = { syslog }
                        )

                PrivNIC ora_priv (
                        Critical = 0
                        Device = { eth1 = 0, eth2 = 1}
                        Address@galaxy = "192.11.12.58"
                        Address@nebula = "192.11.12.59"
                        NetMask = "255.255.255.0"
                )

                cvm_clus requires cvm_vxconfigd

                orabin_voldg requires cvm_clus
                oradata_voldg requires cvm_clus
                ocrvote_voldg requires cvm_clus

                ocrvote_mnt requires vxfsckd
                orabin_mnt requires vxfsckd
                oradata_mnt requires vxfsckd

                orabin_mnt requires orabin_voldg
                oradata_mnt requires oradata_voldg
```

Saving and Checking the Configuration

When you finish configuring the CVM and Oracle service groups by editing the main.cf file, verify the new configuration.

▼ **To save and check the configuration**

  1. Save and close the main.cf file.

  2. Verify the syntax of the file /etc/VRTSvcs/conf/config/main.cf:

    # **cd /etc/VRTSvcs/conf/config**
    # **hacf -verify .**

3. Start the VCS engine on one system:

   # **hastart**

4. Type the command hastatus:

   # **hastatus**

5. When "LOCAL_BUILD" is listed in the message column, start VCS on the other system:

   # **hastart**

6. Verify that the service group resources are brought online. On one system, enter:

   # **hagrp -display**

▼ **To verify the state of newly added resources**

1. Use hargrp -state to check status of the cvm group.

2. Use hargrp -state to check status of resources.

▼ **To restart the cluster nodes**

A restart is required to make sure that CRS and Oracle RAC database instances use VERITAS libraries.

1. Stop CRS using /etc/init.d/init.crs stop on all nodes.

2. Stop VCS using /opt/VRTSvcs/bin/hastop -local on all nodes.

3. Restart all nodes.

Modifying the VCS Configuration

For additional information and instructions on modifying the VCS configuration by editing the main.cf file, refer to the *VERITAS Cluster Server User's Guide*.

Location of VCS Log Files

On all cluster nodes, look at the following log files for any errors or status messages:

    /var/VRTSvcs/log/engine_A.log

When large amounts of data are written, multiple log files may be required. For example, `engine_B.log`, `engine_C.log`, and so on, may be required. The `engine_A.log` contains the most recent data.

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Digital Encryption Standard (DES) - MIT

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Storage Foundation for Oracle RAC Release Notes

[This is the first released version of the library GPL. It is numbered 2 because it goes with version 2 of the ordinary GPL.]

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The End

Perl Compatible Regular Expressions

Philip Hazel

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PCRE is a library of functions to support regular expressions whose syntax and semantics are as close as possible to those of the Perl 5 language.

Written by: Philip Hazel <ph10@cam.ac.uk>

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Strlcat.c

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Tomcat

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Xerces Java

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