

Oracle® Database

Oracle Clusterware and Oracle Real Application Clusters
Installation Guide

10g Release 2 (10.2) for hp Tru64

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Oracle Database Oracle Clusterware and Oracle Real Application Clusters Installation Guide, 10g Release 2 (10.2) for hp Tru64

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Contents

Preface	xi
Intended Audience.....	xi
Documentation Accessibility	xi
Related Documents	xii
Conventions	xii
 What's New in Oracle Database 10g Oracle Real Application Clusters Installation and Configuration?	xv
New Features for Oracle Clusterware and RAC Installation	xv
 Part I Oracle Clusterware and Oracle Real Application Clusters Installation Planning and Requirements	
 1 Introduction to Installing and Configuring Oracle Clusterware and Oracle Real Application Clusters	
Oracle Clusterware and Oracle Real Application Clusters Documentation Overview	1-1
Oracle Real Application Clusters Administration and Deployment Guide.....	1-2
General System Installation Requirements	1-2
Overview of Cluster Verification Utility	1-2
Overview of Oracle Universal Installer	1-3
Overview of Upgrading and Multiple-release Systems	1-3
Hardware Requirements for Oracle Clusterware and Oracle Real Application Clusters.....	1-3
Software Requirements for Oracle Clusterware and Oracle Real Application Clusters	1-5
Configuration Tasks for Oracle Clusterware and Oracle Real Application Clusters	1-5
Overview of Installation Procedures	1-6
Pre-Installation Overview for Oracle Database 10g Real Application Clusters	1-6
Installation Overview for Oracle Database 10g Real Application Clusters	1-6
Post-Installation Overview for Oracle Database 10g Real Application Clusters	1-7
Installation with Oracle Universal Installer	1-7
Storage Considerations for Installing Oracle Clusterware and RAC	1-8
Overview of Automatic Storage Management	1-8
Shared Storage for Database Recovery Area.....	1-11
Additional Considerations for Using Oracle Database 10g Features in RAC	1-11
Oracle Database 10g and Real Application Clusters Components	1-11
Oracle Clusterware	1-11

The Installed Real Application Clusters Components.....	1-12
Oracle Database 10g Real Application Clusters Release Compatibility	1-12
Required Operating System Groups.....	1-13
Cloning Oracle Clusterware and RAC in Grid Environments.....	1-14
Cloning Oracle Clusterware Homes	1-14
Cloning RAC Homes	1-15

Part II Oracle Clusterware and Oracle Real Application Clusters Pre-Installation Procedures

2 Pre-Installation Tasks

Understanding and Using Cluster Verification Utility.....	2-1
Entering Cluster Verification Utility Commands.....	2-2
Using CVU to Determine if Installation Prerequisites are Complete	2-2
Using the Cluster Verification Utility Help.....	2-3
Using Cluster Verification Utility with Oracle 10g Release 1	2-3
Verbose Mode and "Unknown" Output	2-3
Logging In to the System as root.....	2-4
Creating Required Operating System Groups and User.....	2-5
Creating the Oracle Inventory Group	2-6
Creating the OSDBA Group	2-7
Creating an OSOPER Group (Optional)	2-7
Creating the Oracle Software Owner User	2-8
Verifying that the User nobody Exists	2-9
Creating Identical Users and Groups on Other Cluster Nodes.....	2-9
Configuring SSH on All Cluster Nodes	2-11
Configuring SSH2 on Cluster Member Nodes	2-11
Enabling SSH2 User Equivalency on Cluster Member Nodes.....	2-13
Preventing Oracle Clusterware Installation Errors Caused by stty Commands.....	2-14
Configuring the oracle User's Environment	2-15
Checking the Hardware Requirements.....	2-17
Checking the Network Requirements.....	2-18
Checking IP Address Requirements.....	2-18
Checking Network Hardware Requirements	2-19
Configuring the Network Requirements.....	2-20
Checking Node Time Requirements	2-21
Configuring Asynchronous I/O	2-21
Checking the Network Setup with CVU	2-21
Verifying Software Requirements	2-22
Software Requirements List for HP Tru64 Platforms	2-22
Checking the Software Requirements.....	2-23
Verifying Required Patches.....	2-24
Patch Requirements List for HP Tru64	2-24
Checking the Patch Requirements.....	2-24
Configuring Kernel Subsystem Attributes	2-25
Configuring Reliable Datagram (RDG)	2-27
Checking the Hardware and Operating System Setup with CVU	2-28

Checking the Operating System Requirements Setup with CVU.....	2-28
Identifying Required Software Directories	2-29
Identifying or Creating an Oracle Base Directory	2-31
Creating the Oracle Clusterware Home Directory.....	2-33
Overview of the Spike Optimization Tool.....	2-34
Stopping Existing Oracle Processes for Upgrades or Co-existing Databases	2-35

3 Configuring Oracle Clusterware and Oracle Database Storage

Reviewing Storage Options for Oracle Clusterware, Database, and Recovery Files.....	3-1
Overview of Oracle Clusterware Storage Options.....	3-1
Overview of Oracle Database and Recovery File Options.....	3-2
General Storage Considerations.....	3-2
TruCluster Cluster File System	3-2
Direct I/O and Oracle Real Application Clusters	3-2
Voting Disk File Placement	3-2
Single-Instance Systems Using Oracle Clusterware	3-3
Selecting Storage Options	3-3
After You Have Selected Disk Storage Options	3-4
Checking for Available Shared Storage with CVU	3-5
Configuring Storage for Oracle Clusterware Files on a Supported Shared File System	3-5
Requirements for Using a File System for Oracle Clusterware Files.....	3-5
Creating Required Directories for Oracle Clusterware Files on Shared File Systems	3-7
Configuring Storage for Oracle Clusterware Files on Raw Devices	3-8
Identifying Required Raw Partitions for Clusterware Files	3-8
Configuring Raw Devices	3-9
Completing Supported Shared Storage Configuration	3-10
Choosing a Storage Option for Oracle Database Files.....	3-10
Deciding to Use a Cluster File System for Data Files.....	3-11
Guidelines for Placing Oracle Recovery Files on a File System	3-11
Configuring Disks for Automatic Storage Management	3-12
Identifying Storage Requirements for Automatic Storage Management	3-12
Using an Existing Automatic Storage Management Disk Group	3-15
Configuring Database File Storage on ASM and Raw Devices.....	3-17
Configuring Database File Storage on Raw Devices	3-17
Identifying Required Raw Partitions for Database Files.....	3-17
Creating the Database Configuration Assistant Raw Device Mapping File	3-18

Part III Installing Oracle Clusterware and Oracle Database 10g with Oracle Real Application Clusters, Creating Oracle Real Application Clusters Databases, and Performing Post-Installation Tasks

4 Installing Oracle Clusterware

Verifying Oracle Clusterware Requirements with CVU	4-1
Troubleshooting Oracle Clusterware Setup	4-2
Preparing to Install Oracle Clusterware with OUI.....	4-4
Installing Oracle Clusterware with OUI	4-7

Running OUI to Install Oracle Clusterware.....	4-7
Installing Oracle Clusterware Using a Cluster Configuration File.....	4-8
Troubleshooting Oracle Clusterware Installation Verification	4-8
Oracle Clusterware Background Processes	4-10
5 Installing Oracle Database 10g with Oracle Real Application Clusters	
Verifying System Readiness for installing Oracle Database with CVU	5-1
Troubleshooting Installation Setup for HP Tru64	5-2
Selecting a Configuration Option	5-3
Automatic Storage Management Configuration	5-4
Database Configuration Type Descriptions	5-4
General Purpose, Transaction Processing, and Data Warehouse Configuration Types ..	5-4
Using the Advanced Configuration Type	5-5
Actions of OUI, DBCA, and Other Assistants During Installation.....	5-5
Installation of Oracle Database 10g with RAC Using Oracle Universal Installer	5-5
De-Installing Oracle Real Application Clusters Software	5-7
De-Installing Oracle Database 10g RAC Software and ASM.....	5-7
De-Installing Oracle Clusterware	5-9
6 Creating Oracle Real Application Clusters Databases with Database Configuration Assistant	
Using Database Configuration Assistant in Oracle Real Application Clusters	6-1
Benefits of Using Database Configuration Assistant	6-2
Oracle Real Application Clusters High Availability Services.....	6-2
Service Configuration and Instance Preferences	6-2
Transparent Application Failover Policies	6-2
Automatic Listener Migration from Release 10.1 to 10.2	6-3
Verifying Requirements for DBCA	6-3
Creating an Oracle Real Application Clusters Database with DBCA	6-4
Deleting an Oracle Real Application Clusters Database with DBCA	6-6
7 Oracle Real Application Clusters Post-Installation Procedures	
Required Post-Installation Tasks	7-1
Back Up the Voting Disk After Installation.....	7-1
Download and Install Patch Updates	7-1
Configure Oracle Products	7-2
Relocate Instance-related Memory-mapped files from OCFS Using Symbolic Links	7-2
Recommended Post-Installation Tasks	7-3
Verifying Oracle Enterprise Manager Operations	7-3
Recommended Post-Installation Tasks	7-3
Back Up the root.sh Script	7-3
Set Up Users Accounts	7-4
Set the ORACLE_HOME and ORACLE_SID Environments	7-4
Logging in to Oracle Enterprise Manager Database Control	7-4
Additional Postinstallation Tasks for Tru64	7-5
Creating a New Partitions to a New Database.....	7-5

Adding a Partition to a Tablespace in an Existing Database	7-5
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Part IV Oracle Real Application Clusters Environment Configuration

8 Configuring the Server Parameter File in Oracle Real Application Clusters Environments

Parameter Files and Oracle Real Application Clusters.....	8-1
Using Server Parameter Files in Real Application Clusters	8-1
Location of the Server Parameter File	8-2
Parameter File Search Order in Real Application Clusters.....	8-2
Migrating to the Server Parameter File in Real Application Clusters Environments	8-3
Server Parameter File Placement in Real Application Clusters	8-3
Procedures for Migrating to the Server Parameter File	8-3
Server Parameter File Errors in Real Application Clusters.....	8-4

9 Understanding the Oracle Real Application Clusters Installed Configuration

Understanding the Configured Environment in Oracle Real Application Clusters.....	9-1
Oracle Cluster Registry in Oracle Real Application Clusters	9-1
Oratab Configuration for Oracle Real Application Clusters.....	9-2
Database Components Created Using Database Configuration Assistant.....	9-2
Tablespaces and Data files.....	9-2
Control Files.....	9-3
Redo Log Files	9-3
Managing Undo Tablespaces in Real Application Clusters	9-3
Initialization Parameter Files.....	9-3
Configuring Service Registration-Related Parameters in Real Application Clusters	9-4
Configuring the Listener File (listener.ora).....	9-4
Local Listeners	9-5
Multiple Listeners	9-5
How Oracle Database Uses the Listener (listener.ora File).....	9-5
Listener Registration and PMON Discovery	9-6
Directory Server Access (ldap.ora File).....	9-6
Net Service Names (tnsnames.ora File).....	9-6
Net Services Profile (sqlnet.ora File).....	9-11

Part V Oracle Clusterware and Oracle Real Application Clusters Installation and Configuration Reference Information

A Troubleshooting the Oracle Clusterware and Oracle Real Application Clusters Installation Process

Troubleshooting the Oracle Real Application Clusters Installation.....	A-1
General Installation Issues.....	A-1
Real Application Clusters Installation Error Messages	A-2
Performing Cluster Diagnostics During Real Application Clusters Installations	A-2

B	Using Scripts to Create Oracle Real Application Clusters Databases	
	Creating a Database Using Scripts.....	B-1
C	Configuring Raw Devices for Oracle Real Application Clusters	
	Raw Devices Required by DBCA for Non-OCFS Environments	C-1
	Planning Your Raw Device Creation Strategy	C-1
D	Converting to Oracle Real Application Clusters from Single-Instance Oracle Databases	
	Single-Instance to Cluster-Enabled Conversion Administrative Issues	D-1
	Converting with DBCA	D-2
	Single Instance on a Non-Cluster Computer to Oracle Database 10g with RAC	D-2
	Back Up the Original Single-Instance Database	D-2
	Perform the Pre-Installation Steps	D-3
	Set Up the Cluster	D-3
	Validate the Cluster	D-3
	Copy the Preconfigured Database Image.....	D-3
	Install Oracle Database 10g Software with Real Application Clusters	D-3
	Single Instance on a Cluster to Oracle Database 10g RAC.....	D-4
	Single Instance on a Cluster Running from a Cluster-Enabled Oracle Home	D-4
	Single Instance on a Cluster Running from a RAC-Disabled Oracle Home	D-7
	Single Instance on a Cluster Running from a Single-Instance Installed Oracle Home....	D-7
	Converting with rconfig and Oracle Enterprise Manager.....	D-7
	Prerequisites for Converting to RAC Databases	D-8
	Single-Instance to RAC Conversion Scenarios	D-8
	Converting Single-Instance Databases to RAC Using rconfig	D-9
	Example of an rconfig XML Input File.....	D-10
	Converting Single-Instance Databases to RAC Using Oracle Enterprise Manager	D-11
	Converting Single-Instance ASM to Cluster ASM	D-12
	Post-Conversion Steps.....	D-13
E	Directory Structure for Oracle Database 10g Oracle Real Application Clusters Environments	
	Understanding the Real Application Clusters Directory Structure	E-1
	Directory Structures for Real Application Clusters	E-1
F	How to Stop Processes in an Existing Oracle Real Application Clusters Database, and How to Perform Oracle Clusterware Rolling Upgrades	
	Back Up the Oracle Software	F-1
	Verify System Readiness for Patches and Upgrades	F-1
	How to Stop Processes in an Existing Oracle Database.....	F-2
	Shut Down Oracle Real Application Clusters Databases.....	F-2
	Stop All Oracle Processes.....	F-2
	Stop Oracle Clusterware or Cluster Ready Services Processes	F-2
	Stop Oracle Database 10g Processes Before Adding Products or Upgrading	F-3

How to Perform Oracle Clusterware Rolling Upgrades	F-3
Copy Patch Software to the Primary Upgrade Node	F-4
Shut Down Oracle Real Application Clusters Instances on Upgrade Nodes	F-4
Stop All Oracle Processes on Upgrade Nodes	F-4
Start OUI and Complete Upgrade Processes on Upgrade Nodes	F-5

G Managing Oracle Database Port Numbers

About Managing Ports	G-1
Viewing Port Numbers and Access URLs.....	G-1
Port Numbers and Protocols of Oracle Components	G-2
Changing the Oracle Enterprise Management Agent Port.....	G-4
Changing the Oracle Enterprise Manager Database Console Ports.....	G-4
Changing the iSQL*Plus Ports	G-5
Changing the Oracle Ultra Search Ports	G-5
Changing the Oracle XML DB Ports.....	G-6

Index

Preface

Oracle Database Oracle Clusterware and Oracle Real Application Clusters Installation Guide explains how to install and configure Oracle Clusterware and Oracle Real Application Clusters (RAC). This preface contains the following topics:

- [Intended Audience](#)
- [Documentation Accessibility](#)
- [Related Documents](#)
- [Conventions](#)

Intended Audience

Oracle Database Oracle Clusterware and Oracle Real Application Clusters Installation Guide provides configuration information for network and system administrators, and database installation information for database administrators (DBAs) who install and configure RAC.

Documentation Accessibility

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Related Documents

For more information, refer to the following Oracle resources:

- Platform-specific Administrator's Reference guides
- *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*
- *Oracle Database 2 Day DBA*
- *Oracle Database Administrator's Guide*
- *Oracle Database Concepts*
- *Oracle Database New Features*
- *Oracle Enterprise Manager Grid Control Installation and Basic Configuration*
- *Oracle Enterprise Manager Advanced Configuration*
- *Oracle Other Product Two Tuning and Performance Guide*

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When you have logged in, click **Database** on the navigation tree under **Products**, and follow the navigation links to Oracle documentation.

Conventions

This section describes the conventions used in the text and code examples of this documentation set. It describes:

- [Conventions in Text](#)
- [Conventions in Code Examples](#)

Conventions in Text

We use various conventions in text to help you more quickly identify special terms. The following table describes those conventions and provides examples of their use.

Convention	Meaning	Example
Bold	Bold typeface indicates terms that are defined in the text or terms that appear in a glossary, or both.	When you specify this clause, you create an index-organized table .
<i>Italics</i>	Italic typeface indicates book titles or emphasis.	<i>Oracle Database Concepts</i> Ensure that the recovery catalog and target database do <i>not</i> reside on the same disk.
UPPERCASE monospace (fixed-width) font	Uppercase monospace typeface indicates elements supplied by the system. Such elements include parameters, privileges, datatypes, RMAN keywords, SQL keywords, SQL*Plus or utility commands, packages and methods, as well as system-supplied column names, database objects and structures, usernames, and roles.	You can specify this clause only for a NUMBER column. You can back up the database by using the BACKUP command. Query the TABLE_NAME column in the USER_TABLES data dictionary view. Use the DBMS_STATS.GENERATE_STATS procedure.
lowercase monospace (fixed-width) font	Lowercase monospace typeface indicates executables, filenames, directory names, and sample user-supplied elements. Such elements include computer and database names, net service names, and connect identifiers, as well as user-supplied database objects and structures, column names, packages and classes, usernames and roles, program units, and parameter values. Note: Some programmatic elements use a mixture of UPPERCASE and lowercase. Enter these elements as shown.	Enter sqlplus to start SQL*Plus. The password is specified in the orapwd file. Back up the data files and control files in the /disk1/oracle/dbs directory. The department_id, department_name, and location_id columns are in the hr.departments table. Set the QUERY_REWRITE_ENABLED initialization parameter to true. Connect as oe user. The JRepUtil class implements these methods.
<i>lowercase italic monospace (fixed-width) font</i>	Lowercase italic monospace font represents placeholders or variables.	You can specify the <i>parallel_clause</i> . Run <i>old_release.SQL</i> where <i>old_release</i> refers to the release you installed prior to upgrading.

Conventions in Code Examples

Code examples illustrate SQL, PL/SQL, SQL*Plus, or other command-line statements. They are displayed in a monospace (fixed-width) font and separated from normal text as shown in this example:

```
SELECT username FROM dba_users WHERE username = 'MIGRATE';
```

The following table describes typographic conventions used in code examples and provides examples of their use.

Convention	Meaning	Example
[]	Brackets enclose one or more optional items. Do not enter the brackets.	DECIMAL (<i>digits</i> [, <i>precision</i>])
{ }	Braces enclose two or more items, one of which is required. Do not enter the braces, and do not enter more than one option.	{ENABLE DISABLE}
	A vertical bar represents a choice of two or more options within brackets or braces. Enter one of the options. Do not enter the vertical bar.	{ENABLE DISABLE} [COMPRESS NOCOMPRESS]

Convention	Meaning	Example
...	Horizontal ellipsis points indicate either: <ul style="list-style-type: none"> ■ That we have omitted parts of the code that are not directly related to the example ■ That you can repeat a portion of the code 	<pre>CREATE TABLE ... AS subquery; SELECT col1, col2, ... , coln FROM employees;</pre>
. . .	Vertical ellipsis points indicate that we have omitted several lines of code not directly related to the example.	<pre>SQL> SELECT NAME FROM V\$DATAFILE; NAME ----- /fs1/dbs/tbs_01.dbf /fs1/dbs/tbs_02.dbf . . . /fs1/dbs/tbs_09.dbf 9 rows selected.</pre>
Other notation	You must enter symbols other than brackets, braces, vertical bars, and ellipsis points as shown.	<pre>acctbal NUMBER(11,2); acct CONSTANT NUMBER(4) := 3;</pre>
<i>Italics</i>	Italicized text indicates placeholders or variables for which you must supply particular values.	<pre>CONNECT SYSTEM/system_password DB_NAME = database_name</pre>
UPPERCASE	Uppercase typeface indicates elements supplied by the system. We show these terms in uppercase in order to distinguish them from terms you define. Unless terms appear in brackets, enter them in the order and with the spelling shown. However, because these terms are not case sensitive, you can enter them in lowercase.	<pre>SELECT last_name, employee_id FROM employees; SELECT * FROM USER_TABLES; DROP TABLE hr.employees;</pre>
lowercase	Lowercase typeface indicates programmatic elements that you supply. For example, lowercase indicates names of tables, columns, or files. Note: Some programmatic elements use a mixture of UPPERCASE and lowercase. Enter these elements as shown.	<pre>SELECT last_name, employee_id FROM employees; sqlplus hr/hr CREATE USER mjones IDENTIFIED BY ty3MU9;</pre>

What's New in Oracle Database 10g Oracle Real Application Clusters Installation and Configuration?

This section describes Oracle Database 10g Release 2 (10.2) features as they pertain to the installation and configuration of Oracle Real Application Clusters (RAC) and Oracle Clusterware. The topic in this section is:

- [New Features for Oracle Clusterware and RAC Installation](#)

Note: Updates from the preceding 10.x releases are preceded by the release number, in parentheses. For example: (10.1). Where there are lists of updates to a feature that contain multiple releases, these releases are preceded by the release number in parentheses. For example:

- (10.1) *feature*
 - (10.2) *feature*
-
-

New Features for Oracle Clusterware and RAC Installation

- Oracle Database 10g Release 2 (10.2) is provided with Cluster Verification Utility. Cluster Verification Utility (CVU) is a validation tool that you can use to check whether or not your cluster is properly configured, to avoid installation failures, and to avoid database creation failures. It provides the following cluster setup checks:
 - The cluster configuration meets the requirements for installing Oracle Clusterware
 - The cluster configuration meets the requirements for Real Application Clusters installation
 - The cluster configuration meets the requirements for creating a database with Oracle Real Application Clusters, or meets the requirements for a change in database configuration

You can use the CVU command-line interface:

- To validate cluster components individually, including node connectivity, and proper configuration of administrative privileges, Oracle Cluster Registry (OCR), Oracle Clusterware, and other required components for Real Application Clusters

- To validate a pre-defined set of requirements, including the proper setup for node connectivity, shared storage accessibility, integrity of the Oracle Clusterware stack, and other requirements that a system must meet for a specific stage of Oracle Clusterware or RAC database installation or configuration.

CVU is available on the Oracle 10g Release 2 (10.2) installation media. You can either run CVU from the installation media, or run it from your local system after installation to perform configuration checks before installing Oracle software. CVU commands to perform installation checks are provided in this installation guide.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for detailed information about CVU

- With Oracle Database 10g Release 2 (10.2), you can create duplicates of a cluster node (or "clone" a node) using an image file. Cloning is now the preferred method for adding nodes to a cluster. You can manage node cloning using a GUI provided by Enterprise Manager Grid Control. The command line process for cloning, as well as details about using non-interactive (silent) installation scripts, is described in the manual *Oracle Universal Installer and OPatch User's Guide*.

Both Oracle Clusterware and Oracle Real Application Clusters can be cloned.

- With Oracle Database 10g Release 2 (10.2), Cluster Ready Services, or CRS, is now called Oracle Clusterware.
- Oracle Database 10g Release 2 (10.2) enables rolling upgrades from Oracle Database 10g Release 1 (10.1) Cluster Ready Services to Oracle Database 10g Release 2 (10.2) Oracle Clusterware.

During Oracle Clusterware installation, if Oracle Universal Installer (OUI) detects a 10g Release 1 (10.1) Cluster Ready Services installation, then OUI provides the option to install Oracle Clusterware across all nodes in the cluster, or across a subset of nodes in the cluster. During Oracle Clusterware installation, Oracle Database 10g Release 1 (10.1) Cluster Ready Services remains available on nodes that are not being upgraded.

- Starting with Oracle Database 10g Release 2 (10.2), Oracle Clusterware should be installed in a separate Oracle Clusterware home directory. This is a change to the Optimal Flexible Architecture (OFA) rules. You should not install Oracle Clusterware in a release-specific Oracle home mount point, typically `/u01/app/oracle/product/10.2.0`, as succeeding versions of Oracle Clusterware will overwrite the Oracle Clusterware installation in the same path. Also, If Oracle Clusterware 10g Release 2 (10.2) detects an existing Oracle Cluster Ready Services installation, then it overwrites the existing installation in the same path.
- Oracle Database 10g Release 2 (10.2) Oracle Clusterware installation provides the option to use a Cluster Configuration File. The Cluster Configuration File simplifies Oracle Clusterware installation in situations such as installing in test environments, or installing Oracle Clusterware on a large number of nodes.
- With Oracle Database 10g Release 2 (10.2), Database Configuration Assistant (DBCA) provides a simplified procedure for creating an Automatic Storage Management (ASM) instance and for configuring disk groups.

- With Oracle Database 10g Release 2 (10.2), Automatic Storage Management should be installed in a separate ASM home directory. This is a change to the Optimal Flexible Architecture (OFA) rules.
- With Oracle Database 10g Release 2 (10.2), a single ASM instance for each node is now able to serve disk groups to all the database instances in the cluster, whether or not database instances are configured with the RAC parameter turned on in the database parameter file. This change simplifies managing the cluster, because you do not need to distribute disks across multiple ASM instances statically. Instead, you can manage all disks with a single cluster of ASM instances.
- (10.1) Oracle Database 10g with RAC is available in both Standard Edition and Enterprise Edition.
- (10.1) Oracle Database 10g installation requires you to perform a two-phase process in which you run Oracle Universal Installer (OUI) twice. The first phase installs Oracle Clusterware 10g Release 2 (10.2) and the second phase installs the Oracle Database 10g software with RAC. The installation also enables you to create and configure services for your RAC environment.

(10.1) If you have a previous Oracle Database version with RAC or Oracle Parallel Server, then OUI activates Database Upgrade Assistant (DBUA) to automatically upgrade your previous release Oracle Database. DBUA can upgrade the following to Oracle Database 10g Release 2 (10.2): Oracle8i (8.1.7.4) Oracle Parallel Server databases; Oracle9i (9.0.1.4 and higher) and Oracle 9i (9.2.0.4 and higher) RAC databases; and can upgrade 10.1.0.2 and higher RAC databases, including those using ASM. It can also upgrade ASM 10.1 to ASM 10.2.

See Also: *Oracle Database Upgrade Guide* for information about how to plan for upgrading an existing database

- Oracle Database 10g Release 2 (10.2) Oracle Clusterware contains the cluster management software required to support Oracle Database 10g RAC databases. Oracle Clusterware also provides high availability components that provide many system management features, including determining node availability, cluster group membership, and locking services for Oracle Database processes. The components of Oracle Clusterware interact with third-party vendor clusterware, if present, to coordinate cluster membership information.

In addition, while continuing to be required for RAC databases, Oracle Clusterware is also available for use with single-instance databases and applications that you deploy on clusters. The API libraries required for use with single-instance databases are provided with the Oracle Client installation media.

The components of Oracle Clusterware interact with third-party vendor clusterware, if present, to coordinate cluster membership information. With this release, the following updates have been made to Oracle Clusterware:

- The Oracle Database cluster manager on database releases previous to 10g Release 1 was referred to as "Cluster Manager." In Oracle Database 10g releases, the cluster manager role is performed by Cluster Synchronization Services (CSS), a component of Oracle Clusterware, on all platforms. The Cluster Synchronization Service Daemon (CSSD) performs this function.
- With Oracle Database 10g Release 2 (10.2) with RAC, Oracle Clusterware provides for the creation of a mirrored Oracle Cluster Registry (OCR) file, enhancing cluster reliability.
- With Oracle Database 10g Release 2 (10.2) with RAC, CSS has been modified to allow you to configure CSS with multiple voting disks. In 10g Release 1 (10.1),

you could configure only one voting disk. By enabling multiple voting disk configuration, the redundant voting disks allow you to configure a RAC database with multiple voting disks on independent shared physical disks.

Note: To obtain the benefits of multiple voting disks, you must configure at least three voting disks.

- (10.1) There are new and changed pages and dialog boxes for Oracle Universal Installer (OUI), Database Configuration Assistant (DBCA), and Database Upgrade Assistant (DBUA). The Virtual Internet Protocol Configuration Assistant (VIPCA) is a new tool for the 10.x releases. These enhancements are described in the following:
 - (10.1) Database Creation Page: This page lets you select the type of starter database to create, and allows you to configure a database using DBCA after the software installation is complete.
 - (10.1) Database Backup and Recovery Page
 - (10.1) Database Security Page: You can now set the password for the ASM instance `SYS` user as well as the other database administration and monitoring accounts during installation.
 - (10.1) Database Management Page: This page provides the option to use Oracle Enterprise Manager Grid Control or Database Control to monitor the database.
 - (10.1) Create Disk Group Page: This page lets you create one disk group for ASM database data file management for backup and recovery.
 - (10.1) Existing ASM Disk Groups Page: This page provides assistance with placing disk groups in cases where you already have an ASM instance on your system.
 - (10.1) OUI Cluster Installation Mode Page: This page lets you select whether to perform a cluster or a single-instance Oracle Database 10g installation.
 - (10.1) `SYS` and `SYSTEM` Passwords Page: This page has fields for entering and confirming the `SYS` and `SYSTEM` user passwords. This includes `SYSMAN` and `DBSNMP` if you use Oracle Enterprise Manager Database Control.
 - (10.1) Storage Options Page: This page has storage options for selecting the storage type for the database files such as control files, data files, and redo logs.
 - (10.1) DBCA Services Page: This page lets you create and configure services for your RAC environment.
 - (10.1) DBCA Initialization Parameters Page: This page has two dialog boxes to display both Basic and Advanced parameter settings.
 - (10.1) VIPCA: The pages for this assistant lets you configure virtual Internet protocol addresses for your RAC database.
- (10.1) A new auxiliary, system-managed tablespace called `SYSAUX` contains performance data and combines content that was stored in different tablespaces (some of which are no longer required) in earlier releases. This is a required tablespace for which you must plan disk space.
- (10.1) The `gsdctl` commands should be used only with Oracle9i databases. The Oracle Clusterware installation process stops any existing Global Service Daemon

(GSD) processes. To start or stop the GSD processed manually, use `srvctl start nodeapps` or `srvctl stop nodeapps` respectively.

- (10.1) On some platforms, versions of the cluster manager previous to Oracle Database 10g were referred to as Cluster Manager. On all platforms in Oracle Database 10g, this function is performed by an Oracle Clusterware component known as Cluster Synchronization Services (CSS). Cluster Synchronization Service Daemon (CSSD) performs this function.
- (10.1) RAC and Database Configuration Assistant (DBCA) support Automatic Storage Management (ASM) and Oracle Managed Files (OMF).

See Also:

- *Oracle Database Administrator's Guide* for information about Automatic Storage Management, a new database file management feature
 - *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about administering services and storage in RAC
 - *Oracle Database Upgrade Guide* for information about using DBUA
- (10.2) The Oracle Database 10g version of the `srvConfig.loc` file is the `ocr.loc` file. The Oracle9i version of `srvConfig.loc` still exists for backward compatibility.

Note: If OUI detects the Oracle9i `svrconfig.loc` file, then the Oracle9i `srvConfig.loc` file is modified to point to `/dev/null`. Changing the `srvConfig.loc` file prevents Oracle9i clients such as GSD and `srvconfig` from overwriting contents of the device used for Oracle Cluster Registry in Oracle 10g Release 2 (10.2).

Part I

Oracle Clusterware and Oracle Real Application Clusters Installation Planning and Requirements

Part I describes how to plan your Oracle Clusterware and Oracle Real Application Clusters (RAC) installations, and describes Oracle Clusterware and RAC installation requirements. Part I contains the following chapter:

[Chapter 1, "Introduction to Installing and Configuring Oracle Clusterware and Oracle Real Application Clusters"](#)

Introduction to Installing and Configuring Oracle Clusterware and Oracle Real Application Clusters

This chapter provides an overview of Oracle Clusterware and Oracle Real Application Clusters (RAC) installation and configuration procedures. It includes the following topics:

- [Oracle Clusterware and Oracle Real Application Clusters Documentation Overview](#)
- [General System Installation Requirements](#)
- [Configuration Tasks for Oracle Clusterware and Oracle Real Application Clusters](#)
- [Overview of Installation Procedures](#)
- [Installation with Oracle Universal Installer](#)
- [Storage Considerations for Installing Oracle Clusterware and RAC](#)
- [Additional Considerations for Using Oracle Database 10g Features in RAC](#)
- [Oracle Database 10g and Real Application Clusters Components](#)
- [Oracle Database 10g Real Application Clusters Release Compatibility](#)
- [Required Operating System Groups](#)
- [Cloning Oracle Clusterware and RAC in Grid Environments](#)

Oracle Clusterware and Oracle Real Application Clusters Documentation Overview

This section describes the Oracle Clusterware and RAC documentation set.

This book contains the information required to complete pre-installation tasks, to complete installation, and to complete post-installation tasks for hp Tru64. Additional information for this release may be available in the Oracle Database 10g README or Release Notes. The platform-specific Oracle Database 10g installation media contains a copy of this book in both HTML and PDF formats.

The Server Documentation directory on the installation media contains *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*.

Oracle Real Application Clusters Administration and Deployment Guide

Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide describes how to administer Oracle Clusterware components such as the voting disks and Oracle Cluster Registry (OCR) devices. This book also explains how to administer storage, how to use RAC scalability features to add and delete instances and nodes, how to use Recovery Manager (RMAN), and how to perform backup and recovery in RAC.

Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide describes RAC deployment topics such as services, high availability, and workload management. The book describes how the Automatic Workload Repository (AWR) tracks and reports service levels, and how you can use service level thresholds and alerts to improve high availability in your RAC environment. The book also describes how to make your applications highly available using Oracle Clusterware.

Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide also provides information about how to monitor and tune performance in RAC environments by using Oracle Enterprise Manager, and by using information in AWR and Oracle Database performance views. This book also provides some application-specific deployment techniques for online transaction processing and data warehousing environments.

General System Installation Requirements

Each node that you want to make part of your Oracle Clusterware or Oracle Clusterware and RAC installation must meet the hardware and software requirements specified in [Part II](#) of this book. You can use the new Cluster Verification Utility to assist you with verification of requirements.

If you are uncertain about concepts related to setting up and configuring a RAC database, then read *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* to inform yourself about concepts such as services, setting up storage, and other information relevant to configuring your cluster.

Overview of Cluster Verification Utility

Cluster Verification Utility (CVU) is provided with Oracle Clusterware and Oracle Database 10g Release 2 (10.2) with Real Application Clusters. The purpose of CVU is to enable you or your hardware vendors to verify during setup and configuration that all components required for a successful installation of Oracle Clusterware or Oracle Clusterware and a RAC database are installed and configured correctly, and to provide you with ongoing assistance any time you need to make changes to your RAC cluster. You are provided with commands to use CVU to verify completion of tasks in this guide.

There are two types of CVU commands:

- **Stage Commands** are CVU commands used to test system setup and readiness for successful software installation, database creation, or configuration change steps. These commands are also used to validate successful completion of specific cluster configuration steps.
- **Component Commands** are CVU commands used to check individual cluster components, and determine their state.

This guide provides stage and component CVU commands where appropriate to assist you with cluster verification.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for detailed information about Cluster Verification Utility

Overview of Oracle Universal Installer

Oracle Universal Installer (OUI) is a graphical user interface (GUI) tool that assists you with installing and configuring Oracle Database. It can be run using different command options to perform installation pre-checks, specialized installation processes, and other tasks. To see an overview of OUI options, navigate to the directory path `oui/bin` in the Oracle home directory, and type the following command:

```
$ ./runInstaller -help
```

See Also: *Oracle Universal Installer and OPatch User's Guide* for more detailed information about OUI options

Overview of Upgrading and Multiple-release Systems

The path that you must take to upgrade to the new Oracle Database 10g release depends on the release number of your current database. It may not be possible to upgrade directly from your current release of Oracle Database to the latest release. Depending on your current release, you may need to upgrade through one or more intermediate releases to upgrade to the new Oracle Database 10g release.

For example, if the current database is running release 8.1.6, then first upgrade to release 8.1.7 using the instructions in *Oracle8i Migration for release 8.1.7*. The release 8.1.7 database can then be upgraded to the new Oracle Database 10g release.

Oracle9i database can coexist with Oracle Database 10g Release 2 (10.2). However, if you want separate releases of the database to coexist, then you must install Oracle Database 10g with Oracle9i already installed. You should not install Oracle9i after installing Oracle10g.

See Also: *Oracle Database Upgrade Guide* for more information about upgrading

Hardware Requirements for Oracle Clusterware and Oracle Real Application Clusters

Each node in a cluster requires the following hardware:

- External shared disks for storing the Oracle Clusterware (Oracle Cluster Registry and voting disk) files, and database files.

[Chapter 3](#) describes the storage disk configuration options that are available. Review these options before you decide which storage option to use in your RAC environment. However, note that when Database Configuration Assistant (DBCA) configures automatic disk backup, it uses a database recovery area that must be shared.

Note: Oracle Clusterware software can be installed on Oracle Cluster File System 2 (OCFS2). However, Oracle Clusterware software *cannot* be installed on Oracle Cluster File System (OCFS). Oracle Clusterware software can be installed on network-attached storage (NAS).

For OCFS2 certification status, refer to the Certify page on OracleMetaLink:

<http://metalink.oracle.com>

- One private internet protocol (IP) address for each node to serve as the private interconnect. The following must be true for each private IP address:
 - It must be separate from the public network
 - It must be accessible on the same network interface on each node
 - It must have a unique address on each node

The private interconnect is used for internode communication by both Oracle Clusterware and RAC. The private IP address must be available in each node's `/etc/hosts` file.

During Oracle Clusterware installation, the information you enter as the private IP address determines which private interconnects are used by Oracle Clusterware for its own communication. They must all be available, and capable of responding to a `ping` command.

Oracle recommends that you use a logical Internet Protocol (IP) address that is available across all private networks, and that you take advantage of any available operating system-based failover mechanism by configuring it according to your third-party vendor's instructions for using their product to support failover.

- One public IP address for each node, to be used as the Virtual IP address for client connections and for connection failover.

During installation this public virtual IP address (VIP) is associated with the same interface name on every node that is part of your cluster. The IP addresses that you use for all of the nodes that are part of a cluster must be from the same subnet. If you have a domain name server (DNS), then register the host names for the VIP with the DNS. The VIP should not be in use at the time of the installation, because this is a VIP that Oracle Clusterware manages.

- One public fixed host name address for each node, typically assigned by the system administrator during operating system installation. If you have a domain name server (DNS), then you can register both the fixed IP and the VIP address with the DNS. If you do not have a DNS, then you must make sure that both public IP addresses are in the node `/etc/hosts` file (for all cluster nodes), and any client system's `/etc/hosts` file that requires access to the database.

Note: In addition to these requirements, Oracle recommends the following:

- While installing and using Real Application Clusters software, you should attempt to keep the system clocks on all cluster nodes as close as possible to the same time. Oracle strongly recommends using the Network Time Protocol feature of most operating systems for this purpose, with all nodes using the same reference Network Time Protocol server.
 - Use redundant switches as a standard configuration for all cluster sizes.
-

Software Requirements for Oracle Clusterware and Oracle Real Application Clusters

Each node in a cluster requires a supported interconnect software protocol to support Cache Fusion, and to support Oracle Clusterware polling. Your interconnect *must* be certified by Oracle for your platform. You should also have a Web browser, both to enable Oracle Enterprise Manager, and to view online documentation.

For Oracle Database 10g requirements, Oracle Clusterware provides the same functions as third-party vendor clusterware. Using Oracle Clusterware also reduces installation and support complications. However, you may require third-party vendor clusterware if you use a non-ethernet interconnect, or if you have deployed clusterware-dependent applications on the same cluster where you deploy RAC.

Configuration Tasks for Oracle Clusterware and Oracle Real Application Clusters

Before installing Oracle Clusterware and RAC, perform the following procedures:

1. Ensure that you have a certified combination of the operating system and an Oracle Database software release by referring to the *OracleMetaLink* certification information, which is located at the following Web site:

<http://metalink.oracle.com>

Click **Certify & Availability**, and select **1.View Certifications by Product**.

Note: The layout of the *OracleMetaLink* site and the site's certification policies are subject to change.

2. Configure a high-speed interconnect that uses a private network. Some platforms support automatic failover to an additional interconnect.
3. Determine the storage option for your system and configure the shared disk. Oracle recommends that you use Automatic Storage Management (ASM) and Oracle Managed Files (OMF), or a cluster file system. If you use ASM or a cluster file system, then you can also take advantage of OMF and other Oracle Database 10g storage features. If you use RAC on Oracle Database 10g Standard Edition, then you must use ASM.

When you start Oracle Universal Installer (OUI) to install Oracle Clusterware, you are asked to provide the paths for voting disks, and for the Oracle Cluster Registry (OCR).

For voting disks: Configure one disk, if you have existing redundancy support for the voting disk. If you intend to use multiple voting disks managed by Oracle Clusterware, then you must have at least three disks to provide sufficient redundancy, and you must ensure that each voting disk is located on physically independent storage.

In addition, if you select multiple voting disks managed by Oracle Clusterware, then you should ensure that all voting disks are located on a secure network protected from external security threats, and you should ensure that all voting disks are on regularly maintained systems. If a voting disk fails, then you need to fix the physical hardware and bring it back online. The Cluster Synchronization Services (CSS) component of Oracle Clusterware continues to use the other voting disks, and automatically makes use of the restored drive when it is brought online again.

For OCR: Configure one disk if you have existing redundancy support. If you intend to use OCR mirroring managed by Oracle Clusterware, then you must have two OCR locations, and you must ensure that each OCR is located on physically independent storage.

In addition, if you select mirrored OCRs managed by Oracle Clusterware, then you should ensure that all OCRs are located on a secure network protected from external security threats, and you should ensure that all OCRs are on regularly maintained systems. If an OCR copy fails or becomes inaccessible, then you can use the `ocrconfig` tool to replace the OCR.

4. Install the operating system patch updates that are listed in the pre-installation chapter in this book in [Part II](#).
5. Use the Cluster Verification Utility (CVU) to help you to verify that your system meets requirements for installing Oracle Database with Oracle Clusterware and RAC.

Overview of Installation Procedures

The following describes the installation procedures that are covered in [Part II](#) and [Part III](#) of this book.

Pre-Installation Overview for Oracle Database 10g Real Application Clusters

The pre-installation procedures in [Part II](#) explain how to verify user equivalence, perform network connectivity tests, how to set directory and file permissions, and other required pre-installation tasks. Complete all pre-installation tasks and verify that your system meets all pre-installation requirements before proceeding to the install phase.

Installation Overview for Oracle Database 10g Real Application Clusters

Oracle Database 10g Real Application Clusters installation is a two-phase installation. In phase one, use Oracle Universal Installer (OUI) to install Oracle Clusterware as described in [Chapter 4, "Installing Oracle Clusterware"](#). Note that the Oracle home in phase one is a home for the Oracle Clusterware software, which *must be different* from the Oracle home that you use in phase two for the installation of the Oracle database software with RAC components. The Oracle Clusterware installation starts the Oracle Clusterware processes in preparation for installing Oracle Database 10g with RAC, as described in [Chapter 5, "Installing Oracle Database 10g with Oracle Real Application Clusters"](#). Use OUI in this phase to install the RAC software.

You must install Oracle Clusterware and Oracle Database in separate home directories. You should create the listener in the Oracle database Oracle home. If you will use multiple Oracle Database homes with ASM, then you should install a separate Oracle Database home for ASM. To create a new, independent ASM home, you should run the database OUI and select the option to install ASM.

If OUI detects a previous release of Oracle Clusterware (previously known as Oracle Cluster Ready Services), then you are prompted to select either a rolling upgrade, or a full upgrade.

If OUI detects a previous release of the Oracle database, then OUI provides you with the option to start Database Upgrade Assistant (DBUA) to upgrade your database to Oracle Database 10g Release 2 (10.2). In addition, DBUA displays a Service Configuration page for configuring services in your RAC database.

See Also: *Oracle Database Upgrade Guide* for additional information about preparing for upgrades

After the installation completes, OUI starts the Oracle Database assistants, such as Database Configuration Assistant (DBCA), to configure your environment and create your RAC database. You can later use the DBCA Instance Management feature to add or modify services and instances as described in [Chapter 6, "Creating Oracle Real Application Clusters Databases with Database Configuration Assistant"](#).

Post-Installation Overview for Oracle Database 10g Real Application Clusters

After you create your database, download and install the most recent patch set for your Oracle Database 10g release, as described in [Chapter 7, "Oracle Real Application Clusters Post-Installation Procedures"](#). If you are using other Oracle products with your RAC database, then you must also configure them.

You must also perform several post-installation configuration tasks to use certain Oracle Database 10g features.

On the installation media, you can select additional Oracle Database 10g software that may improve performance or extend database capabilities. Examples: Oracle JAccelerator, Oracle *interMedia*, and Oracle Text.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*, and *Oracle Universal Installer and OPatch User's Guide* for more information about using the RAC scalability features of adding and deleting nodes and instances from RAC databases

Installation with Oracle Universal Installer

Oracle Universal Installer (OUI) facilitates the installation of Oracle Clusterware and Oracle Database 10g software. In most cases, you use the graphical user interface (GUI) provided by OUI to install the software. However, you can also use OUI to complete non-interactive (or *silent*) installations, without using the GUI. Refer to [Appendix B](#) for information about non-interactive installations.

The Oracle Inventory maintains records of Oracle software releases and patches. Each installation has a central inventory where the Oracle home is registered. Oracle software installations have a local inventory directory, whose path location is recorded in the central inventory Oracle home. The local inventory directory for each Oracle software installation contains a list of components and applied interim patches associated with that software. Because your Oracle software installation can be

corrupted by faulty inventory information, OUI must perform all read and write operations on Oracle inventories.

When you install Oracle Clusterware or RAC, OUI copies this Oracle software onto the node from which you are running it. If your Oracle home is not on a shared file system, then OUI propagates the software onto the other nodes that you have selected to be part of your OUI installation session. The Oracle Inventory maintains a list of each node that is a member of the RAC database, and lists the paths to each node's Oracle home. This is used to maintain software patches and updates for each member node of the RAC database.

If you create your RAC database using OUI, or if you create it later using DBCA, then Oracle Enterprise Manager Database Control is configured for your RAC database. Database Control can manage your RAC database, all its instances, and the hosts where instances are configured.

You can also configure Enterprise Manager Grid Control to manage multiple databases and application servers from a single console. To manage RAC databases in Grid Control, you must install a Grid Control agent on each of the nodes of your cluster. The Agent installation is designed to recognize a cluster environment and install across all cluster nodes; you need to perform the installation on only one of the cluster nodes to install Grid Control agent on all cluster nodes.

When OUI installs the Oracle Clusterware or Oracle Database software, Oracle recommends that you select a preconfigured database, or use Database Configuration Assistant (DBCA) interactively to create your RAC database. You can also manually create your database as described in procedures posted on the Oracle Technical Network, which is at the following URL:

<http://www.oracle.com/technology/index.html>

Oracle recommends that you use Automatic Storage Management (ASM). You must configure shared storage before you create your database.

See Also:

- *Oracle Universal Installer and OPatch User's Guide* for more details about OUI
- *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for information about using Oracle Enterprise Manager to administer RAC environments
- The Grid Technology Center on the Oracle Technology Network (OTN), which is available at the following URL:

<http://www.oracle.com/technology/tech/index.html>

Storage Considerations for Installing Oracle Clusterware and RAC

This section discusses storage configuration options that you should consider before installing Oracle Database 10g Release 2 (10.2) with Real Application Clusters.

Overview of Automatic Storage Management

Oracle recommends using Automatic Storage Management (ASM) or a cluster file system with Oracle Managed Files (OMF) for database storage. This section provides an overview of ASM.

Note that RAC installations using Oracle Database Standard Edition must use ASM for database file storage.

You can use ASM to simplify the administration of Oracle database files. Instead of having to manage potentially thousands of database files, using ASM, you need to manage only a small number of disk groups. A **disk group** is a set of disk devices that ASM manages as a single logical unit. You can define a particular disk group as the default disk group for a database, and Oracle Database will automatically allocate storage for, create, or delete, the files associated with the appropriate database object. When administering the database, you need to refer to database objects only by name, rather than by file name.

When using ASM with a single Oracle home for database instances on a node, the ASM instance can run from that same home. If you are using ASM with Oracle Database instances from multiple database homes on the same node, then Oracle recommends that you run the ASM instance from an Oracle home that is distinct from the database homes. In addition, the ASM home should be installed on every cluster node. Following this recommendation prevents the accidental removal of ASM instances that are in use by databases from other homes during the de-installation of a database's Oracle home.

Benefits of Automatic Storage Management

ASM provides many of the same benefits as storage technologies such as a redundant array of independent disks (RAID) or a logical volume manager (LVM). Like these technologies, ASM lets you create a single disk group from a collection of individual disk devices. It balances input and output (I/O) loads to the disk group across all of the devices in the disk group. It also implements striping and mirroring to improve I/O performance and data reliability.

However, unlike RAID or LVMs, ASM implements striping and mirroring at the file level. This implementation lets you specify different storage attributes for individual files in the same disk group.

Disk Groups and Failure Groups

A disk group can contain between 1 to 10000 disk devices. Each disk device can be an individual physical disk, a multiple disk device such as a RAID storage array or logical volume, or even a partition on a physical disk. However, in most cases, disk groups consist of one or more individual physical disks. To enable ASM to balance I/O and storage appropriately within the disk group, all devices in the disk group should have similar, if not identical, storage capacity and performance.

Note: Do not put more than one partition of a single disk into the same disk group. You can put separate partitions of a single disk into separate disk groups.

When you add a device to a disk group, you can specify a failure group for that device. Failure groups define ASM disks that share a common potential failure mechanism. An example of a failure group is a set of SCSI disks sharing the same SCSI controller. Failure groups are used to determine which ASM disks to use for storing redundant copies of data. For example, if two-way mirroring is specified for a file, then ASM automatically stores redundant copies of file extents in separate failure groups. Failure groups apply only to normal and high redundancy disk groups. You define the failure groups in a disk group when you create or alter the disk group.

Redundancy Levels

ASM provides three levels of mirroring, called redundancy levels, that you can specify when creating a disk group. The redundancy levels are:

- External redundancy

In disk groups created with external redundancy, the contents of the disk group are not mirrored by ASM. Choose this redundancy level when:

- The disk group contains devices, such as RAID devices, that provide their own data protection
- Your use of the database does not require uninterrupted access to data. For example: a development environment where you have a suitable backup strategy

- Normal redundancy

In disk groups created with normal redundancy, the contents of the disk group are two-way mirrored by default. However, you can choose to create certain files that are three-way mirrored, or that are not mirrored. To create a disk group with normal redundancy, you must specify at least two failure groups (a minimum of two devices).

The effective disk space of a disk group that uses normal redundancy is half the total disk space of all of its devices.

- High redundancy

In disk groups created with high redundancy, the contents of the disk group are three-way mirrored by default. To create a disk group with high redundancy, you must specify at least three failure groups (a minimum of three devices).

The effective disk space of a disk group that uses high redundancy is one-third of the total disk space of all of its devices.

See Also: *Oracle Database Administrator's Guide* for additional information about ASM and redundancy

ASM and Installation Types

The type and number of disk groups that you can create when installing Oracle Database software depends on the type of database you choose to create during the installation, as follows:

- Preconfigured database

If you choose to create the default preconfigured database that uses ASM, then OUI prompts you to specify one or more disk device names and redundancy. By default, OUI creates a disk group named DATA, with normal redundancy.

- Advanced database

If you choose to create an advanced database that uses ASM, then you can create one or more disk groups. These disk groups can use one or more devices. For each disk group, you can specify the redundancy level that suits your requirements.

- Configure Automatic Storage Management

If you choose to create an ASM instance only, then OUI prompts you to create Disk Group. If OUI finds a Grid Control service is found on the system, then OUI prompts you to indicate if the ASM instance shall be managed by Grid Control. The Management Service box lists the available Oracle Management Services.

Shared Storage for Database Recovery Area

When you configure a database recovery area in a RAC environment, the database recovery area must be on shared storage. When Database Configuration Assistant (DBCA) configures automatic disk backup, it uses a database recovery area that must be shared.

If the database files are stored on a cluster file system, then the recovery area can also be shared through the cluster file system.

If the database files are stored on an Automatic Storage Management (ASM) disk group, then the recovery area can also be shared through ASM.

Note: ASM disk groups are always valid recovery areas, as are cluster file systems. Recovery area files do not have to be in the same location where data files are stored.

Additional Considerations for Using Oracle Database 10g Features in RAC

Oracle recommends that you use the following Oracle Database 10g features to simplify RAC database management:

- Oracle Enterprise Manager—Use Enterprise Manager to administer your *entire* processing environment, not just the RAC database. Enterprise Manager lets you manage a RAC database with its instance targets, listener targets, host targets, and a cluster target, as well as ASM targets if you are using ASM storage for your database.
- Automatic undo management—This feature automatically manages undo processing.
- Automatic segment-space management—This feature automatically manages segment freelists and freelist groups.
- Locally managed tablespaces—This feature enhances space management performance.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about these features in RAC environments

Oracle Database 10g and Real Application Clusters Components

Oracle Database 10g provides single-instance database software and the additional components to operate RAC databases. Some of the RAC-specific components include the following:

- Oracle Clusterware
- A RAC-enabled Oracle home

Oracle Clusterware

OUI installs Oracle Clusterware on each node of the cluster. If third-party vendor clusterware is not present, then you must use OUI to enter the nodes on which you want Oracle Clusterware to be installed. The Oracle Clusterware home can either be shared by all nodes, or private to each node, depending on your responses when you run OUI. The home that you select for Oracle Clusterware *must* be different from the RAC-enabled Oracle home.

When third-party vendor clusterware is present, Oracle Clusterware may interact with the third-party vendor clusterware. For Oracle Database 10g on Linux and Windows, Oracle Clusterware coexists with but does not interact with previous Oracle clusterware releases. In using third-party vendor clusterware, note the following:

- Oracle Clusterware can integrate with third-party vendor clusterware for all operating systems except Linux and Windows.

Note: The Oracle Database cluster manager in database releases previous to 10g Release 1 was referred to as "Cluster Manager." In Oracle Database 10g, the cluster manager role is performed by Cluster Synchronization Services (CSS), a component of Oracle Clusterware, on all platforms. The Cluster Synchronization Service Daemon (CSSD) performs this function.

The Installed Real Application Clusters Components

All instances in RAC environments share the control file, server parameter file, redo log files, and all data files. These files reside on a shared cluster file system or on shared disks. Either of these types of file configurations are accessed by all the cluster database instances. Each instance also has its own set of redo log files. During failures, shared access to redo log files enables surviving instances to perform recovery.

Oracle Database 10g Real Application Clusters Release Compatibility

You can install and operate different releases of Oracle Database software on the same computer:

- With Oracle Database 10g Release 2 (10.2) if you have an existing Oracle home, then you must install the database into the existing Oracle home. You should install Oracle Clusterware in a separate Oracle Clusterware home. Each node can have only one Oracle Clusterware home.

During installation, Oracle Universal Installer (OUI) prompts you to install additional Oracle Database 10g components if you have not already installed all of them.

- OUI lets you de-install and re-install Oracle Database 10g Real Application Clusters if needed.
- If you want to install Oracle9i and Oracle Database 10g Release 2 (10.2) on the same system, then you must install Oracle9i first. You cannot install Oracle9i on a system with Oracle Database 10g.
- If OUI detects an earlier database release, then OUI asks you about your upgrade preferences. You have the option to upgrade one of the previous release databases with DBUA or to create a new database using DBCA. The information collected during this dialog is passed to DBUA or DBCA after the software is installed.

Note: Do not move Oracle binaries from the Oracle home to another location. Doing so can cause dynamic link failures.

- You can run different releases of Oracle Database and Automatic Storage Management (ASM). If the Oracle Database release and the ASM release are the same release, then they can both run out of the same Oracle home. If they are different releases, then the Oracle Database release and the ASM release must be in

their separate release homes. For example, you can install an ASM release 10g Release 2 (10.2) instance and use it with Oracle Database 10g Release 1 (10.1) database, or you can install an Oracle 10g Release 2 (10.2) database and use it with an ASM 10g Release 1 (10.1) instance.

Note: When using different release ASM and Oracle Database releases, the functionality of each is dependent on the functionality of the earlier software release. For example, an Oracle Database 10g release 10.1.0.2 using an ASM 10.1.0.3 instance will not be able to use new features available for ASM in the 10.1.0.3 release, but instead only ASM 10.1.0.2 features. Conversely, an Oracle Database 10g release 10.1.0.3 using an ASM instance release 10.1.0.2 will function like a release 10.1.0.2 database.

Required Operating System Groups

Depending on whether this is the first time that you are installing Oracle server software on your system, you may need to create several groups and a user account to own Oracle software, as described later in the pre-installation procedures. The required groups and user are:

- The Oracle Inventory group (`oinstall`)
You must create this group the first time you install Oracle software on the system. The usual name for this group is `oinstall`. Members of this group own the Oracle inventory, which is a catalog of all of the Oracle software installed on the system. Group membership in `oinstall` is also required to perform some tasks involving Oracle Cluster Registry (OCR) keys that are created during Oracle Clusterware installation.
- The OSDBA group (`dba`)
You must create the OSDBA group the first time you install Oracle software on the system.

The OSDBA group provides operating system verification of users that have database administrative privileges (the SYSDBA and SYSOPER privileges). The default name for this group is `dba`. During installation, if you want to specify a group name other than the default, then you are prompted during installation for the name of the OSDBA group.

You must create a new OSDBA group if you have an existing OSBDA group, but you want to give a different group of users database administrative privileges in a new Oracle server installation.
- The OSOPER group (`oper`)
The OSOPER group is optional. Create this group if you want a separate group of users to have a limited set of database administrative privileges (the SYSOPER privilege), to perform such operations as backing up, recovering, starting up, and shutting down the database. The default name for this group is `oper`. To use this group, choose the **Custom** installation type to install the software. To use an OSOPER group, you must create it in the following circumstances:
 - If an OSOPER group does not exist (for example, if this is the first installation of Oracle server software on the system)
 - If an OSOPER group exists, but you want to give a different group of users database operator privileges in a new Oracle server installation

- The Oracle Software Owner user (`oracle`)

You must create the Oracle user account the first time you install Oracle software on the system. The Oracle user account owns all of the software installed during the installation. The usual name for the Oracle user account is `oracle`. The `oracle` user must have the Oracle Inventory group as its primary group and the `OSDBA` group as its secondary group. It must also have the `OSOPER` group as a secondary group if you choose to create that group.

If an Oracle software owner user exists, but you want to use a different user with different group membership in a new Oracle server installation, then you must give database administrative privileges to those groups.

A single Oracle Inventory group is required for all installations of Oracle software on the system. However, you can create different Oracle software owner users, `OSDBA` groups, and `OSOPER` groups (other than `oracle`, `dba`, and `oper`) for separate installations. In addition, you can create a separate owner for Oracle Clusterware. Using different groups lets you grant DBA privileges to a particular operating system user on one database, which they would not have on another database on the same system.

See Also: *Oracle Database Administrator's Reference, 10g Release 2 (10.2) for UNIX Systems* and *Oracle Database 10g Administrator's Guide for hp Tru64* for additional information about the `OSDBA` and `OSOPER` groups, and the `SYSDBA` and `SYSOPER` privileges

Cloning Oracle Clusterware and RAC in Grid Environments

The preferred method to clone Oracle Clusterware and RAC software is to use Enterprise Manager Grid Control. The following sections provide a summary of the command line procedures for deployments of RAC in grid environments with large numbers of nodes using cloned Clusterware and RAC images:

- [Cloning Oracle Clusterware Homes](#)
- [Cloning RAC Homes](#)

See Also: For detailed information about cloning RAC and Oracle Clusterware images, refer to the following documents:

Cloning, and adding and deleting nodes:

Oracle Universal Installer and OPatch User's Guide

Additional information about adding and deleting nodes:

Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide

Cloning Oracle Clusterware Homes

Complete the following tasks to clone an Oracle Clusterware home on multiple nodes:

1. On the source node, install Oracle Clusterware software. All required root scripts must run successfully.
2. As root, create a tar file of the Oracle Clusterware home
3. On the target node, create an Oracle Clusterware home, and copy the Oracle Clusterware tar file from the source node to the target node Oracle Clusterware home.

4. As root, uncompress the tar file.
5. Run OUI in clone mode, as described in *Oracle Universal Installer and OPatch User's Guide*.
6. Run root scripts.
7. Repeat steps 1 through 6 on each node that you want to add to the cluster. On the last node that you install, run the tool `oifcfg` to configure the network interfaces.

Cloning RAC Homes

Complete the following tasks to Clone a RAC database image on multiple nodes:

1. On the source node, install a RAC database Oracle home. All required root scripts must run successfully. Do not create a database, and do not run any configuration tools.
2. As root, create a tar file of the RAC database Oracle home.
3. On the target node, create an Oracle home directory for the RAC database, and copy the RAC database tar from the source node to the target node Oracle home.
4. Create required Oracle users and groups, ensuring that you use the same names, user ID numbers and group ID numbers as those on the source node.
5. As root, uncompress the tar file.
6. Run OUI in clone mode, as described in *Oracle Universal Installer and OPatch User's Guide*.
7. Run root scripts.
8. Repeat steps 1 through 7 for on each node that you want to add to the cluster.
9. Run the configuration assistant NetCA on a local node of the cluster, and provide a list when prompted of all nodes that are part of the cluster. This procedure creates the listener.
10. Run the configuration assistant DBCA to create the database.
11. Follow post-cloning phase instructions as provided in *Oracle Universal Installer and OPatch User's Guide*.

Part II

Oracle Clusterware and Oracle Real Application Clusters Pre-Installation Procedures

Part II describes the pre-installation procedures for hp Tru64 that you must complete before installing Oracle Clusterware and Oracle Database 10g Real Application Clusters (RAC). Part II contains the following chapters:

- [Chapter 2, "Pre-Installation Tasks"](#)
- [Chapter 3, "Configuring Oracle Clusterware and Oracle Database Storage"](#)

Pre-Installation Tasks

This chapter describes the system configuration tasks that you must complete before you start Oracle Universal Installer. It includes information about the following tasks:

- [Understanding and Using Cluster Verification Utility](#)
- [Logging In to the System as root](#)
- [Creating Required Operating System Groups and User](#)
- [Configuring the oracle User's Environment](#)
- [Checking the Hardware Requirements](#)
- [Checking the Network Requirements](#)
- [Checking the Network Setup with CVU](#)
- [Verifying Software Requirements](#)
- [Verifying Required Patches](#)
- [Configuring Kernel Subsystem Attributes](#)
- [Checking the Hardware and Operating System Setup with CVU](#)
- [Checking the Operating System Requirements Setup with CVU](#)
- [Identifying Required Software Directories](#)
- [Identifying or Creating an Oracle Base Directory](#)
- [Creating the Oracle Clusterware Home Directory](#)
- [Overview of the Spike Optimization Tool](#)
- [Stopping Existing Oracle Processes for Upgrades or Co-existing Databases](#)

Understanding and Using Cluster Verification Utility

Cluster Verification Utility (CVU) is a tool that performs system checks. This guide provides CVU commands to assist you with confirming that your system is properly configured for Oracle Clusterware and Oracle Real Application Clusters installation.

This section describes the following topics:

- [Entering Cluster Verification Utility Commands](#)
- [Using CVU to Determine if Installation Prerequisites are Complete](#)
- [Using the Cluster Verification Utility Help](#)
- [Using Cluster Verification Utility with Oracle 10g Release 1](#)

- [Verbose Mode and "Unknown" Output](#)

Entering Cluster Verification Utility Commands

Note: You must have the utility `unzip` installed and configured with a path command for `runcluvfy.sh` to run.

Before the database is installed, to enter a CVU command, change directory and use the following syntax to start CVU:

```
$ /mountpoint/crs/Disk1/cluvfy/  
$ ./runcluvfy.sh options
```

In the preceding example, the variable *mountpoint* represents the mountpoint path for the installation media, and the variable *options* represents the CVU command options that you select. For example:

```
$ /dev/dvdrom/crs/Disk1/cluvfy/  
$ ./runcluvfy.sh comp nodereach -n node1,node2 -verbose
```

By default, when you enter a CVU command, CVU provides a summary of the test. During pre-installation, Oracle recommends that you obtain detailed output by using the `-verbose` argument with the CVU command. The `-verbose` argument produces detailed output of individual checks. Where applicable, it shows results for each node in a tabular layout.

Note: The script `runcluvfy.sh` contains temporary variable definitions which enable it to be run before installing Oracle Clusterware or Oracle Database. After you install Oracle Clusterware, use the command `cluvfy` to check prerequisites and perform other system readiness checks.

Using CVU to Determine if Installation Prerequisites are Complete

You can use CVU to determine which system prerequisites for installation are already completed. Use this option if you are installing Oracle 10g Release 2 (10.2) on a system with a pre-existing Oracle software installation. In using this option, note the following:

- You must complete the prerequisites for using CVU
- CVU can assist you by finding pre-installation steps that need to be completed, but it cannot perform pre-installation tasks

Use the following syntax to determine what pre-installation steps are completed, and what pre-installation steps must be performed

```
/$ ./runcluvfy.sh stage -pre crsinst -n node_list
```

In the preceding syntax example, replace the variable *node_list* with the names of the nodes in your cluster, separated by commas.

For example, for a cluster with mountpoint `/dev/dvdrom/`, and with nodes `node1`, `node2`, and `node3`, enter the following command:

```
$ cd /dev/dvdrom/crs/Disk1/cluvfy/  
$ ./runcluvfy.sh stage -pre crsinst -n node1,node2,node3
```

Review the CVU report, and proceed to the sections of the pre-installation chapter to complete additional steps as needed.

Using the Cluster Verification Utility Help

The `cluvfy` commands have context-sensitive help that shows correct syntax usage based on the command line arguments that you enter.

If you enter an invalid CVU command, then CVU shows the correct usage for that command. For example, if you type `runcluvfy.sh stage -pre dbinst`, then CVU shows the correct syntax for the database pre-installation checks that CVU performs with the `dbinst` stage option. The following is a list of context help commands.

- `cluvfy`: CVU displays high-level generic usage text describing the stage and component syntax.
- `cluvfy -help`: CVU displays detailed CVU command information.
- `cluvfy comp -list`: CVU displays a list of components that can be checked, and brief descriptions of how each component is checked.
- `cluvfy comp -help`: CVU displays detailed syntax for each of the valid component checks.
- `cluvfy stage -list`: CVU displays a list of valid stages.
- `cluvfy stage -help`: CVU displays detailed syntax for each of the valid stage checks.

Using Cluster Verification Utility with Oracle 10g Release 1

You can use CVU on the Oracle 10g Release 2 (10.2) media to check system requirements for Oracle 10g Release 1 (10.1) installations. To use CVU to check 10.1 installations, append the command flag `-r 10gR1` to the standard CVU system check commands.

For example, to perform a verification check for a Cluster Ready Services 10.1 installation, on a system where the media mountpoint is `/dev/dvdrom/`, and the cluster nodes are `node1`, `node2`, and `node3`, enter the following command:

```
$ ./runcluvfy.sh stage -pre crsinst -n node1,node2,node3 -r 10gR1
```

Verbose Mode and "Unknown" Output

If you run CVU using the `-verbose` argument, and a CVU command responds with `UNKNOWN` for a particular node, then this is because the CVU cannot determine whether a check passed or failed. The following is a list of possible causes for an "Unknown" response:

- The node is down
- Executables required by CVU are missing in the `CRS_home /bin` or Oracle home directory
- The user account starting CVU does not have privileges to run common operating system executables on the node
- The node is missing an operating system patch, or a required package

- The node has exceeded the maximum number of processes or maximum number of open files, or there is a problem with IPC segments, such as shared memory or semaphores

Logging In to the System as root

Before you install the Oracle software, you must complete several tasks as the `root` user. To log in as the `root` user, complete one of the following procedures:

- If you are installing the software from an X Window System workstation or X terminal, then:
 1. Start a local terminal session, for example, an X terminal (`xterm`).
 2. If you are not installing the software on the local system, then enter the following command to enable remote hosts to display X applications on the local X server:

```
$ xhost + hostname
```

The *hostname* is the name of the local host.

3. If you are not installing the software on the local system, then use the `ssh`, `rlogin`, or `telnet` command to connect to the system where you want to install the software:

```
$ telnet remote_host
```

4. If you are not logged in as the `root` user, then enter the following command to switch the user to `root`:

```
$ su - root
password:
#
```

- If you are installing the software from a PC or other system with X server software installed, then:

Note: If necessary, refer to your X server documentation for more information about completing this procedure. Depending on the X server software that you are using, you may need to complete the tasks in a different order.

1. Start the X server software.
2. Configure the security settings of the X server software to permit remote hosts to display X applications on the local system.
3. Connect to the remote system where you want to install the software and start a terminal session on that system, for example, an X terminal (`xterm`).
4. If you are not logged in as the `root` user on the remote system, then enter the following command to switch user to `root`:

```
$ su - root
password:
#
```

Creating Required Operating System Groups and User

Depending on whether this is the first time Oracle software is being installed on this system and on the products that you are installing, you may need to create several operating system groups and an operating system user account.

The following operating system groups and user are required if you are installing Oracle Database:

- The OSDBA group (typically, `dba`)

You must create this group the first time you install Oracle Database software on the system. This group identifies operating system user accounts that have database administrative privileges (the SYSDBA privilege). The default name for this group is `dba`.

If you want to specify a group name other than the default `dba` group, then you must choose the Custom installation type to install the software or start Oracle Universal Installer as a user that is not a member of this group. In this case, Oracle Universal Installer prompts you to specify the name of this group.

- The OSOPER group (typically, `oper`)

This is an optional group. Create this group if you want a separate group of operating system users to have a limited set of database administrative privileges (the SYSOPER privilege). By default, members of the OSDBA group also have the SYSOPER privilege.

If you want to specify a separate OSOPER group, other than the default `dba` group, then you must choose the Custom installation type to install the software or start Oracle Universal Installer as a user that is not a member of the `dba` group. In this case, Oracle Universal Installer prompts you to specify the name of this group. The usual name chosen for this group is `oper`.

- An unprivileged user

Verify that the unprivileged user `nobody` exists on the system. The `nobody` user must own the external jobs (`extjob`) executable after the installation.

The following operating system group and user are required for all installations:

- The Oracle Inventory group (typically, `oinstall`)

You must create this group the first time you install Oracle software on the system. The usual name chosen for this group is `oinstall`. This group owns the Oracle Inventory, which is a catalog of all Oracle software installed on the system.

Note: If Oracle software is already installed on the system, then the existing Oracle Inventory group must be the primary group of the operating system user that you use to install new Oracle software. The following sections describe how to identify an existing Oracle Inventory group.

- The Oracle software owner user (typically, `oracle`)

You must create this user the first time you install Oracle software on the system. This user owns all of the software installed during the installation. The usual name chosen for this user is `oracle`. This user must have the Oracle Inventory group as its primary group. It must also have the OSDBA and OSOPER groups as secondary groups. In Oracle documentation, when this user account is referred to, it is called the `oracle` user.

A single Oracle Inventory group is required for all installations of Oracle software on the system. After the first installation of Oracle software, you must use the same Oracle Inventory group for all subsequent Oracle software installations on that system. However, you can choose to create different Oracle software owner users, OSDBA groups, and OSOPER groups (other than `oracle`, `dba`, and `oper`) for separate installations. By using different groups for different installations, members of these different groups have DBA privileges only on the associated databases rather than on all databases on the system.

See Also: *Oracle Database Administrator's Reference for UNIX Systems* and *Oracle Database Administrator's Guide* for more information about the OSDBA and OSOPER groups and the SYSDBA and SYSOPER privileges

The following sections describe how to create the required operating system user and groups:

- [Creating the Oracle Inventory Group](#)
- [Creating the OSDBA Group](#)
- [Creating an OSOPER Group \(Optional\)](#)
- [Creating the Oracle Software Owner User](#)
- [Verifying that the User nobody Exists](#)
- [Creating Identical Users and Groups on Other Cluster Nodes](#)
- [Configuring SSH on All Cluster Nodes](#)

Note: The following sections describe how to create local users and groups. As an alternative to creating local users and groups, you can create the appropriate users and groups in a directory service, such as Network Information Services (NIS). For information about using directory services, contact your system administrator or refer to your operating system documentation.

Creating the Oracle Inventory Group

Oracle Universal Installer (OUI) helps you to choose a group to use as the Oracle Inventory group. If you have an existing Oracle Inventory group, then provide this group name and path when prompted.

The following subsections describe how to determine the Oracle Inventory group name, if it exists, and how to create it if necessary.

Determining If the Oracle Inventory Exists

When you install Oracle software on the system for the first time, Oracle Universal Installer creates the `oraInst.loc` file. This file identifies the name of the Oracle Inventory group (typically, `oinstall`), and the path of the Oracle Inventory directory.

If you have an existing Oracle Inventory, then ensure that you use the same Oracle Inventory for all Oracle software installations.

If you do not have an existing Oracle Inventory, then you should create an Oracle Inventory group.

To determine whether you have an Oracle Inventory on your system, enter the following command:

```
# more /var/opt/oracle/oraInst.loc
```

If the `oraInst.loc` file exists, then the output from this command is similar to the following:

```
inventory_loc=/u01/app/oracle/oraInventory
inst_group=oinstall
```

In the previous output example:

- The `inventory_loc` group shows the location of the Oracle Inventory
- The `inst_group` parameter shows the name of the Oracle Inventory group (in this example, `oinstall`).

Creating the Oracle Inventory Group If an Oracle Inventory Does Not Exist

If the `oraInst.loc` file does not exist, then create the Oracle Inventory group by entering a command similar to the following:

```
# /usr/sbin/groupadd oinstall
```

Creating the OSDBA Group

You must create an OSDBA group in the following circumstances:

- An OSDBA group does not exist, for example, if this is the first installation of Oracle Database software on the system
- An OSDBA group exists, but you want to give a different group of operating system users database administrative privileges for a new Oracle Database installation

If the OSDBA group does not exist or if you require a new OSDBA group, then create it as follows. In the following procedure, use the group name `dba` unless a group with that name already exists:

```
# /usr/sbin/groupadd dba
```

Creating an OSOPER Group (Optional)

Create an OSOPER group only if you want to identify a group of operating system users with a limited set of database administrative privileges (SYSOPER operator privileges). For most installations, it is sufficient to create only the OSDBA group. If you want to use an OSOPER group, then you must create it in the following circumstances:

- If an OSOPER group does not exist; for example, if this is the first installation of Oracle Database software on the system
- If an OSOPER group exists, but you want to give a different group of operating system users database operator privileges in a new Oracle installation

If you require a new OSOPER group, then create it as follows. In the following, use the group name `oper` unless a group with that name already exists.

```
# /usr/sbin/groupadd oper
```

Creating the Oracle Software Owner User

You must create an Oracle software owner user in the following circumstances:

- If an Oracle software owner user does not exist; for example, if this is the first installation of Oracle software on the system
- If an Oracle software owner user exists, but you want to use a different operating system user, with different group membership, to give database administrative privileges to those groups in a new Oracle Database installation

Note: If you intend to use multiple Oracle software owners for different Oracle homes, then you should create a separate Oracle software owner for Oracle Clusterware, and install Oracle Clusterware using the Oracle Clusterware software owner.

Determining if an Oracle Software Owner User Exists

To determine whether an Oracle software owner user named `oracle` exists, enter the following command:

```
# id oracle
```

If the `oracle` user exists, then the output from this command is similar to the following:

```
uid=440(oracle) gid=200(oinstall) groups=201(dba),202(oper)
```

If the user exists, then determine whether you want to use the existing user, or create another `oracle` user. If you want to use the existing user, then ensure that the user's primary group is the Oracle Inventory group and that it is a member of the appropriate OSDBA and OSOPER groups. Refer to one of the following sections for more information:

Note: If necessary, contact your system administrator before using or modifying an existing user.

- To modify an existing user, refer to the ["Modifying an Existing Oracle Software Owner User"](#) section on page 2-9.
- To create a user, refer to the following section.

Creating an Oracle Software Owner User

If the Oracle software owner user does not exist, or if you require a new Oracle software owner user, then create it as follows. In the following procedure, use the user name `oracle` unless a user with that name already exists.

1. To create the `oracle` user, enter a command similar to the following:

```
# /usr/sbin/useradd -u 200 -g oinstall -G dba[,oper] oracle
```

In the preceding command:

- The `-u` option specifies the user ID. Using this command flag is optional, as you can allow the system to provide you with an automatically generated user ID number. However, you must make note of the `oracle` user ID number, as you require it later during pre-installation.

- The `-g` option specifies the primary group, which must be the Oracle Inventory group—for example, `oinstall`
 - The `-G` option specifies the secondary groups, which must include the OSDBA group, and, if required, the OSOPER group. For example: `dba, or dba, oper`
2. Set the password of the `oracle` user:


```
# passwd oracle
```

Refer to the section ["Verifying that the User nobody Exists"](#) on page 2-9.

Modifying an Existing Oracle Software Owner User

If the `oracle` user exists, but its primary group is not `oinstall`, or it is not a member of the appropriate OSDBA or OSOPER groups, then enter a command similar to the following to modify it. Specify the primary group using the `-g` option and any required secondary group using the `-G` option:

```
# /usr/sbin/usermod -g oinstall -G dba[,oper] oracle
```

Repeat this procedure on all of the other nodes in the cluster.

Verifying that the User nobody Exists

Before installing the software, complete the following procedure to verify that the user `nobody` exists on the system:

1. To determine if the user exists, enter the following command:

```
# id nobody
```

If this command displays information about the `nobody` user, then you do not have to create that user.

2. If the `nobody` user does not exist, then enter the following command to create it:

```
# /usr/sbin/useradd nobody
```

3. Repeat this procedure on all the other nodes in the cluster.

Creating Identical Users and Groups on Other Cluster Nodes

Note: You must complete the following procedures only if you are using local users and groups. If you are using users and groups defined in a directory service such as NIS, then they are already identical on each cluster node.

The Oracle software owner user and the Oracle Inventory, OSDBA, and OSOPER groups must exist and be identical on all cluster nodes. To create these identical users and groups, you must identify the user ID and group IDs assigned them on the node where you created them, then create the user and groups with the same name and ID on the other cluster nodes.

Identifying the User and Group IDs

To determine the user ID (UID) of the Oracle software owner user and the group IDs (GID) of the Oracle Inventory, OSDBA, and OSOPER groups, follow these steps:

1. Enter following command:

```
# id oracle
```

The output from this command is similar to the following:

```
uid=440(oracle) gid=200(oinstall) groups=201(dba),202(oper)
```

2. From the output, identify the user ID (UID) for the `oracle` user and the group identities (GIDs) for the groups to which it belongs.

Creating the User and Groups on the Other Cluster Nodes

To create the user and groups on the other cluster nodes, repeat the following procedure on each node:

1. Log in to the next cluster node as `root`.
2. Enter commands similar to the following to create the `oinstall` and `dba` groups, and if required, the `oper` group. Use the `-g` option to specify the correct GID for each group.

```
# /usr/sbin/groupadd -g 200 oinstall
# /usr/sbin/groupadd -g 201 dba
# /usr/sbin/groupadd -g 202 oper
```

Note: If the group already exists, then use the `groupmod` command to modify it if necessary. If you cannot use the same group ID for a particular group on this node, then view the `/etc/group` file on all nodes to identify a group ID that *is* available on every node. You must then specify that ID for the group on all of the nodes.

3. To create the `oracle` user, enter a command similar to the following:

```
# /usr/sbin/useradd -u 200 -g oinstall -G dba[,oper] oracle
```

In the preceding command:

- The `-u` option specifies the user ID, which must be the user ID that you identified in the previous subsection
- The `-g` option specifies the primary group, which must be the Oracle Inventory group, for example `oinstall`
- The `-G` option specifies the secondary groups, which must include the OSDBA group and if required, the OSOPER group. For example: `dba` or `dba, oper`

Note: If the `oracle` user already exists, then use the `usermod` command to modify it if necessary. If you cannot use the same user ID for the `oracle` user on this node, then view the `/etc/passwd` file on all nodes to identify a user ID that *is* available on every node. You must then specify that ID for the user on all of the nodes.

4. Set the password of the `oracle` user:

```
# passwd oracle
```

Configuring SSH on All Cluster Nodes

Before you install and use Oracle Real Application clusters, you must configure secure shell 2 (SSH2) for the `oracle` user on all cluster nodes. Oracle Universal Installer uses the `ssh2` and `scp` commands during installation to run remote commands on and copy files to the other cluster nodes. You must configure SSH2 so that these commands do not prompt for a password.

Note: This section describes how to configure Tru64 UNIX Secure Shell (SSH). Secure Shell is included as part of the Operating System for Tru64 UNIX Version 5.1B.

To determine if SSH2 is running, enter the following command:

```
$ ps -aef | grep sshd
```

If SSH2 is running, then the response to this command is process ID numbers. To find out more about SSH2, enter the following command:

```
$ man ssh2
```

Also note that Oracle Net Configuration Assistant (NetCA) and Database Configuration Assistant (DBCA) require `scp` and `ssh2` to be located in the path `/usr/bin`. If `scp` and `ssh2` are not in this location, then create a symbolic link in `/usr/bin` to the location where `scp` and `ssh2` are found.

Configuring SSH2 on Cluster Member Nodes

To configure SSH2, you must first create DSA and RSA keys on each cluster node, and then copy the keys from all cluster node members into an authorized keys file on each node. To do this task, complete the following steps:

Create DSA and RSA keys on each node: Complete the following steps on each node:

1. Log in as the `oracle` user.
2. Enter the following commands to generate a DSA key for version 2 of the SSH protocol:

```
$ /usr/bin/ssh-keygen2 -t dsa
```

At the prompts:

- Accept the default location for the key file
- Enter and confirm a pass phrase that is different from the `oracle` user's password

This command writes the public key to the `~/.ssh/id_dsa.pub` file and the private key to the `~/.ssh/id_dsa` file. Never distribute the private key to anyone.

3. Enter the following commands to generate an RSA key for version 2 of the SSH protocol:

```
$ /usr/bin/ssh-keygen2 -t rsa
```

At the prompts:

- Accept the default location for the key file.
- Enter and confirm a pass phrase that is different from the `oracle` user's password.

This command writes the public key to the `~/.ssh2/id_rsa.pub` file and the private key to the `~/.ssh2/id_rsa` file. *Never distribute the private key to anyone.*

Add keys to an authorized key file: Complete the following steps:

1. On the local node, determine if you have an authorized key file (`~/.ssh2/authorization`). If the authorized key file already exists, then proceed to step 2. Otherwise, enter the following commands:

```
$ touch ~/.ssh2/authorization
$ cd ~/.ssh2
$ ls
```

You should see the `id_dsa.pub` and `id_rsa.pub` keys that you have created.

2. Using SSH2, copy the *contents* of the `~/.ssh2/id_dsa.pub` and `~/.ssh/id_rsa.pub` files to the file `~/.ssh2/authorization`, and provide the `oracle` user password as prompted. This process is illustrated in the following syntax example with a two-node cluster, with nodes `node1` and `node2`, where the `oracle` user path is `/home/oracle`:

```
[oracle@node1 .ssh]$ ssh2 node1 cat $HOME/.ssh2/id_rsa_2048_*.pub >>
authorization
oracle@node1's password:
[oracle@node1 .ssh]$ ssh2 node1 cat /home/oracle/.ssh2/id_dsa_2048_*.pub >>
authorization
[oracle@node1 .ssh]$ ssh2 node2 cat /home/oracle/.ssh2/id_rsa_2048_*.pub >>
authorization
oracle@node2's password:
[oracle@node1 .ssh]$ ssh2 node2 cat /home/oracle/.ssh2/id_dsa_2048_*.pub
>>authorization
oracle@node2's password:
```

Note: Repeat this process for each node in the cluster.

3. Use SCP (Secure Copy) or SFTP (Secure FTP) to copy the `authorization` file to the `oracle` user `.ssh` directory on a remote node. The following example is with SCP, on a node called `node2`, where the `oracle` user path is `/home/oracle`:

```
[oracle@node1 .ssh2]$ scp authorization node2:/home/oracle/.ssh2/
```

4. Repeat step 2 and 3 for each cluster node member. When you have added keys from each cluster node member to the `authorization` file on the last node you want to have as a cluster node member, then use SCP to copy the complete `authorization` file back to each cluster node member.

Note: the `oracle` user's `~/.ssh2/authorization` file on every node must contain the contents from all of the `~/.ssh2/id_dsa.pub` and `~/.ssh/id_rsa.pub` files that you generated on all cluster nodes.

5. Change the permissions on the `oracle` user's `~/.ssh2/authorization` file on all cluster nodes:

```
$ chmod 700 ~/.ssh2/authorization
$ chmod 700
```

At this point, if you use `ssh2` to log in to or run a command on another node, you are prompted for the pass phrase that you specified when you created the DSA key.

Enabling SSH2 User Equivalency on Cluster Member Nodes

To enable user equivalency, follow these steps:

1. On the system where you want to run Oracle Universal Installer, log in as the `oracle` user.

2. Enter the following commands:

```
$ exec /usr/bin/ssh-agent2 $SHELL
$ /usr/bin/ssh-add2
```

3. At the prompts, enter the pass phrase for each key that you generated.

If you have configured SSH2 correctly, then you can now use the `ssh2` or `scp` commands without being prompted for a password or a pass phrase.

4. If you are on a remote terminal, and the local node has only one visual (which is typical), then use the following syntax to set the `DISPLAY` environment variable:

Bourne, Korn, and Bash shells

```
$ export DISPLAY=hostname:0
```

C shell:

```
$ setenv DISPLAY 0
```

For example, if you are using the Bash shell, and if your hostname is `node1`, then enter the following command:

```
$ export DISPLAY=node1:0
```

5. To test the SSH2 configuration, enter the following commands from the same terminal session, testing the configuration of each cluster node, where *nodename1*, *nodename2*, and so on, are the names of nodes in the cluster:

```
$ ssh2 nodename1 date
$ ssh2 nodename2 date
```

```
·
·
·
```

These commands should display the date set on each node.

If any node prompts for a password or pass phrase, then verify that the `~/.ssh2/authorization` file on that node contains the correct public keys.

If you are using a remote client to connect to the local node, and you see a message similar to "Warning: No xauth data; using fake authentication data for X11 forwarding," then this means that your authorized keys file is configured correctly, but your `ssh2` configuration has X11 forwarding enabled. To correct this, proceed to step 6.

Note: The first time you use SSH2 to connect to a node from a particular system, you may see a message similar to the following:

```
The authenticity of host 'node1 (140.87.152.153)' can't be
established.
RSA key fingerprint is
7z:ez:e7:f6:f4:f2:4f:8f:9z:79:85:62:20:90:92:z9.
Are you sure you want to continue connecting (yes/no)?
```

Enter **yes** at the prompt to continue. You should not see this message again when you connect from this system to that node.

If you see any other messages or text, apart from the date, then the installation can fail. Make any changes required to ensure that only the date is displayed when you enter these commands.

You should ensure that any parts of login scripts that generate any output, or ask any questions, are modified so that they act only when the shell is an interactive shell.

6. To ensure that X11 forwarding will not cause the installation to fail, create a user-level SSH2 client configuration file for the Oracle software owner user, as follows:

- a. Using any text editor, edit or create the `~oracle/.ssh2/config` file.
 - b. Make sure that the `ForwardX11` attribute is set to `no`. For example:

```
Host *
    ForwardX11 no
```

7. You must run Oracle Universal Installer from this session or remember to repeat steps 2 and 3 before you start Oracle Universal Installer from a different terminal session.

Preventing Oracle Clusterware Installation Errors Caused by `stty` Commands

During an Oracle Clusterware installation, Oracle Universal Installer uses SSH2 (if available) to run commands and copy files to the other nodes. During the installation, hidden files on the system (for example, `.bashrc` or `.cshrc`) will cause installation errors if they contain `stty` commands.

To avoid this problem, you must modify these files to suppress all output on `STDERR`, as in the following examples:

- Bourne, Bash, or Korn shell:

```
if [ -t 0 ]; then
    stty intr ^C
fi
```

- C shell:

```
test -t 0
if ($status == 0) then
    stty intr ^C
endif
```

Note: When SSH is not available, the Installer uses the `rsh` and `rcp` commands instead of `ssh2` and `scp2`.

If there are hidden files that contain `stty` commands that are loaded by the remote shell, then OUI indicates an error and stops the installation.

Configuring the oracle User's Environment

You run Oracle Universal Installer from the `oracle` account. However, before you start Oracle Universal Installer you must configure the environment of the `oracle` user.

To configure the environment, you must:

- Set the default file mode creation mask (`umask`) to 022 in the shell startup file
- Set the `DISPLAY`, `ORACLE_BASE`, and `ORACLE_HOME` environment variables in preparation for the Oracle Clusterware installation

You should also ensure that the `PATH` variable contains `$ORACLE_HOME/bin` before `/usr/X11R6/bin`

To set the `oracle` user's environment, follow these steps:

1. Start a new terminal session; for example, start an X terminal (`xterm`).
2. Enter the following command to ensure that X Window applications can display on this system:

```
$ xhost + hostname
```

The *hostname* is the name of the local host.

3. If you are not already logged in to the system where you want to install the software, then log in to that system as the `oracle` user.
4. If you are not logged in as the `oracle` user, then switch user to `oracle`:

```
$ su - oracle
```

5. To determine the default shell for the `oracle` user, enter the following command:

```
$ echo $SHELL
```

6. Open the `oracle` user's shell startup file in any text editor:

- Bourne shell (`sh`), Bash shell (`bash`) or Korn shell (`ksh`):

```
% vi .bash_profile
```

- C shell (`csh` or `tcsh`):

```
% vi .login
```

7. Enter or edit the following line, specifying a value of 022 for the default file mode creation mask:

```
umask 022
```

8. If the `ORACLE_SID`, `ORACLE_HOME`, or `ORACLE_BASE` environment variable is set in the file, then remove the appropriate lines from the file.
9. Save the file, and exit from the text editor.

10. To run the shell startup script, enter one of the following commands:

- Bash shell:

```
$ . ~/.bash_profile
```

- Bourne, Bash, or Korn shell:

```
$ . ~/.profile
```

- C shell:

```
% source ~/.login
```

11. If you are not installing the software on the local system, then enter a command similar to the following to direct X applications to display on the local system:

- Bourne, Bash, or Korn shell:

```
$ DISPLAY=local_host:0.0 ; export DISPLAY
```

- C shell:

```
% setenv DISPLAY local_host:0.0
```

In this example, *local_host* is the host name or IP address of the system that you want to use to display Oracle Universal Installer (your workstation or PC).

12. If you determined that the `/tmp` directory has less than 400 MB of free disk space, then identify a file system with at least 400 MB of free space and set the `TEMP` and `TMPDIR` environment variables to specify a temporary directory on this file system:

Note: You cannot use a shared file system as the location of the temporary file directory (typically `/tmp`) for RAC installation. If you place `/tmp` on a shared file system, then the installation fails.

- a. Use the `df -h` command to identify a suitable file system with sufficient free space.
- b. If necessary, enter commands similar to the following to create a temporary directory on the file system that you identified, and set the appropriate permissions on the directory:

```
$ su - root
# mkdir /mount_point/tmp
# chmod 775 /mount_point/tmp
# exit
```

- c. Enter commands similar to the following to set the `TEMP` and `TMPDIR` environment variables:

- * Bourne, Bash, or Korn shell:

```
$ TEMP=/mount_point/tmp
$ TMPDIR=/mount_point/tmp
$ export TEMP TMPDIR
```

- * C shell:

```
% setenv TEMP /mount_point/tmp
% setenv TMPDIR /mount_point/tmp
```


Checking the Hardware Requirements

Each system must meet the following minimum hardware requirements:

- At least 1 GB of physical RAM
- Swap space equivalent to the multiple of the available RAM, as indicated in the following table:

Available RAM	Swap Space Required
Between 1 GB and 2 GB	1.5 times the size of RAM
More than 2 GB	Equal to the size of RAM

- 400 MB of disk space in the `/tmp` directory
- Up to 4 GB of disk space for the Oracle software, depending on the installation type and platform
- 1.2 GB of disk space for a preconfigured database that uses file system storage (optional)

Additional disk space, either on a file system or in an Automatic Storage Management disk group, is required for the flash recovery area if you choose to configure automated backups.

To ensure that each system meets these requirements, follow these steps:

1. To determine the physical RAM size, enter the following command:

```
# /bin/vmstat -P | grep "Total Physical Memory"
```

If the size of the physical RAM installed in the system is less than the required size, then you must install more memory before continuing.

2. To determine the size of the configured swap space, enter the following command:

```
# /sbin/swapon -s
```

If necessary, refer to your operating system documentation for information about how to configure additional swap space.

3. To determine the amount of disk space available in the `/tmp` directory, enter the following command:

```
# df -k /tmp
```

This command displays disk space in 1 kilobyte blocks.

Alternatively, with HP Tru64 version 5.1 B or later, you can use the `df -h` command, which displays disk space in gigabyte or megabyte blocks.

If there is less than 400 MB of disk space available in the `/tmp` directory (less than 4194304 1-k blocks), then complete one of the following steps:

- Delete unnecessary files from the `/tmp` directory to make available the disk space required.
- Set the `TEMP` and `TMPDIR` environment variables when setting the `oracle` user's environment (described later).

- Extend the file system that contains the `/tmp` directory. If necessary, contact your system administrator for information about extending file systems.
- 4. To determine the amount of free disk space on the system, enter the following command:

```
# df -h
```

The following table shows the approximate disk space requirements for software files for each installation type:

Installation Type	Requirement for Software Files (GB)
Enterprise Edition	at least 1.5
Standard Edition	at least 1.5
Custom (maximum)	at least 1.5

Checking the Network Requirements

Check that you have the networking hardware and internet protocol (IP) addresses required for an Oracle Real Application Clusters installation. This section contains the following:

- [Checking IP Address Requirements](#)
- [Checking Network Hardware Requirements](#)
- [Configuring the Network Requirements](#)
- [Checking Node Time Requirements](#)
- [Configuring Reliable Datagram \(RDG\)](#)

Note: For the most up-to-date information about supported network protocols and hardware for RAC installations, refer to the Certify pages on the *Oracle MetaLink* Web site at

<http://metalink.oracle.com>

Checking IP Address Requirements

Before starting the installation, you must have the following IP addresses available for each node:

- An IP address with an associated network name registered in the domain name service (DNS) for the public interface. If you do not have an available DNS, then record the network name and IP address in the system hosts file, `/etc/hosts`.
- One virtual IP (VIP) address with an associated network name registered in DNS. If you do not have an available DNS, then record the network name and VIP address in the system hosts file, `/etc/hosts`. Select an address for your VIP that meets the following requirements:
 - The IP address and network name are currently unused
 - The VIP is on the same subnet as your public interface

Before installation, check that the default gateway can be accessed by a `ping` command. During installation, OUI uses the `ping` command to ensure that the VIP is reachable. To find the default gateway, use the `route` command, as

described in your operating system's help utility. After installation, configure clients to use either the VIP address, or the network name associated with the VIP. If a node fails, then the node's virtual IP address fails over to another node.

- A private IP address with a host name for each private interface

Oracle recommends that you use private network IP addresses for these interfaces (for example: 10.*.* or 192.168.*.*). Use the `/etc/hosts` file on each node to associate private network names with private IP addresses.

For example, with a two node cluster where each node has one public and one private interface, you might have the configuration shown in the following table for your network interfaces, where the hosts file is `/etc/hosts`:

Node	Interface Name	Type	IP Address	Registered In
rac1	rac1	Public	143.46.43.100	DNS (if available, else the hosts file)
rac1	rac1-vip	Virtual	143.46.43.104	DNS (if available, else the hosts file)
rac1	rac1-priv	Private	10.0.0.1	Hosts file
rac2	rac2	Public	143.46.43.101	DNS (if available, else the hosts file)
rac2	rac2-vip	Virtual	143.46.43.105	DNS (if available, else the hosts file)
rac2	rac2-priv	Private	10.0.0.2	Hosts file

To enable VIP failover, the configuration shown in the preceding table defines the public and VIP addresses of both nodes on the same subnet, 143.46.43. When a node or interconnect fails, then the associated VIP is relocated to the surviving instance, enabling fast notification of the failure to the clients connecting through that VIP. If the application and client are configured with transparent application failover options, then the client is reconnected to the surviving instance.

Checking Network Hardware Requirements

Each node in the cluster must meet the following requirements:

- Each node must have at least two network adapters: one for the public network interface, and one for the private network interface (the interconnect).
- The public interface names associated with the network adapters for each network must be the same on all nodes, and the private interface names associated with the network adaptors should be the same on all nodes.

For example: With a two-node cluster, you cannot configure network adapters on `node1` with `eth0` as the public interface, but on `node2` have `eth1` as the public interface. Public interface names must be the same, so you must configure `eth0` as public on *both* nodes. You should configure the private interfaces on the same network adapters as well. If `eth1` is the private interface for `node1`, then `eth1` should be the private interface for `node2`.

- For increased reliability, configure redundant public and private network adapters for each node.
- For the public network, each network adapter must support TCP/IP.
- For the private network, Oracle supports the following interconnect protocols and hardware:
 - Reliable datagram (RDG) using Memory Channel adapters and hubs

- RDG or user datagram protocol (UDP) using high-speed network adapters and switches that support TCP/IP (Gigabit Ethernet or better recommended)

Note: On HP Tru64, RDG is the default interconnect protocol (IPC) for RAC, and TCP is the interconnect protocol for Oracle Clusterware.

When the Oracle Real Application Clusters option is enabled, the Global Cache Service (GCS), Global Enqueue Service (GES), Interprocessor Parallel Query (IPQ), and Cache Fusion use RDG. The User Datagram Protocol (UDP) IPC implementation is still available but you must enable it explicitly.

To use UDP as the interconnect protocol for RAC, you must relink the Oracle executable. Refer to *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about enabling UDP for RAC on Tru64 UNIX systems.

Token-Ring is not supported for the interconnect.

- For the private network, the endpoints of all designated interconnect interfaces must be completely reachable on the network. There should be no node that is not connected to every private network. You can test whether an interconnect interface is reachable using a ping command.

Configuring the Network Requirements

To verify that each node meets the requirements, follow these steps:

1. If necessary, install the network adapters for the public and private networks and configure them with either public or private IP addresses.
2. Register the host names and IP addresses for the public network interfaces in DNS.
3. For each node, register one virtual host name and IP address in DNS.
4. For each private interface on every node, add a line similar to the following to the `/etc/hosts` file on all nodes, specifying the private IP address and associated private host name:

```
10.0.0.1    rac1-priv1
```

5. To identify the interface name and associated IP address for every network adapter, enter the following command:

```
# /sbin/ifconfig
```

From the output, identify the interface name and IP address for all network adapters that you want to specify as public or private network interfaces.

Note: When you install Oracle Clusterware and RAC, you will require this information.

6. To prevent network hangs with failovers from public to virtual IP addresses with RAC databases using NAS devices or NFS mounts, enter the following command as root to enable the Name Service Cache Daemon (`nscd`):

```
# /sbin/service nscd start
```

Checking Node Time Requirements

Before starting the installation, ensure that each member node of the cluster is set as closely as possible to the same date and time. Oracle strongly recommends using the Network Time Protocol feature of most operating systems for this purpose, with all nodes using the same reference Network Time Protocol server.

Many Oracle processes are timed, especially if the initialization parameter `TIMED_STATISTICS` is set to `true`. These timing functions call the HP Tru64 kernel, and can affect Oracle Database performance. You can improve performance on heavily loaded systems by enabling processes to access the real time clock directly.

To enable access to the real time clock:

1. Log in as the `root` user.
2. Enter the following commands on one cluster node.:

```
# mknod /dev/timedev c 15 0
# chmod a+r /dev/timedev
```

Note: The special file `/dev/timedev` remains on the system after restarts.

3. Restart the Oracle Database instance.

The system checks for the existence of the `/dev/timedev` file only on instance startup.

4. Repeat steps 1 through 3 on each node of the cluster.

Configuring Asynchronous I/O

Oracle Database for Tru64 UNIX systems can perform either synchronous or asynchronous I/O. To improve performance, Oracle recommends that you use asynchronous I/O. Set the `DISK_ASYNC_IO` initialization parameter to `true` to enable asynchronous I/O.

Oracle Database can use asynchronous I/O on any datafiles that are stored on AdvFS or clustered file systems (CFS), in Automatic Storage Management disk groups, or on raw devices. You must tune some kernel subsystem attributes for optimal asynchronous I/O performance.

Checking the Network Setup with CVU

As the `oracle` user, enter a command using the following syntax to verify node connectivity among all of the nodes for which your cluster is configured:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh comp nodecon -n node_list [-verbose]
```

In the preceding syntax example, the variable `node_list` is a comma-separated list of nodes in your cluster. This command detects all the network interfaces available on the cluster nodes, and verifies the connectivity among all the nodes through the network interfaces it finds.

Select the option `-verbose` to receive progress updates as the CVU performs its system checks, and detailed reporting of the test results.

For example, to verify node connectivity on a two-node cluster with nodes `node1` and `node2`, with the mountpoint `/dev/dvdrom`, and with updates and a summary of the verification checks the CVU performs, enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh comp nodecon -n node1,node2 -verbose
```

Note: You can use this command to obtain a list of all the interfaces available on the nodes that are suitable for use as VIPs, as well as a list of private interconnects that are connecting successfully on all nodes.

Verifying Software Requirements

Depending on the products that you intend to install, verify that the following software is installed on the system. To check these requirements refer to the section ["Checking the Software Requirements"](#) on page 2-23, following this section.

Note: Oracle Universal Installer performs checks on your system to verify that it meets the listed requirements. To ensure that these checks pass, verify the requirements before you start Oracle Universal Installer.

Software Requirements List for HP Tru64 Platforms

Table 2–1 HP Tru64 System Requirements

Item	Requirement
All installations	Operating system version: HP Tru64 UNIX 5.1B-3 (patchkit 5) The following operating system subsets must be installed: OSFCMPLRS OSFLIBA OSFPGMR OSFSER OSFX11
Oracle Real Application Clusters	HP TruCluster 5.1B: TCRBASE TCRMIGRATE
Oracle Spatial	X Window and X/Motif software: OSFXDEVX OSFXINCLUDE OSFXLIBA Note: This software is required only to build the sample programs.

Table 2–1 (Cont.) HP Tru64 System Requirements

Item	Requirement
PL/SQL native compilation, Pro*C/C++, Oracle Call Interface, Oracle C++ Call Interface, Oracle XML Developer's Kit (XDK)	Compaq C Compiler version DEC 6.5-207 developer's toolkit supplement (dtk): DTCCMPLR Compiler Driver V6.5-207 (dtk) cc Driver V6.5-207 (dtk) Entrust IPsec Toolkit for C 6.0 Entrust Server Login 6.0 GNU C compiler gcc version 3.0 Compaq C++ Compiler (cxx) version DEC 6.5-014: CXXBASE CXXLIB CXXOLD
Pro*COBOL	Micro Focus Server Express for Tru64 2.2
Pro*FORTRAN	Compaq Fortran 5.4A
Oracle JDBC/OCI Drivers	You can use the following optional JDK versions with the Oracle JDBC/OCI drivers; however, they are not required for the installation: <ul style="list-style-type: none"> ■ SDK v. 1.3.1-5 ■ SDK v 1.2.2-12 <p>Note: SDK v 1.4.2 is installed by Oracle Universal Installer.</p>

Checking the Software Requirements

To ensure that the system meets these requirements, follow these steps:

1. To determine which version of Tru64 is installed, enter the following command:

```
# /usr/sbin/sizer -v
Compaq Tru64 UNIX V5.1B (Rev. 2650); Mon Nov 3 10:13:28 PST 200
```

In this example, the version shown is V5.1B. If necessary, refer to your operating system documentation for information about upgrading the operating system.

2. To determine whether Java SDK 1.4.2 is installed, enter the following command:

```
# /usr/sbin/setld -i JAVA142 | more
```

If Java SDK 1.4.2 is installed, this command displays the paths to all of the installed files. Note the path of the Java home directory. You must specify this value during the installation. The default path is:

```
/usr/opt/java142
```

If this command returns the message Unknown subset, then Java SDK 1.4.2 is not installed. You must have at least Java SDK 1.4.2-3 or higher. Download the Java SDK from the following Web site and install it:

```
http://www.compaq.com/java/download/index.html
```

3. To determine whether the required software subsets are installed, enter one of the following commands:
 - To view the list of all software subsets installed on the system, enter the following command:

```
# /usr/sbin/setld -i | more
```

- To determine whether a particular software subset is installed, enter a command similar to the following:

```
# /usr/sbin/setld -i | grep subsetname
```

If necessary, install the required software subset. If you require the Compaq C Compiler V6.5-207 (dtk), you can download it from the following Web site:

<http://www.tru64unix.compaq.com/dtk/>

4. To determine whether X Window and X/Motif packages are installed, enter a command similar to the following:

```
$ setld -i |grep Window
```

5. If you intend to use Oracle Messaging Gateway and require MQSeries classes for Java and MQSeries classes for Java Message Service (SupportPac MA88), download it from the following Web site:

<http://www.ibm.com/support>

Verifying Required Patches

Depending on the products that you intend to install, verify that the following patches are installed on the system. The procedure following the table describes how to check these requirements.

Patch Requirements List for HP Tru64

Table 2-2 Required Patches for HP Tru64 UNIX

Installation Type or Product	Requirement
All installations	Tru64 UNIX V5.1B Patch Kit 5 or higher: T64V51BB26AS0005-20050502
Oracle Messaging Gateway	Corrective service diskette (CSD) for MQSeries: CSD09 or later for MQSeries V5.1

Checking the Patch Requirements

To determine whether the required patch kits are installed, enter the following command:

```
# /usr/sbin/dupatch -track -type kit
```

If this command does not display the identifiers shown in the previous table for the required patch kits (or the identifier for a higher patch kit level), download the latest patch kit from the following Web site and install it (registration is required to access this Web site):

<http://itrc.hp.com/service/patch/mainPage.do>

If you require a CSD for MQSeries, refer to the following Web site for download and installation information:

<http://www.ibm.com/software/integration/mqfamily/support/summary/dig.html>

Configuring Kernel Subsystem Attributes

Note: The kernel subsystem attribute values shown in the following section are recommended values only. For production database systems, Oracle recommends that you tune these values to optimize the performance of the system. Refer to your operating system documentation for more information about tuning kernel parameters.

On all cluster nodes, verify that the kernel subsystem attributes are set to values greater than or equal to the recommended value shown.

To view the current value specified for these kernel subsystem attributes, and to change them if necessary, follow these steps:

1. Log in as root, and make a copy of your existing `/etc/sysconfigtab` file. For example:

```
# cp /etc/sysconfigtab /etc/sysconfigtab.orig
```

2. Using a text editor, create a stanza-formatted modification file called `sysconfigmod` for the `/etc/sysconfigtab` file, with the following contents:

```
vfs:
    fifo_do_adaptive=0
```

3. Using the following command, merge the contents of `sysconfigmod` with the existing `/etc/sysconfigtab` file:

```
# sysconfigdb -m -f sysconfigmod
```

4. Use the following command syntax to confirm this change, and to determine the current values of subsystem attributes:

```
# /sbin/sysconfig -q subsystem
```

In the preceding syntax example, replace the variable `subsystem` with the name of the subsystem whose value you want to check.

For example, to check the attribute values of the `ipc` subsystem, enter the following command:

```
# /sbin/sysconfig -q ipc
```

To check the attribute values of the `proc` subsystem, enter the following command:

```
# /sbin/sysconfig -q proc
```

To check the attribute values of the `rdg` subsystem, enter the following command:

```
# /sbin/sysconfig -q rdg
```

Check the kernel subsystems listed in the following table:

Note: Make a note of the current values and identify any values that you must change.

Table 2–3 Required Values for HP Tru64 Kernel Subsystem Attributes

Subsystem	Attribute	Recommended Value
ipc	shm_max	4278190080 (4 GB minus 16 MB)
	shm_min	1
	shm_mni	256
	shm_seg	256
	ssm_threshold	Set this attribute to 0 only if the rad_gh_regions[n] or gh_chunks attributes are set in the vm subsystem. Otherwise, do not change the value.
proc	exec_disable_arg_limit	1
	per_proc_stack_size	8388608 (8 MB) ¹
	max_per_proc_stack_size	33554432 (32 MB) ¹
	per_proc_data_size	335544320 (320MB)
	max_per_proc_data_size	335544320 (320MB)
	max_per_proc_address_space	Equal to the size of RAM or 1073741824 (1 GB), whichever is larger.
rdg	per_proc_address_space	Equal to the size of RAM or 1073741824 (1 GB), whichever is larger.
	msg_size	32768
	max_objs	5120
	max_async_req	256
	max_sessions	500 (or at least 20 plus the value of the PROCESSES initialization parameter for all databases on the system, if this value is higher.)
	rdg_max_auto_msg_wires	0
rt	rdg_auto_msg_wires	0
	aio_task_max_num	8193
vfs	fifo_do_adaptive	0

¹ The maximum value supported by Oracle for this parameter is 512 MB.

Note: The vfs parameter new_wire_method is obsoleted with the current patchset for HP Tru64.

5. If you must change any of the current values, then follow these steps:
 - a. Create a backup copy of the /etc/sysconfigtab file. For example:

```
# cp /etc/sysconfigtab /etc/sysconfigtab.mod1
```

- b. Using any text editor, create a stanza-formatted file similar to the following, specifying the subsystems and attributes that you want to modify:

```
ipc:
    shm_max = 4278190080
    shm_min = 1
    shm_mni = 256
    shm_seg = 128

proc:
    exec_disable_arg_limit = 1
    per_proc_stack_size = 8388608
    max_per_proc_stack_size = 33554432
    per_proc_data_size = 335544320
    max_per_proc_data_size = 335544320
    max_per_proc_address_space = 4294967296
    per_proc_address_space = 4294967296

rdg:
    msg_size = 32768
    max_objs = 5120
    max_async_req = 256
    max_sessions = 500
    rdg_max_auto_msg_wires = 0
    rdg_auto_msg_wires = 0
```

- c. Enter a command similar to the following to merge the missing or modified subsystem attributes to the `/etc/sysconfigtab` file:

```
# /sbin/sysconfigdb -m -f filename
```

In this example, *filename* is the name of the file you created in step b.

- d. Enter the following command to restart the system:

```
# /sbin/shutdown -r now
```

- e. When the system restarts, log in and switch user to `root`.

6. (Optional) If you have a `db_block_size` of 16 KB or greater, and you are using UDP IPC implementation, then edit the `inet` parameter in the `/etc/sysconfigtab` file to be at least the following:

```
inet: udp_recvspace = 65536
udp_sendspace = 65536
```

Note: Default IPC for Oracle Real Application Clusters is RDG

7. Repeat this procedure on all other cluster nodes.

Configuring Reliable Datagram (RDG)

Reliable Data Gram (RDG) is an IPC infrastructure for the Tru64 UNIX TruCluster platform. It is the default IPC method for Oracle Database on Tru64 UNIX and is optimized for Oracle Real Application Clusters environments.

To use reliable datagram (RDG) for IPC:

```
# make -f ins_rdbms.mk rac_on
```

```
# make -f ins_rdbms.mk ioracle
```

To use RDG, each node must be a member of the cluster and connected through the memory channel. Oracle recommends that you set the node-wide subsystem attributes listed in [Table 2–4](#) when using RDG.

Table 2–4 *rdg Subsystem Attribute Settings*

Attribute	Setting
max_objs	At least 5 times the number of Oracle processes per node, and up to the larger value either of 10240, or of the number of Oracle processes multiplied by 70.
msg_size	Equal to or greater than the maximum value of the DB_BLOCK_SIZE parameter for the database. Oracle recommends to set the value of msg_size to 32768, because Oracle Database supports different block sizes for each tablespace.
max_async_req	At least 100, or the operating system default, whichever is larger. Note: Depending on system load, a value of 1000 or greater may provide better performance.
max_sessions	170 (20 + value of Oracle PROCESSES initialization parameter).
rdg_max_auto_msg_wires	Must be set to 0.

Checking the Hardware and Operating System Setup with CVU

As the `oracle` user, use the following command syntax to start Cluster Verification Utility (CVU) stage verification to check hardware and operating system setup:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh stage -post hws -n node_list [-verbose]
```

In the preceding syntax example, replace the variable `node_list` with the names of the nodes in your cluster, separated by commas. For example, to check the hardware and operating system of a two-node cluster with nodes `node1` and `node2`, with the mountpoint `/dev/dvdrom/` and with the option to limit the output to the test results, enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh stage -post hws -n node1,node2
```

Select the option `-verbose` to receive detailed reports of the test results, and progress updates about the system checks performed by Cluster Verification Utility.

Checking the Operating System Requirements Setup with CVU

As the `oracle` user, use the following command syntax to check if your system meets the operating system requirement pre-installation tasks:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh comp sys -n node_list -p {crs|database}  
-osdba osdba_group -orainv orainv_group -verbose
```

In the preceding syntax example:

- The variable `mountpoint` is the mountpoint of the Oracle 10g Release 2 (10.2) installation media
- The variable `node_list` is the list of nodes in your cluster, separated by commas
- The `-p` flag identifies either `crs` or `database`, and indicates that checks are performed for Oracle Clusterware or Oracle Database system requirements

- The variable *osdba_group* is the name of your OSDBA group, typically dba
- The variable *orainv_group* is the name of your Oracle Inventory group, typically oinstall

You can select the option `-verbose` to receive progress updates as the CVU performs its system checks, and detailed reporting of the test results.

For example, to perform a system check for an Oracle Clusterware installation on a two-node cluster with nodes *node1* and *node2*, with the OSDBA dba and Oracle inventory group *oinstall*, and with the media mountpoint */dev/dvdrom/*, then enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh comp sys -n node1,node2 -p crs -osdba
crs -orainv oinstall
```

Identifying Required Software Directories

You must identify or create the following directories for the Oracle software, as follows:

- [Oracle Base Directory](#)
- [Oracle Inventory Directory](#)
- [Oracle Clusterware Home Directory](#)
- [Oracle Home Directory](#)

The following subsections describe the requirements for these directories.

Oracle Base Directory

The Oracle base directory acts as a top-level directory for Oracle software installations. Optimal Flexible Architecture (OFA) guidelines recommend that you use a path similar to the following for the Oracle base directory:

```
/mount_point/app/oracle_sw_owner
```

In this example:

- *mount_point* is the mount point directory for the file system that will contain the Oracle software.

The examples in this guide use */u01* for the mount point directory. However, you could choose another mount point directory, */oracle* or */opt/oracle* for example.

- *oracle_sw_owner* is the operating system user name of the Oracle software owner, for example *oracle*.

You can use the same Oracle base directory for more than one installation or you can create separate Oracle base directories for different installations. If different operating system users install Oracle software on the same system, then each user must create a separate Oracle base directory. The following example Oracle base directories could all exist on the same system:

```
/u01/app/oracle
/u01/app/orauser
/opt/oracle/app/oracle
```

The following sections describe how to identify existing Oracle base directories that might be suitable for your installation and how to create an Oracle base directory if necessary.

Regardless of whether you create an Oracle base directory or decide to use an existing one, you must set the `ORACLE_BASE` environment variable to specify the full path to the Oracle base directory.

Note: The Oracle base directory must be on a cluster file system.

Oracle Inventory Directory

The Oracle Inventory directory (`oraInventory`) stores an inventory of all software installed on the system. It is required by, and shared by, all Oracle software installations on a single system. The first time you install Oracle software on a system, Oracle Universal Installer prompts you to specify the path to this directory. If you are installing the software on a local file system, then Oracle recommends that you choose the following path:

`oracle_base/oraInventory`

As the Oracle base directory is located on a cluster file system, you must place the Oracle Central Inventory directory on a local file system, privately mounted on each node, so that each node has a separate copy of the central inventory.

If you specify a shared location for the Oracle Central Inventory, then each node attempts to write to the same central inventory. This is not supported.

Oracle Universal Installer creates the directory that you specify, and sets the correct owner, group, and permissions for it. You do not need to create it.

Note: All Oracle software installations rely on the Oracle base directory. Make sure that you back it up regularly.

Do not delete the Oracle base directory unless you have completely removed all Oracle software from the system.

Oracle Clusterware Home Directory

The Oracle Clusterware home directory is the directory where you choose to install the software for Oracle Clusterware. You must install Oracle Clusterware in a separate home directory. When you run Oracle Universal Installer, it prompts you to specify the path to this directory, as well as a name that identifies it. Oracle recommends that you specify a path similar to the following for the Oracle Clusterware home directory:

`/u01/app/oracle/product/crs`

Note: Because you must change the permissions of all of the parent directories of the Oracle Clusterware home directory after installing the software to grant write access only to the `root` user, the Oracle Clusterware home directory must not be a subdirectory of the Oracle base directory.

Oracle Home Directory

The Oracle home directory is the directory where you choose to install the software for a particular Oracle product. You must install different Oracle products, or different releases of the same Oracle product, in separate Oracle home directories.

Note: The Oracle Home directory must be on a cluster file system.

When you run Oracle Universal Installer, it prompts you to specify the path to this directory, as well as a name that identifies it. The directory that you specify must be a subdirectory of the Oracle base directory. Oracle recommends that you specify a path similar to the following for the Oracle home directory:

```
oracle_base/product/10.2.0/db_1
```

Oracle Universal Installer creates the directory path that you specify under the Oracle base directory. It also sets the correct owner, group, and permissions on it. You do not need to create this directory.

Caution: During the installation, you must not specify an existing directory that has predefined permissions applied to it as the Oracle home directory. If you do, then you may experience installation failure due to file and group ownership permission errors.

Identifying or Creating an Oracle Base Directory

Before starting the installation, you must either identify an existing Oracle base directory or if required, create one. This section contains information about the following:

- [Identifying an Existing Oracle Base Directory](#)
- [Creating an Oracle Base Directory](#)

Note: You can choose to create an Oracle base directory, even if other Oracle base directories exist on the system.

Identifying an Existing Oracle Base Directory

Existing Oracle base directories might not have paths that comply with OFA guidelines. However, if you identify an existing Oracle Inventory directory or existing Oracle home directories, you can usually identify the Oracle base directories, as follows:

- Identifying an existing Oracle Inventory directory

Enter the following command on all nodes in the cluster to view the contents of the `oraInst.loc` file:

```
# more /var/opt/oracle/oraInst.loc
```

If the `oraInst.loc` file exists, then the output from this command is similar to the following:

```
inventory_loc=/u01/app/oracle/oraInventory
inst_group=oinstall
```

The `inventory_loc` parameter identifies the Oracle Inventory directory (`oraInventory`) on that system. The parent directory of the `oraInventory` directory is typically an Oracle base directory. In the previous example, `/u01/app/oracle` is an Oracle base directory.

- Identifying existing Oracle home directories

Enter the following command on all nodes in the cluster to view the contents of the `oratab` file:

```
# more /etc/oratab
```

If the `oratab` file exists, then it contains lines similar to the following:

```
*/u03/app/oracle/product/10.2.0/db_1:N
*/opt/orauser/infra_904:N
*/oracle/9.2.0:N
```

The directory paths specified on each line identify Oracle home directories. Directory paths that end with the user name of the Oracle software owner that you want to use are valid choices for an Oracle base directory. If you intend to use the `oracle` user to install the software, then you could choose one of the following directories from the previous example:

```
/u03/app/oracle
/oracle
```

Note: If possible, choose a directory path similar to the first (`/u03/app/oracle`). This path complies with the OFA guidelines.

Before deciding to use an existing Oracle base directory for this installation, make sure that it satisfies the following conditions:

- It should not be on the same file system as the operating system.
- It must have an identical path on all nodes in the cluster.
- It must have at least 1.5 GB free disk space on all the nodes in the cluster

To determine the free disk space on the file system where the Oracle base directory is located, enter the following command:

```
# df -h oracle_base_path
```

When you are configuring the `oracle` user's environment in the section "[Creating the Oracle Clusterware Home Directory](#)" on page 2-33, set the `ORACLE_BASE` environment variable to specify the directory you choose.

If an Oracle base directory does not exist on the system, or if you want to create an Oracle base directory, then refer to the following section.

Creating an Oracle Base Directory

Before you create an Oracle base directory, you must identify an appropriate file system. The Oracle base directory requires at least 1.5 GB of free disk space.

To identify an appropriate file system, follow these steps:

1. Use the `df -h` command to determine the free disk space on each mounted file system.
2. From the display, identify a file system that has appropriate free space.

Note: The Oracle base directory must be on a cluster file system.

The path to the Oracle base directory must be the same on all nodes.

3. Note the name of the mount point directory for the file system that you identified.

To create the Oracle base directory and specify the correct owner, group, and permissions for it, follow these steps:

1. Enter commands similar to the following to create the recommended subdirectories in the mount point directory that you identified, and to set the appropriate owner, group, and permissions on them:

```
# mkdir -p /mount_point/app/oracle_sw_owner
# chown -R oracle:oinstall /mount_point/app/oracle_sw_owner
# chmod -R 775 /mount_point/app/oracle_sw_owner
```

For example, if the mount point you identify is /u01, and `oracle` is the user name of the Oracle software owner, then the recommended Oracle base directory path is as follows:

```
/u01/app/oracle
```

2. If necessary, repeat the commands listed in the previous step to create the same directory on the other nodes in the cluster.
3. When you configure the `oracle` user's environment later in this chapter, set the `ORACLE_BASE` environment variable to specify the Oracle base directory you have created in this task.

Creating the Oracle Clusterware Home Directory

Oracle Universal Installer (OUI) creates the Oracle Clusterware home directory for you. Ensure before you start the installation that you provide sufficient disk space on a file system for the Oracle Clusterware directory, and the parent directory of the Oracle Clusterware directory space is writable by the `oracle` user.

To identify an appropriate file system, follow these steps:

1. Use the `df -h` command to determine the free disk space on each mounted file system.
2. From the display, identify a file system that has at least 1.4 GB of free disk space.

If you are using the same file system for the Oracle base directory, then this 1.4 GB of disk space is additional to the free disk space requirement that you identified previously.

Note: The file system must be a cluster file system.

The path to the Oracle Clusterware home directory must be the same on all nodes.

3. Note the name of the mount point directory for the file system that you identified.

To create the Oracle Clusterware home directory and specify the correct owner, group, and permissions for it, follow these steps:

1. Enter commands similar to the following to create the recommended subdirectories in the mount point directory that you identified and set the appropriate owner, group, and permissions on them:

```
# mkdir -p /mount_point/crs/oracle_sw_owner/product/10/app
# chown -R root:oinstall /mount_point/crs
# chmod -R 775 /mount_point/crs/oracle_sw_owner
```

If the mount point you identified is /u01, then the recommended Oracle Clusterware home directory path is as follows:

```
/u01/crs/oracle/product/10/crs
```

Note: After installation, you should change permissions so that only the root user can write to the Oracle Clusterware home directory.

2. If necessary, repeat the commands listed in the previous step to create the same directory on the other nodes in the cluster.
3. Enter commands similar to the following to set the ORACLE_BASE and ORACLE_HOME environment variable in preparation for the Oracle Clusterware installation:

- Bourne, Bash, or Korn shell:

```
$ ORACLE_BASE=/u01/app/oracle
$ ORACLE_HOME=/u01/crs/oracle/product/10/app
$ export ORACLE_BASE
$ export ORACLE_HOME
```

- C shell:

```
% setenv ORACLE_BASE /u01/app/oracle
% setenv ORACLE_HOME /u01/crs/oracle/product/10/app
```

4. Enter the following commands to ensure that the TNS_ADMIN environment variable is not set:

- Bourne, Bash, or Korn shell:

```
$ unset TNS_ADMIN
```

- C shell:

```
% unsetenv TNS_ADMIN
```

5. To verify that the environment has been set correctly, enter the following commands:

```
$ umask
$ env | more
```

Verify that the umask command displays a value of 22, 022, or 0022 and the environment variables that you set in this section have the correct values.

Overview of the Spike Optimization Tool

The Spike optimization tool (Spike) is a performance optimization tool that increases the performance of the Tru64 UNIX binary. In a testing environment, Spike, with

feedback, increased the performance of Oracle Database by up to 23 percent on an OLTP workload.

For information about Spike, refer to the Tru64 UNIX documentation, or enter one of the following commands:

```
man spike
spike
```

See Also: *Oracle Database Administrator's Reference for UNIX-Based Operating Systems* for additional configuration and recommendations for using Spike.

Stopping Existing Oracle Processes for Upgrades or Co-existing Databases

[Table 2–5](#) provides an overview of what you need to do if you have an existing Oracle database on the system where you plan to install Oracle Database 10g Release 2 (10.2). Review the table, and perform tasks as required.

See Also: *Oracle Database Upgrade Guide* for additional information about preparing for and performing upgrades.

Table 2–5 Overview of System Preparation for Upgrades or Co-existing Databases

Installation Scenario	What you need to do
Upgrading from Oracle Database 10g Release 1 (10.1) to 10g Release 2 (10.2)	No additional tasks. Refer to Installing Oracle 10g Release 2 on a System with Oracle 10g Release 1 on page 2-36
installing Oracle Database 10g Release 2 (10.2) on a system to co-exist with Oracle Database 10g Release 1 (10.1)	No additional tasks. Refer to Installing Oracle 10g Release 2 on a System with Oracle 10g Release 1 on page 2-36
Upgrading from Oracle9i Release 9.2 to Oracle Database 10g Release 2 (10.2)	Shut down the Global Service Daemon, and shut down a default listener on port 1521, if present. Refer to Installing Oracle 10g Release 2 on a System with Oracle9i Release 2 on page 2-36
Installing Oracle Database 10g Release 2 (10.2) on a system to co-exist with Oracle9i Release 9.2	Shut down a default listener on port 1521, if present, and shut down the Global Service Daemon. Refer to Installing Oracle 10g Release 2 on a System with Oracle9i Release 2 on page 2-36

Installing Oracle 10g Release 2 on a System with Oracle 10g Release 1

If your system has an Oracle Database Release 10g Release 10.1 installation, and you install an Oracle Database 10g Release 2 (10.2) either to coexist with or to upgrade the 10.1, then most installation types configure and start a default Oracle Net listener using TCP/IP port 1521 and the IPC key value EXTPROC. One of the following occurs:

- During a co-existing installation, Database Configuration Assistant (DBCA) automatically migrates the listener and related files from the 10.1 Oracle home to the 10.2 Oracle home.

- During an upgrade, Oracle Database Upgrade Assistant (DBUA) automatically locates the Oracle 10g release 1 (10.1) listener, and migrates it to Oracle 10g release 2.

Proceed to [Chapter 3](#).

Installing Oracle 10g Release 2 on a System with Oracle9i Release 2

This section provides instructions for preparing

Explanation of Tasks If you are installing an Oracle Database 10g Release 2 (10.2) on a system with an existing Oracle9i Release 2 (9.2) database, and the Oracle Net listener process is using the *same* port or key value as the default used with the Oracle 10g Release 2 (10.2) installation, port 1521, then Oracle Universal Installer can only configure the new listener; it cannot start it. To ensure that the new listener process starts during the installation, you must shut down any existing listeners before starting Oracle Universal Installer. To do this, refer to "[Shutting Down the Listener](#)" on page 2-36

You must shut down the Global Services Daemon (GSD), because otherwise, during 10g Release 2 (10.2) installation, the Oracle9i Release 2 SRVM shared data is upgraded into an Oracle Cluster Registry that the 9.2 GSD will not be able to use. The 10.2 Oracle Clusterware installation starts a 10g Release 2 (10.2) GSD to serve the Oracle9i 9.2 clients. To do this, refer to "[Shutting down the Global Services Daemon](#)" on page 2-37

Shutting Down the Listener To determine whether an existing Oracle9i listener process is running and to shut it down if necessary, follow these steps:

1. Switch user to oracle:

```
# su - oracle
```

2. Enter the following command to determine whether an Oracle9i listener process is running and to identify its name and the Oracle home directory in which it is installed:

```
$ ps -ef | grep tnslnsr
```

This command displays information about the Oracle Net listeners running on the system:

```
... oracle_home1/bin/tnslnsr LISTENER -inherit
```

In this example, *oracle_home1* is the Oracle home directory where the listener is installed and LISTENER is the listener name.

Note: If no Oracle Net listeners are running, then proceed to [Chapter 3](#).

3. Set the ORACLE_HOME environment variable to specify the appropriate Oracle home directory for the listener:

- Bourne, Bash, or Korn shell:

```
$ ORACLE_HOME=oracle_home1
$ export ORACLE_HOME
```

- C or tcsh shell:

```
% setenv ORACLE_HOME oracle_home1
```

4. Enter the following command to identify the TCP/IP port number and IPC key value that the listener is using:

```
$ $ORACLE_HOME/bin/lsnrctl status listenername
```

Note: If the listener uses the default name LISTENER, then you do not have to specify the listener name in this command.

5. Enter a command similar to the following to stop the listener process:

```
$ $ORACLE_HOME/bin/lsnrctl stop listenername
```

6. Repeat this procedure to stop all listeners running on this system and on all other nodes in the cluster.

Shutting down the Global Services Daemon As the `oracle` user, on each node of the cluster, use the following syntax to shut down the GSD:

```
$ cd 92_Oracle_home
```

```
$ bin/gsdctl stop
```

In the preceding syntax example, the variable `92_Oracle_home` is the Oracle9i Release 2 (9.2) database home.

Configuring Oracle Clusterware and Oracle Database Storage

This chapter describes the storage configuration tasks that you must complete before you start Oracle Universal Installer. It includes information about the following tasks:

- [Reviewing Storage Options for Oracle Clusterware, Database, and Recovery Files](#)
- [Checking for Available Shared Storage with CVU](#)
- [Configuring Storage for Oracle Clusterware Files on a Supported Shared File System](#)
- [Configuring Storage for Oracle Clusterware Files on Raw Devices](#)
- [Choosing a Storage Option for Oracle Database Files](#)
- [Configuring Disks for Automatic Storage Management](#)
- [Configuring Database File Storage on Raw Devices](#)

Reviewing Storage Options for Oracle Clusterware, Database, and Recovery Files

This section describes supported options for storing Oracle Clusterware files, Oracle Database files, and data files.

Overview of Oracle Clusterware Storage Options

There are three ways of storing Oracle Clusterware files:

- **A supported shared file system:** Supported file systems include the following:
 - Cluster File System with TruCluster v. 5.1B with Advanced File System (AdvFS)
- **Raw partitions:** Raw partitions are disk partitions that are not mounted and written to using the file system, but instead are accessed directly by the application.
- **Logical Storage Manager** with TruCluster v. 5.1B

Note: Tru64 UNIX NFS V2 is not supported with Oracle Real Application Clusters.

Overview of Oracle Database and Recovery File Options

There are three ways of storing Oracle Database and recovery files:

- **Automatic Storage Management:** Automatic Storage Management (ASM) is an integrated, high-performance database file system and disk manager for Oracle Database files.
- **A supported shared file system:** Supported file systems include the following:
 - **HP Tru64 TruCluster**
- **Raw partitions** (database files only): A raw partition is required for each database file.

See Also: For information about certified compatible storage options, refer to the Oracle Storage Compatibility Program (OSCP) Web site, which is at the following URL:

<http://www.oracle.com/technology/deploy/availability/htdocs/oscp.html>

General Storage Considerations

For all installations, you must choose the storage option that you want to use for Oracle Clusterware files and Oracle Database files. If you want to enable automated backups during installation, then you must also choose the storage option that you want to use for recovery files (the flash recovery area). You do not have to use the same storage option for each file type.

TruCluster Cluster File System

On V5.1B systems and higher, Oracle requires using the HP Tru64 TruCluster Cluster File Systems (CFS). TruCluster provides a single namespace file system for all nodes in a cluster. All file systems mounted in a cluster are automatically seen by all nodes in the cluster. Because it is layered on top of the AdvFS file system, the TruCluster file system inherits much of the characteristics of non-clustered systems.

The TruCluster file system supports a concurrent direct I/O model. Any node that has physical connectivity to a drive can issue data I/O to its file systems without consulting with the owning node. However, all metadata changes to a file (for example, extending, closing, changing the access or modification date) are still served by the owner node and can still cause cluster interconnect saturation. Therefore, it is possible for the CREATE TABLESPACE, ALTER TABLESPACE, ADD DATAFILE, ALTER DATABASE DATAFILE, or RESIZE commands to perform poorly on a CFS file system when compared to raw devices.

Direct I/O and Oracle Real Application Clusters

If you use the TruCluster file system for Oracle Real Application Clusters data file storage, then you must enable Direct I/O on your system. The disks that use the TruCluster file system must be physically connected to all computers running the Oracle instances, including disks attached by fiber channel. It excludes cases where I/O must be served by another node because of physical connectivity.

Voting Disk File Placement

For voting disk file placement, ensure that each voting disk is configured so that it does not share any hardware device or disk, or other single point of failure. An

absolute majority of voting disks configured (more than half) must be available and responsive at all times for Oracle Clusterware to operate.

Single-Instance Systems Using Oracle Clusterware

For single-instance Oracle Database installations using Oracle Clusterware for failover, if you do not want the failover processing to include dismounting and remounting disks, then you must use ASM, or shared raw disks.

Selecting Storage Options

The following table shows the storage options supported for storing Oracle Clusterware files, Oracle Database files, and Oracle Database recovery files. Oracle Database files include data files, control files, redo log files, the server parameter file, and the password file. Oracle Clusterware files include the Oracle Cluster Registry (OCR), a mirrored OCR file (optional), the Oracle Clusterware voting disk, and additional voting disk files (optional).

Note: For the most up-to-date information about supported storage options for RAC installations, refer to the Certify pages on the OracleMetaLink Web site:

<http://metalink.oracle.com>

Table 3–1 Supported Storage Options for Oracle Clusterware, Database, and Recovery Files

Storage Option	File Types Supported			
	OCR and Voting Disks	Oracle Software	Database	Recovery
Automatic Storage Management	No	No	Yes	Yes
Cluster File System with TruCluster v.5.1B	Yes	Yes	Yes	Yes
Logical Storage Manager with TruCluster v. 5.1B	Voting Disks only	Yes	Yes	No
Shared raw partitions	Voting Disks only	No	Yes	No

Use the following guidelines when choosing the storage options that you want to use for each file type:

- You can choose any combination of the supported storage options for each file type provided that you satisfy all requirements listed for the chosen storage options.
- Oracle recommends that you choose Automatic Storage Management (ASM) as the storage option for database and recovery files.
- The Oracle Cluster Registry must be stored on a cluster file system. A shared Logical Storage Manager volume or shared disk partition is not a supported storage option for the OCR.
- For Standard Edition RAC installations, ASM is the only supported storage option for database or recovery files.

- You cannot use ASM to store Oracle Clusterware files, because these files must be accessible before any ASM instance starts.
- If you intend to use ASM with RAC, and you are configuring a new ASM instance, then your system must meet the following conditions:
 - All nodes on the cluster have the release 2 (10.2) version of Oracle Clusterware installed.
 - Any existing ASM instance on any node in the cluster is shut down.
- If you intend to upgrade an existing RAC database, or a RAC database with ASM instances, then you must ensure that your system meets the following conditions:
 - Oracle Universal Installer (OUI) and Database Configuration Assistant (DBCA) are run on the node where the RAC database or RAC database with ASM instance is located.
 - The RAC database or RAC database with an ASM instance is running on the *same* nodes that you intend to make members of the new cluster installation. For example, if you have an existing RAC database running on a three-node cluster, then you must install the upgrade on all three nodes. You cannot upgrade only 2 nodes of the cluster, removing the third instance in the upgrade.

See Also: *Oracle Database Upgrade Guide* for information about how to prepare for upgrading an existing database
- If you do not have a storage option that provides external file redundancy, then configure additional storage areas to provide voting disk redundancy, either as storage areas on the cluster file system, or three raw devices or logical volume manager areas. You must configure at least three voting disk areas. At least two voting disks must be available for Oracle Clusterware to operate.

After You Have Selected Disk Storage Options

When you have determined your disk storage options, you must perform the following tasks in the following order:

1: Check for available shared storage with CVU

Refer to [Checking for Available Shared Storage with CVU](#) on page 3-5.

2: Configure shared storage for Oracle Clusterware files

- To use a File System for Oracle Clusterware Files, refer to ["Configuring Storage for Oracle Clusterware Files on a Supported Shared File System"](#) on page 3-5
- To use raw devices (partitions) for Oracle Clusterware files, refer to ["Configuring Storage for Oracle Clusterware Files on Raw Devices"](#) on page 3-8.

3: Configure storage for Oracle Database files and recovery files

- To use a file system for database or recovery file storage, refer to [Configuring Storage for Oracle Clusterware Files on a Supported Shared File System](#) on page 3-5, and ensure that in addition to the volumes you create for Oracle Clusterware files, you also create additional volumes with sizes sufficient to store database files.

- To use **Automatic Storage Management for database or recovery file storage**, refer to ["Configuring Database File Storage on ASM and Raw Devices"](#) on page 3-17.
- To use **raw devices (partitions) for database file storage**, refer to ["Configuring Database File Storage on Raw Devices"](#) on page 3-17.

Checking for Available Shared Storage with CVU

To check for all shared file systems available across all nodes on the cluster on a supported shared file system, use the following command:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh comp ssa -n node_list
```

If you want to check the shared accessibility of a specific shared storage type to specific nodes in your cluster, then use the following command syntax:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh comp ssa -n node_list -s storageID_list
```

In the preceding syntax examples, the variable *mountpoint* is the mountpoint path of the installation media, the variable *node_list* is the list of nodes you want to check, separated by commas, and the variable *storageID_list* is the list of storage device IDs for the storage devices managed by the TruCluster file system you want to check.

For example, if you want to check the shared accessibility from *node1* and *node2* of storage devices */dev/sdb* and */dev/sdc*, and your mountpoint is */dev/dvdrom/*, then enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh comp ssa -n node1,node2 -s  
/dev/sdb,/dev/sdc
```

Note: On HP Tru64, only CFS shared storage checks are performed with CVU. Shared storage checks for LVM or raw disks are not performed, as these are not supported shared storage options.

Configuring Storage for Oracle Clusterware Files on a Supported Shared File System

Oracle Universal Installer (OUI) does not suggest a default location for the Oracle Cluster Registry (OCR) or the Oracle Clusterware voting disk. If you choose to create these files on a file system, then review the following sections to complete storage requirements for Oracle Clusterware files:

- [Requirements for Using a File System for Oracle Clusterware Files](#)
- [Deciding to Use a Cluster File System for Data Files](#)
- [Creating Required Directories for Oracle Clusterware Files on Shared File Systems](#)

Requirements for Using a File System for Oracle Clusterware Files

To use a file system for Oracle Clusterware files, the file system must comply with the following requirements:

- To use a cluster file system, it must be a supported cluster file system, as listed in the section ["Deciding to Use a Cluster File System for Data Files"](#) on page 3-11.

- If you choose to place your Oracle Cluster Registry (OCR) files on a shared file system, then one of the following must be true:
 - The disks used for the file system are on a highly available storage device, (for example, a RAID device that implements file redundancy).
 - At least two file systems are mounted, and use the features of Oracle Database 10g Release 2 (10.2) to provide redundancy for the OCR.
- If you intend to use a shared file system to store database files, then use at least two independent file systems, with the database files on one file system, and the recovery files on a different file system.
- The `oracle` user must have write permissions to create the files in the path that you specify.

Note: If you are upgrading from Oracle9i release 2, then you can continue to use the raw device or shared file that you used for the SRVM configuration repository instead of creating a new file for the OCR.

Use [Table 3–2](#) to determine the partition size for shared file systems.

Table 3–2 Shared File System Volume Size Requirements

File Types Stored	Number of Volumes	Volume Size
Oracle Clusterware files (OCR and voting disks) with external redundancy	1	At least 256 MB for each volume
Oracle Clusterware files (OCR and voting disks) with redundancy provided by Oracle software.	1	At least 256 MB for each volume
Redundant Oracle Clusterware files with redundancy provided by Oracle software (mirrored OCR and two additional voting disks)	1	At least 256 MB of free space for each OCR location, if the OCR is configured on a file system <i>or</i> At least 256 MB available for each OCR location if the OCR is configured on raw devices or block devices. <i>and</i> At least 256 MB for each voting disk location, with a minimum of three disks.
Oracle Database files	1	At least 1.2 GB for each volume
Recovery files	1	At least 2 GB for each volume
Note: Recovery files must be on a different volume than database files		

In [Table 3–2](#), the total required volume size is cumulative. For example, to store all files on the shared file system, you should have at least 3.4 GB of storage available over a minimum of two volumes.

Creating Required Directories for Oracle Clusterware Files on Shared File Systems

Use the following instructions to create directories for Oracle Clusterware files. You can also configure shared file systems for the Oracle Database and recovery files.

Note: For cluster file system storage, you must complete this procedure only if you want to place the Oracle Clusterware files on a separate file system from the Oracle base directory.

To create directories for the Oracle Clusterware files on separate file systems from the Oracle base directory, follow these steps:

1. If necessary, configure the shared file systems that you want to use and mount them on each node.

Note: The cluster file system directory that you use for the file system must be identical on each node. Ensure that the file systems are configured to mount automatically when a node restarts.

2. Use the `df -h` command to determine the free disk space on each storage area.
3. From the display, identify the file systems that you want to use:

File Type	File System Requirements
Oracle Clusterware files	Choose a file system with at least 512 MB of free disk space (one OCR and one voting disk, with external redundancy)
Database files	Choose either: <ul style="list-style-type: none"> ■ A single file system with at least 1.2 GB of free disk space. ■ Two or more file systems with at least 1.2 GB of free disk space in total.
Recovery files	Choose a file system with at least 2 GB of free disk space.

If you are using the same file system for more than one type of file, then add the disk space requirements for each type to determine the total disk space requirement.

4. Note the names of the cluster file system directories for the file systems that you identified.
5. If the user performing installation (typically, `oracle`) has permissions to create directories on the disks where you plan to install Oracle Clusterware and Oracle Database, then OUI creates the Oracle Clusterware file directory, and DBCA creates the Oracle Database file directory, and the Recovery file directory.

If the user performing installation does not have write access, then you must create these directories manually using commands similar to the following to create the recommended subdirectories in each of the cluster file system (*cfsdirectory*) directories and set the appropriate owner, group, and permissions on them:

- Oracle Clusterware file directory:


```
# mkdir /cfsdirectory/oracrs
# chown oracle:oinstall /cfsdirectory/oracrs
# chmod 775 /cfsdirectory/oracrs
```

- Database file directory:

```
# mkdir /cfsdirectory/oradata
# chown oracle:oinstall /cfsdirectory/oradata
# chmod 775 /cfsdirectory/oradata
```
- Recovery file directory (flash recovery area):

```
# mkdir /cfsdirectory/flash_recovery_area
# chown oracle:oinstall /cfsdirectory/flash_recovery_area
# chmod 775 /cfsdirectory/flash_recovery_area
```

By making the `oracle` user the owner of these directories, this permits them to be read by multiple Oracle homes, including those with different OSDBA groups.

When you have completed creating subdirectories in each of the mount point directories, and set the appropriate owner, group, and permissions, you have completed TruCluster configuration.

Configuring Storage for Oracle Clusterware Files on Raw Devices

The following subsections describe how to configure Oracle Clusterware files on raw partitions.

- [Identifying Required Raw Partitions for Clusterware Files](#)
- [Configuring Raw Devices](#)
- [Completing Supported Shared Storage Configuration](#)

Identifying Required Raw Partitions for Clusterware Files

[Table 3–3](#) lists the number and size of the raw partitions that you must configure for Oracle Clusterware files.

Table 3–3 Raw Partitions Required for Oracle Clusterware Files

Number	Size for Each Partition (MB)	Purpose
2 (or 1, if you have external redundancy support for this file)	256	Oracle Cluster Registry Note: You need to create these raw partitions only once on the cluster. If you create more than one database on the cluster, then they all share the same Oracle Cluster Registry (OCR). You should create two partitions: One for the OCR, and one for a mirrored OCR. If you are upgrading from Oracle9i release 2, then you can continue to use the raw device that you used for the SRVM configuration repository instead of creating this new raw device.
3 (or 1, if you have external redundancy support for this file)	256	Oracle Clusterware voting disks Note: You need to create these raw partitions only once on the cluster. If you create more than one database on the cluster, then they all share the same Oracle Clusterware voting disk. You should create three partitions: One for the voting disk, and two for additional voting disks.

Note: Voting disk and OCR files requires at least 500 MB. The total size required depends on the number of nodes on the cluster.

Configuring Raw Devices

Caution: Do not attempt to set up raw devices without the help of an experienced system administrator and specific knowledge about the system you are using.

To configure raw devices and volumes on Tru64 systems:

1. If necessary, install or configure the shared disk devices that you intend to use for the raw partitions and restart the system.

Ensure that the partitions you are adding are on a shared disk. You can store the files that Oracle Real Application Clusters requires directly on the cluster file system.

Note: Because the number of partitions that you can create on a single device is limited, you might need to create the required raw partitions on more than one device.

2. Determine the names of the free disk partitions.

A free disk partition is one that is not used for a Tru64 file system that complies with the following restrictions:

- It is not listed when you run the command `/usr/sbin/mount`.
- It is not in use as a swap device.
- It does not overlap a swap partition.
- It is not in use by other Tru64 applications.
- It does not overlap the Tru64 file system.
- It does not use a space already used by the file system.

To determine if a partition is free, obtain a complete map of the starting locations and sizes of the partitions on the device and check for free space. Some partitions may contain file systems that are currently not mounted and are not listed in the `/usr/sbin/mount` output.

Note: Ensure that the partition does not start at cylinder 0.

3. Set up the raw device for use by Oracle Clusterware.

Begin by verifying that the disk is partitioned. If it is not, then use the command `disklabel` to partition it.

4. Enter the `ls` command to view the owner and permissions of the device file. For example:

```
$ ls -la
```

5. Ensure that the partition is owned by the `oracle` user. If necessary, use the command `chown` to change the ownership on the block and character files for the device. For example:

```
# chown oracle /dev/rdisk/dsk10c
```

6. Ensure that the partition has the correct permissions. If necessary, use the command `chmod` to make the partition accessible only to the `oracle` user. For example:

```
# chmod 600 /dev/rdisk/dsk10c
```

7. Create a symbolic link to the raw devices you require. For example:

```
$ ln -s /dev/rdisk/dsk10c /oracle_data/datafile.dbf
```

To verify that you have created the symbolic link, use the character special device (not the block special device) and enter the following command:

```
$ ls -l datafile
```

The following message should appear:

```
crwxrwxrwx oracle dba datafile
```

Completing Supported Shared Storage Configuration

When you have completed creating subdirectories in each of the mount point directories, and set the appropriate owner, group, and permissions, you have completed supported shared storage configuration.

Choosing a Storage Option for Oracle Database Files

Database files consist of the files that make up the database, and the recovery area files. There are five options for storing database files:

- Automatic Storage Management (ASM)
- Logical Storage Manager with TruCluster (recovery files not supported)
- Raw partitions (Database files only--not for the recovery area)

During configuration of Oracle Clusterware, if you configure TruCluster logical volumes large enough to hold the database files and recovery files, and you do not plan to use ASM, then you have completed required pre-installation steps. You can proceed to [Chapter 4, "Installing Oracle Clusterware"](#) on page 4-1.

If you want to place your database files on ASM, then proceed to [Configuring Disks for Automatic Storage Management](#) on page 3-12.

If you want to place your database files on raw devices, and manually provide storage management for your database and recovery files, then proceed to ["Configuring Database File Storage on Raw Devices"](#) on page 3-17.

Note: Databases can consist of a mixture of ASM files and non-ASM files. Refer to *Oracle Database Administrator's Guide* for additional information about ASM.

Deciding to Use a Cluster File System for Data Files

If you choose to place the Oracle database files on a file system, then use the following guidelines when deciding where to place them:

- You must choose a shared file system on shared disk; the file system must be a cluster file system.
- The default path suggested by the Installer for the database file directory is a subdirectory of the Oracle base directory. You can choose this path only if you are using an Oracle base directory that is on a shared file system.

This default location is not recommended for production databases.

- You can choose either a single file system or more than one file system to store the database files:
 - If you want to use a single file system, choose a file system on a physical device that is dedicated to the database.

For best performance and reliability, choose a RAID device or a logical volume on more than one physical device and implement the stripe-and-mirror-everything (SAME) methodology.

- If you want to use more than one file system, choose file systems on separate physical devices that are dedicated to the database.

This method enables you to distribute physical I/O and create separate control files on different devices for increased reliability. It also enables you to fully implement the OFA guidelines. You must choose either the Advanced database creation option or the Custom installation type during the installation to implement this method.

- If you intend to create a preconfigured database during the installation, the file system (or file systems) that you choose must have at least 1.2 GB of free disk space.

For production databases, you must estimate the disk space requirement depending on the use that you want to make of the database.

- For optimum performance, the file systems that you choose should be on physical devices that are used only by the database.
- The `oracle` user must have write permissions to create the files in the path that you specify.

Guidelines for Placing Oracle Recovery Files on a File System

Note: You must choose a location for recovery files only if you intend to enable automated backups during the installation.

If you choose to place the Oracle recovery files on a file system, use the following guidelines when deciding where to place them:

- To prevent disk failure from making both the database files and the recovery files unavailable, place the recovery files in a file system on a different physical disk from the database files.

Note: Alternatively use an ASM disk group with a normal or high redundancy level for either or both file types.

- The file system that you choose should have at least 2 GB of free disk space.
The disk space requirement is the default disk quota configured for the flash recovery area (specified by the DB_RECOVERY_FILE_DEST_SIZE initialization parameter).
If you choose the Custom installation type or the Advanced database configuration option, you can specify a different disk quota value. After you create the database, you can also use Oracle Enterprise Manager Grid Control or Database Control to specify a different value.
For more information about sizing the flash recovery area, refer to the *Oracle Backup and Recovery Basics* manual.
- You must use TruClusters.
- The default path suggested by the Installer for the flash recovery area is a subdirectory of the Oracle base directory. You can choose this path only if you are using an Oracle base directory that is on a shared file system.
This default location is not recommended for production databases.
- The `oracle` user must have write permissions to create the files in the path that you specify.

Configuring Disks for Automatic Storage Management

This section describes how to configure disks for use with Automatic Storage Management. Before you configure the disks, you must determine the number of disks and the amount of free disk space that you require. The following sections describe how to identify the requirements and configure the disks:

- [Identifying Storage Requirements for Automatic Storage Management](#)
- [Using an Existing Automatic Storage Management Disk Group](#)
- [Configuring Database File Storage on ASM and Raw Devices](#)

Note: For Automatic Storage Management installations:

- Although this section refers to disks, you can also use zero-padded files on a certified NAS storage device in an Automatic Storage Management disk group. Refer to *Oracle Database Installation Guide for hp Tru64* for information about creating and configuring NAS-based files for use in an Automatic Storage Management disk group.
 - You can run ASM using ASMLIB, or run ASM using raw partitions.
-

Identifying Storage Requirements for Automatic Storage Management

To identify the storage requirements for using Automatic Storage Management, you must determine how many devices and the amount of free disk space that you require. To complete this task, follow these steps:

1. Determine whether you want to use Automatic Storage Management for Oracle Database files, recovery files, or both.

Note: You do not have to use the same storage mechanism for database files and recovery files. You can use the file system for one file type and Automatic Storage Management for the other.

If you choose to enable automated backups and you do not have a shared file system available, then you must choose Automatic Storage Management for recovery file storage.

If you enable automated backups during the installation, you can choose Automatic Storage Management as the storage mechanism for recovery files by specifying an Automatic Storage Management disk group for the flash recovery area. Depending on how you choose to create a database during the installation, you have the following options:

- If you select an installation method that runs Database Configuration Assistant in interactive mode (for example, by choosing the Advanced database configuration option) then you can decide whether you want to use the same Automatic Storage Management disk group for database files and recovery files, or use different disk groups for each file type.

The same choice is available to you if you use Database Configuration Assistant after the installation to create a database.

- If you select an installation method that runs Database Configuration Assistant in noninteractive mode, then you must use the same Automatic Storage Management disk group for database files and recovery files.
2. Choose the Automatic Storage Management redundancy level that you want to use for the Automatic Storage Management disk group.

The redundancy level that you choose for the Automatic Storage Management disk group determines how Automatic Storage Management mirrors files in the disk group and determines the number of disks and amount of free disk space that you require, as follows:

- External redundancy

An external redundancy disk group requires a minimum of one disk device. The effective disk space in an external redundancy disk group is the sum of the disk space in all of its devices.

Because Automatic Storage Management does not mirror data in an external redundancy disk group, Oracle recommends that you use only RAID or similar devices that provide their own data protection mechanisms as disk devices in this type of disk group.

- Normal redundancy

In a normal redundancy disk group, Automatic Storage Management uses two-way mirroring by default, to increase performance and reliability. A normal redundancy disk group requires a minimum of two disk devices (or two failure groups). The effective disk space in a normal redundancy disk group is *half* the sum of the disk space in all of its devices.

For most installations, Oracle recommends that you select normal redundancy disk groups.

- High redundancy

In a high redundancy disk group, Automatic Storage Management uses three-way mirroring to increase performance and provide the highest level of reliability. A high redundancy disk group requires a minimum of three disk devices (or three failure groups). The effective disk space in a high redundancy disk group is *one-third* the sum of the disk space in all of its devices.

While high redundancy disk groups do provide a high level of data protection, you should consider the greater cost of additional storage devices before deciding to select high redundancy disk groups.

3. Determine the total amount of disk space that you require for the database files and recovery files.

Use the following table to determine the minimum number of disks and the minimum disk space requirements for installing the starter database:

Redundancy Level	Minimum Number of Disks	Database Files	Recovery Files	Both File Types
External	1	1.15 GB	2.3 GB	3.45 GB
Normal	2	2.3 GB	4.6 GB	6.9 GB
High	3	3.45 GB	6.9 GB	10.35 GB

For RAC installations, you must also add additional disk space for the Automatic Storage Management metadata. You can use the following formula to calculate the additional disk space requirements (in MB):

$$15 + (2 * \text{number_of_disks}) + (126 * \text{number_of_Automatic_Storage_Management_instances})$$

For example, for a four-node RAC installation, using three disks in a high redundancy disk group, you require an additional 525 MB of disk space:

$$15 + (2 * 3) + (126 * 4) = 525$$

If an Automatic Storage Management instance is already running on the system, then you can use an existing disk group to meet these storage requirements. If necessary, you can add disks to an existing disk group during the installation.

The following section describes how to identify existing disk groups and determine the free disk space that they contain.

4. Optionally, identify failure groups for the Automatic Storage Management disk group devices.

Note: You need to complete this step only if you intend to use an installation method that runs Database Configuration Assistant in interactive mode, for example, if you intend to choose the Custom installation type or the Advanced database configuration option. Other installation types do not enable you to specify failure groups.

If you intend to use a normal or high redundancy disk group, then you can further protect your database against hardware failure by associating a set of disk devices in a custom failure group. By default, each device comprises its own failure group. However, if two disk devices in a normal redundancy disk group are attached to

the same SCSI controller, then the disk group becomes unavailable if the controller fails. The controller in this example is a single point of failure.

To protect against failures of this type, you could use two SCSI controllers, each with two disks, and define a failure group for the disks attached to each controller. This configuration would enable the disk group to tolerate the failure of one SCSI controller.

Note: If you define custom failure groups, then you must specify a minimum of two failure groups for normal redundancy disk groups and three failure groups for high redundancy disk groups.

5. If you are sure that a suitable disk group does not exist on the system, then install or identify appropriate disk devices to add to a new disk group. Locate appropriate disk devices with the following command:

```
# hwmgr -view devices
# df -k
```

When you select Automatic Storage Management (ASM), OUI displays an ASM Management Options page showing the disk partition locations from which you must select. The default partitions are in the following path:

```
/dev/rdisk/*
```

Use the following guidelines when identifying appropriate disk devices:

- All of the devices in an Automatic Storage Management disk group should be the same size and have the same performance characteristics.
- Do not specify more than one partition on a single physical disk as a disk group device. Automatic Storage Management expects each disk group device to be on a separate physical disk.
- Although you can specify a logical volume as a device in an Automatic Storage Management disk group, Oracle does not recommend their use. Logical volume managers can hide the physical disk architecture, preventing Automatic Storage Management from optimizing I/O across the physical devices. They are not supported with RAC.

See Also: The "[Configuring Disks for Automatic Storage Management](#)" section on page 3-12 for information about completing this task

Using an Existing Automatic Storage Management Disk Group

If you want to store either database or recovery files in an existing Automatic Storage Management disk group, then you have the following choices, depending on the installation method that you select:

- If you select an installation method that runs Database Configuration Assistant in interactive mode (for example, by choosing the Advanced database configuration option), then you can decide whether you want to create a disk group, or to use an existing one.

The same choice is available to you if you use Database Configuration Assistant after the installation to create a database.

- If you select an installation method that runs Database Configuration Assistant in noninteractive mode, then you must choose an existing disk group for the new database; you cannot create a disk group. However, you can add disk devices to an existing disk group if it has insufficient free space for your requirements.

Note: The Automatic Storage Management instance that manages the existing disk group can be running in a different Oracle home directory.

To determine if an existing Automatic Storage Management disk group exists, or to determine if there is sufficient disk space in a disk group, you can use Oracle Enterprise Manager Grid Control or Database Control. Alternatively, you can use the following procedure:

1. View the contents of the `oratab` file to determine if an Automatic Storage Management instance is configured on the system:

```
$ more /etc/oratab
```

If an Automatic Storage Management instance is configured on the system, then the `oratab` file should contain a line similar to the following:

```
+ASM2:oracle_home_path
```

In this example, `+ASM2` is the system identifier (SID) of the Automatic Storage Management instance, with the node number appended, and `oracle_home_path` is the Oracle home directory where it is installed. By convention, the SID for an Automatic Storage Management instance begins with a plus sign.

2. Set the `ORACLE_SID` and `ORACLE_HOME` environment variables to specify the appropriate values for the Automatic Storage Management instance that you want to use.
3. Connect to the Automatic Storage Management instance as the SYS user with SYSDBA privilege and start the instance if necessary:

```
$ $ORACLE_HOME/bin/sqlplus "SYS/SYS_password as SYSDBA"
SQL> STARTUP
```

4. Enter the following command to view the existing disk groups, their redundancy level, and the amount of free disk space in each one:

```
SQL> SELECT NAME,TYPE,TOTAL_MB,FREE_MB FROM V$ASM_DISKGROUP;
```

5. From the output, identify a disk group with the appropriate redundancy level and note the free space that it contains.
6. If necessary, install or identify the additional disk devices required to meet the storage requirements listed in the previous section.

Note: If you are adding devices to an existing disk group, then Oracle recommends that you use devices that have the same size and performance characteristics as the existing devices in that disk group.

Configuring Database File Storage on ASM and Raw Devices

To configure disks for Automatic Storage Management (ASM) using raw devices, complete the following tasks:

1. To use ASM with raw partitions, you must create sufficient partitions for your data files, and then bind the partitions to raw devices. To do this, follow the instructions provided for Oracle Clusterware in the section "[Configuring Storage for Oracle Clusterware Files on Raw Devices](#)" on page 3-8. If you want to configure partitions after installing the database, then refer to [Additional Postinstallation Tasks for Tru64](#) on page 7-5.
2. Make a list of the raw device names you create for the data files, and have the list available during database installation.

When you have completed creating and configuring ASM with raw partitions, proceed to [Chapter 4, "Installing Oracle Clusterware"](#) on page 4-1.

Configuring Database File Storage on Raw Devices

The following sections describe how to configure raw partitions for database files.

- [Identifying Required Raw Partitions for Database Files](#)
- [Creating the Database Configuration Assistant Raw Device Mapping File](#)

Identifying Required Raw Partitions for Database Files

[Table 3–4](#) lists the number and size of the raw partitions that you must configure for database files. If you need to create additional raw partitions, then refer to the section [Configuring Raw Devices](#) on page 3-9. If you want to configure partitions after installing the database, then refer to [Additional Postinstallation Tasks for Tru64](#) on page 7-5.

Table 3–4 Raw Partitions or Logical Volumes Required for Database Files

Number	Partition Size (MB)	Purpose
1	500	SYSTEM tablespace
1	300 + (Number of instances * 250)	SYSAUX tablespace
Number of instances	500	UNDOTBS n tablespace (One tablespace for each instance)
1	250	TEMP tablespace
1	160	EXAMPLE tablespace
1	120	USERS tablespace
2 * number of instances	120	Two online redo log files for each instance
2	110	First and second control files
1	5	Server parameter file (SPFILE)
1	5	Password file

Note: If you prefer to use manual undo management, instead of automatic undo management, then, instead of the `UNDOTBSn` raw devices, you must create a single rollback segment tablespace (RBS) raw device that is at least 500 MB in size.

Creating the Database Configuration Assistant Raw Device Mapping File

Note: You must complete this procedure only if you are using raw devices for database files. You do not specify the raw devices for the Oracle Clusterware files in the Database Configuration Assistant raw device mapping file.

To allow Database Configuration Assistant to identify the appropriate raw device for each database file, you must create a raw device mapping file, as follows:

1. Set the `ORACLE_BASE` environment variable to specify the Oracle base directory that you identified or created previously:

- Bourne, Bash, or Korn shell:

```
$ ORACLE_BASE=/u01/app/oracle ; export ORACLE_BASE
```

- C shell:

```
% setenv ORACLE_BASE /u01/app/oracle
```

2. Create a database file subdirectory under the Oracle base directory and set the appropriate owner, group, and permissions on it:

```
# mkdir -p $ORACLE_BASE/oradata/dbname
# chown -R oracle:oinstall $ORACLE_BASE/oradata
# chmod -R 775 $ORACLE_BASE/oradata
```

In this example, *dbname* is the name of the database that you chose previously.

3. Change directory to the `$ORACLE_BASE/oradata/dbname` directory.
4. Edit the `dbname_raw.conf` file in any text editor to create a file similar to the following:

Note: The following example shows a sample mapping file for a two-instance RAC cluster.

```
system=dev/rdisk/raw1
sysaux=dev/rdisk/raw2
example=dev/rdisk/raw3
users=dev/rdisk/raw4
temp=dev/rdisk/raw5
undotbs1=dev/rdisk/raw6
undotbs2=dev/rdisk/raw7
redo1_1=dev/rdisk/raw8
redo1_2=dev/rdisk/raw9
redo2_1=dev/rdisk/raw10
redo2_2=dev/rdisk/raw11
control1=dev/rdisk/raw12
control2=dev/rdisk/raw13
```



```
spfile=dev/rdisk/raw14
pwdfile=dev/rdisk/raw15
```

Use the following guidelines when creating or editing this file:

- Each line in the file must have the following format:
database_object_identifier=raw_device_path
- For a single-instance database, the file must specify one automatic undo tablespace data file (undotbs1), and at least two redo log files (redo1_1, redo1_2).
- For a RAC database, the file must specify one automatic undo tablespace data file (undotbsn) and two redo log files (redon_1, redon_2) for each instance.
- Specify at least two control files (control1, control2).
- To use manual instead of automatic undo management, specify a single rollback segment tablespace data file (rbs) instead of the automatic undo management tablespace data files.

5. Save the file, and note the file name that you specified.
6. If you are using raw devices for database storage, then set the DBCA_RAW_CONFIG environment variable to specify the full path to the raw device mapping file:

Bourne, Bash, or Korn shell:

```
$ DBCA_RAW_CONFIG=$ORACLE_BASE/oradata/dbname/dbname_raw.conf
$ export DBCA_RAW_CONFIG
```

C shell:

```
$ setenv DBCA_RAW_CONFIG=$ORACLE_BASE/oradata/dbname/dbname_raw.conf
```


Part III

Installing Oracle Clusterware and Oracle Database 10g with Oracle Real Application Clusters, Creating Oracle Real Application Clusters Databases, and Performing Post-Installation Tasks

Part III describes the two-phase installation process of how to install Oracle Clusterware and Oracle Database 10g with Real Application Clusters (RAC). It also explains how to create RAC databases, and it describes the post-installation tasks. Part III contains the following chapters:

- [Chapter 4, "Installing Oracle Clusterware"](#)
- [Chapter 5, "Installing Oracle Database 10g with Oracle Real Application Clusters"](#)
- [Chapter 6, "Creating Oracle Real Application Clusters Databases with Database Configuration Assistant"](#)
- [Chapter 7, "Oracle Real Application Clusters Post-Installation Procedures"](#)

Installing Oracle Clusterware

This chapter describes the procedures for installing Oracle Clusterware on HP Tru64. If you are installing Oracle Database 10g Real Application Clusters, then this is phase one of a two-phase installation. The topics in this chapter are:

- [Verifying Oracle Clusterware Requirements with CVU](#)
- [Preparing to Install Oracle Clusterware with OUI](#)
- [Installing Oracle Clusterware with OUI](#)

Verifying Oracle Clusterware Requirements with CVU

Using the following command syntax, start the Cluster Verification Utility (CVU) to check system requirements for installing Oracle Clusterware:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh stage -pre crsinst -n node_list
```

In the preceding syntax example, replace the variable *mountpoint* with the installation media mountpoint, and replace the variable *node_list* with the names of the nodes in your cluster, separated by commas.

For example, for a cluster with mountpoint `/dev/dvdrom/`, and with nodes *node1*, *node2*, and *node3*, enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh stage -pre crsinst -n node1,node2,node3
```

The CVU Oracle Clusterware pre-installation stage check verifies the following:

- **Node Reachability:** All of the specified nodes are reachable from the local node.
- **User Equivalence:** Required user equivalence exists on all of the specified nodes.
- **Node Connectivity:** Connectivity exists between all the specified nodes through the public and private network interconnections, and at least one subnet exists that connects each node and contains public network interfaces that are suitable for use as virtual IPs (VIPs).
- **Administrative Privileges:** The `oracle` user has proper administrative privileges to install Oracle Clusterware on the specified nodes.
- **Shared Storage Accessibility:** If specified, the OCR device and voting disk are shared across all the specified nodes.
- **System Requirements:** All system requirements are met for installing Oracle Clusterware software, including kernel version, kernel parameters, memory, swap directory space, temporary directory space, and required users and groups.
- **Kernel Packages:** All required operating system software packages are installed.

- **Node Applications:** The virtual IP (VIP), Oracle Notification Service (ONS) and Global Service Daemon (GSD) node applications are functioning on each node.

Troubleshooting Oracle Clusterware Setup

If the CVU report indicates that your system fails to meet the requirements for Oracle Clusterware installation, then use the topics in this section to correct the problem or problems indicated in the report, and run the CVU command again.

User Equivalence Check Failed

Cause: Failure to establish user equivalency across all nodes. This can be due to not creating the required users, or failing to complete secure shell (SSH) configuration properly.

Action: The CVU provides a list of nodes on which user equivalence failed. For each node listed as a failure node, review the `oracle` user configuration to ensure that the user configuration is properly completed, and that SSH2 configuration is properly completed.

See Also: ["Creating Identical Users and Groups on Other Cluster Nodes"](#) and ["Configuring SSH on All Cluster Nodes"](#) in [Chapter 2](#) for user equivalency configuration instructions

Use the command `su - oracle` and check user equivalence manually by running the `ssh` command on the local node with the `date` command argument using the following syntax:

```
ssh2 node_name date
```

The output from this command should be the timestamp of the remote node identified by the value that you use for `node_name`. If `ssh2` is in the default location, the `/usr/bin` directory, then use `ssh2` to configure user equivalence. You can also use `rsh` to confirm user equivalence.

If you have not attempted to use SSH2 to connect to the host node before running, then CVU indicates a user equivalence error. If you see a message similar to the following when entering the `date` command with SSH, then this is the probable cause of the user equivalence error:

```
The authenticity of host 'node1 (140.87.152.153)' can't be established.  
RSA key fingerprint is 7z:ez:e7:f6:f4:f2:4f:8f:9z:79:85:62:20:90:92:z9.  
Are you sure you want to continue connecting (yes/no)?
```

Enter `yes`, and then run CVU again to determine if the user equivalency error is resolved.

If `ssh` is in a location other than the default, `/usr/bin`, then CVU reports a user equivalence check failure. To avoid this error, navigate to the directory `$CV_HOME/cv/admin`, open the file `cvu_config` with a text editor, and add or update the key `ORACLE_SRVM_REMOTESHELL` to indicate the `ssh2` path location on your system. For example:

```
# Locations for ssh2 and scp2 commands  
ORACLE_SRVM_REMOTESHELL=/usr/local/bin/ssh2  
ORACLE_SRVM_REMOTECOPY=/usr/local/bin/scp2
```

Note the following rules for modifying the `cvu_config` file:

- Key entries have the syntax *name=value*

- Each key entry and the value assigned to the key defines one property only
- Lines beginning with the number sign (#) are comment lines, and are ignored
- Lines that do not follow the syntax *name=value* are ignored

When you have changed the path configuration, run the CVU check again. If `ssh2` is in another location than the default, you also need to start OUI with additional arguments to specify a different location for the remote shell and remote copy commands. Enter `runInstaller -help` to obtain information about how to use these arguments.

Note: When you or OUI run `ssh` or `rsh` commands, including any login or other shell scripts they start, you may see errors about invalid arguments or standard input if the scripts generate any output. You should correct the cause of these errors.

To stop the errors, remove all commands from the `oracle` user's login scripts that generate output when you run `ssh` or `rsh` commands.

If you see messages about X11 forwarding, then perform step 6 in [Chapter 2, "Enabling SSH2 User Equivalency on Cluster Member Nodes"](#) on page 2-13 to resolve this issue.

If you see errors similar to the following:

```
stty: standard input: Invalid argument
stty: standard input: Invalid argument
```

These errors are produced if hidden files on the system (for example, `.bashrc` or `.cshrc`) contain `stty` commands. If you see these errors, then refer to [Chapter 2, "Preventing Oracle Clusterware Installation Errors Caused by stty Commands"](#) on page 2-14 to correct the cause of these errors.

Node Reachability Check or Node Connectivity Check Failed

Cause: One or more nodes in the cluster cannot be reached using TCP/IP protocol, through either the public or private interconnects.

Action: Use the command `/usr/sbin/ping address` to check each node address. When you find an address that cannot be reached, check your list of public and private addresses to make sure that you have them correctly configured. If you use third-party vendor clusterware, then refer to the vendor documentation for assistance. Ensure that the public and private network interfaces have the same interface names on each node of your cluster.

User Existence Check or User-Group Relationship Check Failed

Cause: The administrative privileges for users and groups required for installation are missing or incorrect.

Action: Use the `id` command on each node to confirm that the `oracle` user is created with the correct group membership. Ensure that you have created the required groups, and create or modify the user account on affected nodes to establish required group membership.

See Also: ["Creating Required Operating System Groups and User"](#) in [Chapter 2](#) for instructions about how to create required groups, and how to configure the `oracle` user

Preparing to Install Oracle Clusterware with OUI

Before you install Oracle Clusterware with Oracle Universal Installer (OUI), use the following checklist to ensure that you have all the information you will need during installation, and to ensure that you have completed all tasks that must be done before starting to install Oracle Clusterware. Mark the check box for each task as you complete it, and write down the information needed, so that you can provide it during installation.

☐ Shut Down Running Oracle Processes

If you are installing Oracle Clusterware on a node that already has a single-instance Oracle Database 10g installation, then stop the existing ASM instances. After Oracle Clusterware is installed, start up the ASM instances again. When you restart the single-instance Oracle database and then the ASM instances, the ASM instances use the Cluster Synchronization Services (CSSD) Daemon instead of the daemon for the single-instance Oracle database.

You can upgrade some or all nodes of an existing Cluster Ready Services installation. For example, if you have a six-node cluster, then you can upgrade two nodes each in three upgrading sessions. Base the number of nodes that you upgrade in each session on the load the remaining nodes can handle. This is called a "rolling upgrade."

If a Global Services Daemon (GSD) from Oracle9i Release 9.2 or earlier is running, then stop it before installing Oracle Database 10g Oracle Clusterware by running the following command:

```
ORACLE_home/bin/gsdctl stop
```

where *Oracle_home* is the Oracle Database home that is running the GSD.

Caution: If you have an existing Oracle9i Release 2 (9.2) Oracle Cluster Manager (Oracle CM) installation, then *do not* shut down the Oracle CM service. Doing so prevents the Oracle Clusterware 10g Release 2 (10.2) software from detecting the Oracle9i Release 2 nodelist, and causes failure of the Oracle Clusterware installation.

Note: If you receive a warning to stop all Oracle services after starting OUI, then run the command

```
Oracle_home/bin/localconfig delete
```

where *Oracle_home* is the home that is running CSS.

☐ Prepare for Clusterware Upgrade If You Have Existing Oracle Cluster Ready Services Software

During an Oracle Clusterware installation, if OUI detects an existing Oracle Database 10g Release 1 (10.1) Cluster Ready Services (CRS), then you are given the option to perform a rolling upgrade by installing Oracle Database 10g Release 2 (10.2) Oracle Clusterware on a subset of cluster member nodes.

If you intend to perform a rolling upgrade, then you should shut down the CRS stack on the nodes you intend to upgrade, and unlock the CRS home using the script `mountpoint/clusterware/upgrade/preupdate.sh`, which is available on the 10g Release 2 (10.2) installation media.

If you intend to perform a standard upgrade, then shut down the CRS stack on all nodes, and unlock the CRS home using the script `mountpoint/clusterware/upgrade/preupdate.sh`.

When you run OUI and select the option to install Oracle Clusterware on a subset of nodes, OUI installs Oracle Database 10g Release 2 (10.2) Oracle Clusterware software into the existing CRS home on the local and remote node subset. When you run the root script, it starts the Oracle Clusterware 10g Release 2 (10.2) stack on the subset cluster nodes, but lists it as an inactive version.

When all member nodes of the cluster are running Oracle Clusterware 10g Release 2 (10.2), then the new clusterware becomes the active version.

If you intend to install RAC, then you must first complete the upgrade to Oracle Clusterware 10g Release 2 (10.2) on all cluster member nodes before you install the Oracle Database 10g Release 2 (10.2) version of RAC.

❑ Prevent Oracle Clusterware Installation Errors Caused by stty Commands

During an Oracle Clusterware installation, OUI uses SSH2 (if available) to run commands and copy files to the other nodes. If you see errors similar to the following, then you have hidden files on the system (for example, `.bashrc` or `.cshrc`) that contain `stty` commands:

```
stty: standard input: Invalid argument
stty: standard input: Invalid argument
```

If you see these errors, then stop the installation, and refer to [Chapter 2, "Preventing Oracle Clusterware Installation Errors Caused by stty Commands"](#) on page 2-14 to correct the cause of these errors.

❑ Determine the Oracle Inventory location

If you have already installed Oracle software on your system, then OUI detects the existing Oracle Inventory directory from the `/var/opt/oracle/oraInst.loc` file, and uses this location.

If you are installing Oracle software for the first time on your system, and your system does not have an Oracle inventory, then you are asked to provide a path for the Oracle inventory, and you are also asked the name of the Oracle Inventory group (typically, `oinstall`).

See Also: The pre-installation chapters in [Part II](#) for information about creating the Oracle Inventory, and completing required system configuration

❑ Obtain root account access

During installation, you are asked to run configuration scripts as the root user. You must run these scripts as root, or be prepared to have your system administrator run them for you.

❑ Decide if you want to install other languages

During installation, you are asked if you want to install additional languages other than the default.

Note: If the language set for the operating system is not supported by Oracle Universal Installer, then Oracle Universal Installer, by default, runs in the English language.

❑ **Determine your cluster name, public node names, private node names, and virtual node names for each node in the cluster**

If you install the clusterware during installation, and are not using third-party vendor clusterware, then you are asked to provide a public node name and a private node name for each node. Use your third-party vendor documentation to complete setup of your public and private domain addresses.

When you enter the public node name, use the primary host name of each node. In other words, use the name displayed by the `hostname` command. This node name can be either the permanent or the virtual host name.

In addition, ensure that the following are true:

- Determine a cluster name with the following characteristics:
 - * It must be globally unique throughout your host domain.
 - * It must be at least one character long and less than 15 characters long.
 - * It must consist of the same character set used for host names: underscores (`_`), hyphens (`-`), and single-byte alphanumeric characters (a to z, A to Z, and 0 to 9). If you use third-party vendor clusterware, then Oracle recommends that you use the vendor cluster name.
- Determine a private node name or private IP address for each node. The private IP address is an address that is accessible only by the other nodes in this cluster. Oracle Database uses private IP addresses for internode, or instance-to-instance Cache Fusion traffic. Oracle recommends that you provide a name in the format *public_hostname-priv*. For example: `myclstr2-priv`.
- Determine a virtual host name for each node. A virtual host name is a public node name that is used to reroute client requests sent to the node if the node is down. Oracle Database uses VIPs for client-to-database connections, so the VIP address must be publicly accessible. Oracle recommends that you provide a name in the format *public_hostname-vip*. For example: `myclstr2-vip`.

Note: The following is a list of additional information about node IP addresses:

- For the local node only, OUI automatically fills in public, private, and VIP fields. If your system uses vendor clusterware, then OUI may fill additional fields.
 - Host names, private names, and virtual host names are not domain-qualified. If you provide a domain in the address field during installation, then OUI removes the domain from the address.
 - Private IP addresses should not be accessible as public interfaces. Using public interfaces for Cache Fusion can cause performance problems.
-

❑ Identify shared storage for Oracle Clusterware files and prepare disk partitions if necessary

During installation, you are asked to provide paths for two files that must be shared across all nodes of the cluster, either on a shared raw device, or a shared file system file:

- The voting disk is a partition that Oracle Clusterware uses to verify cluster node membership and status.

The voting disk must be owned by the `oracle` user, must be in the `dba` group, and must have permissions set to 644. Provide at least 20 MB disk space for the voting disk.

- The Oracle Cluster Registry (OCR) contains cluster and database configuration information for the RAC database and for Oracle Clusterware, including the node list, and other information about cluster configuration and profiles.

The OCR disk must be owned by `root`, must be in the `oinstall` group, and must have permissions set to 640. Provide at least 100 MB disk space for the OCR.

If your disks do not have external storage redundancy, then Oracle recommends that you provide one additional location for the OCR disk, and two additional locations for the voting disk. Creating redundant storage locations protects the OCR and voting disk in the event of a disk failure on the partitions you choose for the OCR and the voting disk.

See Also: The pre-installation chapter in [Part II](#) for information about the minimum raw device sizes

Installing Oracle Clusterware with OUI

This section provides you with information about how to use Oracle Universal Installer (OUI) to install Oracle Clusterware. It contains the following sections:

- [Running OUI to Install Oracle Clusterware](#)
- [Installing Oracle Clusterware Using a Cluster Configuration File](#)
- [Troubleshooting Oracle Clusterware Installation Verification](#)
- [Oracle Clusterware Background Processes](#)

Running OUI to Install Oracle Clusterware

Complete the following steps to install Oracle Clusterware on your cluster. At any time during installation, if you have a question about what you are being asked to do, click the **Help** button on the OUI page.

1. Start the `runInstaller` command from the `clusterware` directory on the Oracle Database 10g Release 2 (10.2) installation media. When OUI displays the Welcome page, click **Next**.
2. Provide information or run scripts as root when prompted by OUI. If you need assistance during installation, click **Help**.
3. After you run `root.sh` on all the nodes, OUI runs the Oracle Notification Server Configuration Assistant, Oracle Private Interconnect Configuration Assistant, and Cluster Verification Utility. These programs run without user intervention.

When you have verified that your Oracle Clusterware installation is completed successfully, Oracle Clusterware installation is complete.

If you intend to install Oracle Database 10g with RAC, then continue to [Chapter 5, "Installing Oracle Database 10g with Oracle Real Application Clusters"](#). If you intend to use Oracle Clusterware by itself, then refer to the single-instance Oracle Database installation guide.

Installing Oracle Clusterware Using a Cluster Configuration File

During installation of Oracle Clusterware, on the Specify Cluster Configuration page, you are given the option either of providing cluster configuration information manually, or of using a cluster configuration file. A cluster configuration file is a text file that you can create before starting OUI, which provides OUI with information about the cluster name and node names that it needs to configure the cluster.

Oracle suggests that you consider using a cluster configuration file if you intend to perform repeated installations on a test cluster, or if you intend to perform an installation on many nodes.

To create a cluster configuration file:

1. On the installation media, navigate to the directory `Disk1/response`.
2. Using a text editor, open the response file `crs.rsp`, and find the section `CLUSTER_CONFIGURATION_FILE`.
3. Follow the directions in that section for creating a cluster configuration file.

Troubleshooting Oracle Clusterware Installation Verification

If the CVU report indicates that your Oracle Clusterware installation has a component issue, then use the topics in this section to correct the problem or problems indicated in the report, and run the CVU command again.

CSS is probably working with a non-clustered, local-only configuration on nodes:

Cause: OCR configuration error. The error message specifies the nodes on which this error is found.

This error occurs when, for each specified node, either the contents of the OCR configuration file `ocr.loc` cannot be retrieved, or the configuration key `local_only` is set to `TRUE` in the configuration file of nodes listed in the error message.

Action: Confirm that Oracle Clusterware was installed on the node. Correct the OCR configuration, if it is incorrect. Also, ensure that you have typed the node name correctly when entering the CVU command.

Unable to obtain OCR integrity details from nodes:

Cause: Unable to run the `ocrcheck` tool successfully on the nodes listed in the error message.

Action: If the `ocrcheck` tool indicates an error on only some nodes in the cluster, then OCR is not configured on that set of nodes. If the `ocrcheck` tool indicates that the OCR integrity check failed on all nodes, then the OCR storage area is corrupted. Refer to *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for instructions about how to use `ocrconfig -repair` to resolve this issue.

To configure OCR, you can use `ocrconfig -repair`, as described in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*, or you can configure OCR manually.

To configure OCR manually, as the `oracle` user, enter the following command from the `bin` directory in the CRS home:

```
$ ./ocrcheck
```

To test if the OCR storage area is corrupted, complete the following task:

1. Enter the following command:

```
ocrconfig -showbackups
```

2. View the contents of the OCR file using the following command syntax:

```
ocrdump -backupfile OCR_filename
```

3. Select a backup file, and use the following command to attempt to restore the file:

```
ocrconfig -restore backupfile
```

If the command returns a failure message, then both the primary OCR and the OCR mirror have failed.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for additional information about testing and restoring the Oracle Cluster Registry

OCR version is inconsistent amongst the nodes.

Cause: The OCR version does not match on all the cluster member nodes. Either all nodes are not part of the same cluster, or nodes do not point to the same OCR, or an OCR configuration file has been changed manually to an invalid configuration on one or more nodes.

Action: Perform the following checks:

1. Ensure that all listed nodes are part of the cluster.
2. Use the `ocrcheck` utility (`/crs/home/bin/ocrcheck`) to find the location of OCR on each node. Start `ocrcheck` with one of the following command:

As root:

```
# ocrcheck
```

As the `oracle` user, or as a user with OSDBA group privileges, from the user home directory:

```
$ /crs/home/bin/ocrcheck
```

3. Repair invalid OCR configurations by logging into a node you suspect has a faulty configuration, stopping the CRS daemon, and entering the following command:

```
ocrconfig -repair ocrmirror device_name
```

the `ocrconfig -repair` command changes the OCR configuration only on the node from which you run the command.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for information about how to use the `ocrconfig` tool to repair OCR files

Incorrect OCR version found for nodes:

Cause: the OCR version on the specified nodes does not match the version required for Oracle Database 10g Release 2 (10.2).

Action: Follow the same actions described in the preceding error message, "[OCR version is inconsistent amongst the nodes.](#)" on page 4-9.

OCR integrity is invalid.

Cause: The data integrity of the OCR is invalid, which indicates that OCR storage is corrupted.

Action: Follow the same actions described in the preceding error message, "[Unable to obtain OCR integrity details from nodes:](#)" on page 4-8.

OCR ID is inconsistent amongst the nodes.

Cause: One or more nodes list the OCR in a different location.

Action: Follow the same actions described in the preceding error message, "[OCR version is inconsistent amongst the nodes.](#)" on page 4-9.

Oracle Clusterware Background Processes

The following processes must be running in your environment after the Oracle Clusterware installation for Oracle Clusterware to function:

- `evmd`: Event manager daemon that starts the `racgevt` process to manage callouts.
- `ocssd`: Manages cluster node membership and runs as `oracle` user; failure of this process results in node restart.
- `crsd`: Performs high availability recovery and management operations such as maintaining the OCR. Also manages application resources and runs as `root` user and restarts automatically upon failure.

Installing Oracle Database 10g with Oracle Real Application Clusters

This chapter describes phase two of the installation procedures for installing Oracle Database 10g with Oracle Real Application Clusters (RAC). This chapter also describes some of the Oracle Universal Installer (OUI) features. This chapter contains the following topics:

- [Verifying System Readiness for installing Oracle Database with CVU](#)
- [Selecting a Configuration Option](#)
- [Installation of Oracle Database 10g with RAC Using Oracle Universal Installer](#)
- [De-Installing Oracle Real Application Clusters Software](#)

Verifying System Readiness for installing Oracle Database with CVU

To help verify that your system is prepared to install Oracle Database with RAC successfully, enter a Cluster Verification Utility (CVU) command using the following command syntax:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh stage -pre dbinst -n node_list [-r {10gR1|10gR2}] [-osdba osdba_group] [-verbose]
```

In the preceding syntax example:

- The variable *mountpoint* is the mountpoint of the installation media.
- The variable *node_list* is the list of nodes in your cluster, separated by commas.
- The optional flag *-r* takes the options 10gR1 (test for an Oracle Database 10g Release 1 Oracle Cluster Ready Services installation) or 10gR2 (test for an Oracle Database 10g Release 2 Oracle Clusterware installation); if the *-r* flag is missing, by default, the command tests for Oracle Clusterware for Oracle Database 10g Release 2 (10.2) installation.
- The variable *osdba_group* is the name of your OSDBA group, which by default is *dba*.

For example, to perform a pre-installation check for Oracle Database 10g Release 2 (10.2) with RAC installation on a two-node cluster with the mountpoint */dev/dvdrom*, with nodes *node1* and *node2*, and with the OSDBA group *dba*, enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh stage -pre dbinst -n node1,node2 -verbose
```

Oracle recommends that you select the option `-verbose` to receive progress updates as the CVU performs its system checks. The `-verbose` option provides detailed test reporting, which you can use to identify the cause of any checks that fail.

If the cluster verification check fails, then review and correct the relevant system configuration steps, and run the test again. Use the system configuration checks described in ["Troubleshooting Installation Setup for HP Tru64"](#) (which follows this section) to assist you.

Troubleshooting Installation Setup for HP Tru64

If you run the CVU and your system fails system configuration checks, then review the the CVU report, and use the output to resolve failed configuration checks. Refer to the following list to assist you with responding to failed checks.

User Equivalence Check Failed

Cause: Failure to establish user equivalency across all nodes.

Action: Check user equivalence on each node for the `oracle` account.

Check for user equivalence for the `oracle` account by performing a remote login (`rlogin`) to each node in the cluster. For example:

```
# su - oracle
$ rlogin node_name
```

If you are prompted for a password, then you have not given the `oracle` account the same attributes on all nodes.

Check permissions on each node to ensure that the `oracle` account can write to the new mount points. For example:

```
# su - oracle
$ touch /u01/test
$ ls -l /u01/test
-rw-rw-r-- 1 oracle dba 0 Aug 15 09:36 /u01/test
```

As the `oracle` user, use SSH2 to connect from each node to itself, and from each node to each other node. For example, to check a two-node cluster with nodes named `node1` and `node2`:

```
[oracle@node1 oracle]:$ ssh2 node1
[oracle@node1 oracle]:$ ssh2 node2
[oracle@node2 oracle]:$ ssh2 node2
[oracle@node2 oracle]:$ ssh2 node1
[oracle@node1 oracle]:$
```

If you are prompted for a password when logging in as the `oracle` user from one node to another in the cluster, then improper SSH configuration is a probable cause. Check to ensure that you have turned off X11 forwarding, and that the `~/ .ssh/id_rsa` and `~/ .ssh/dsa.pub` files for all nodes are listed in the `~/ .ssh/authorized_keys` file that you create during pre-installation.

See Also: ["Configuring SSH on All Cluster Nodes"](#) in [Chapter 2](#), ["Pre-Installation Tasks"](#) on page 2-11

Node Reachability Check Failed

Cause: Failure of one or more nodes to be properly connected for communication.

Action: Possible causes of this message include the following:

- Improper network configuration.
- The node running CVU is unable to connect to one or more nodes in the cluster.

Use the following command to check your current configuration on each node:

```
ifconfig -a
```

See Also: ["Checking the Network Requirements" in Chapter 2, "Pre-Installation Tasks"](#) on page 2-18

Node Connectivity Check Failed

Cause: One or more of the cluster nodes is not able to be connected from all nodes in the cluster.

Action: Check for firewalls preventing the nodes from communicating on their private network interfaces.

User Existence Check Failed or User-Group Relationship Check Failed

Cause: The administrative privileges for users and groups required for installation are missing or incorrect.

Action: Use the `id` command on each node to confirm that the `oracle` account is created with the correct group membership.

See Also: ["Creating Required Operating System Groups and User" in Chapter 2, "Pre-Installation Tasks"](#) on page 2-5

Shared Storage Check Failed

Cause: Shared storage access from each node in the cluster is not confirmed.

Action: If you are using shared disk storage, then as root, use the command `fdisk -l` to confirm the reachability of shared storage.

System Requirements Check Failed

Cause: Insufficient system resources, missing software packages, or other operating system or hardware problem.

Action: If you did not run the CVU command with the `-verbose` option, then run the command again using `-verbose`, and review the report to determine which system requirement failed. Correct the problem.

See Also: [Chapter 2, "Pre-Installation Tasks"](#) contains instructions for completing any system requirement configuration that CVU lists as incomplete

Selecting a Configuration Option

This section describes OUI features that you should understand before beginning phase two of the RAC installation process.

See Also: [Appendix D, "Converting to Oracle Real Application Clusters from Single-Instance Oracle Databases"](#) for information about how to convert single-instance databases to RAC

On the Select Configuration page, you are given the following options:

- **Create a database:** Provides you with the option to create a database using a preconfigured database template designed for particular system load demands, as described in the section "[Database Configuration Type Descriptions](#)" on page 5-4. If you select the Automatic Storage Management option for storage, then an ASM instance is installed as part of the database installation. The Oracle home is used for the ASM home when you install the database using this method. If you plan to use the ASM instance for multiple database homes, you should select the Configure Automatic Storage Management option to create a separate ASM home.
- **Configure Automatic Storage Management:** Installs an ASM instance only. You are prompted for the ASM SYS password.
- **Install database software only:** Installs Oracle Database software; you must complete database configuration later.

If you are installing Oracle Database software, then Oracle recommends that you use one of the preconfigured database options, or select the **Advanced** option on the Select Configuration page, and configure a custom starter database.

If you want to configure your environment and create your database manually, then select **Do not create a database** on the Select Configuration page, and refer to the manual database creation procedures posted at the following Web site:

<http://otn.oracle.com>

Automatic Storage Management Configuration

If you want to use Automatic Storage Management, then select **Configure Automatic Storage Management (ASM)**, and provide information as prompted. Click **Help** if you need assistance.

Database Configuration Type Descriptions

When you run OUI, you can select the **General Purpose**, **Transaction Processing**, **Data Warehouse**, or **Advanced** database configuration type.

For the first three configuration types, you can complete additional procedures that are described later in this chapter. If you select Advanced configuration, then you can use Database Configuration Assistant (DBCA) to create the database as described in [Chapter 6](#). Oracle recommends that you use DBCA to create your database.

General Purpose, Transaction Processing, and Data Warehouse Configuration Types

The General Purpose, Transaction Processing, and Data Warehouse configuration types use preconfigured database templates.

During installation, if you select one of the preconfigured database templates, then OUI starts Oracle Network Configuration Assistant (NETCA) and DBCA, and installs the preconfigured database without further input. During database installation, OUI displays a progress indicator.

DBCA processing for these three configuration types creates a starter database, and configures the Oracle network services. If you choose raw devices on the Specify Database File Storage Option page, then DBCA verifies that you configured the raw devices for each tablespace.

If you select Advanced configuration, then you must enter specific information as described in the next section.

Using the Advanced Configuration Type

If you select the Advanced configuration type, then OUI runs DBCA, which displays General Purpose, Transaction Processing, Data Warehouse, and a fourth configuration type, Custom Database.

The first three templates are customizable versions of the preconfigured database types. The Custom Database type creates a database without using preconfigured options.

The following section provides more detail about OUI and DBCA processing when creating a RAC database.

Actions of OUI, DBCA, and Other Assistants During Installation

After installation, OUI starts the NETCA. After the NETCA completes its processing, OUI runs DBCA to create your database using Optimal Flexible Architecture (OFA). This means that DBCA creates your database files, including the default server parameter file (SPFILE), using standard file naming and file placement practices. The primary phases of DBCA processing are the following:

- Verify that you correctly configured the shared disks for each tablespace if you are using raw storage.
- Create the database.
- Configure the Oracle network services.
- Start the listeners and database instances.

You can also use DBCA in standalone mode to create a database.

See Also: *Oracle Database Net Services Administrator's Guide* if you experience problems (for example, with the listener configuration), and for further information about Lightweight Directory Access Protocol (LDAP) support

You can use your Oracle9i database language and territory definition files with Oracle Database 10g Release 2 (10.2) that you are about to install. To enable these functions, you must run OUI from a command line, as described in step 1 in "[Installation of Oracle Database 10g with RAC Using Oracle Universal Installer](#)" on page 5-5, and use the following statement to set the `b_cr9idata` variable to true:

```
runInstaller oracle.rsfnlsrtl_rsf:b_cr9idata=true
```

The remainder of this chapter explains how to use OUI to install Oracle Database 10g with Oracle Real Application Clusters (RAC).

Installation of Oracle Database 10g with RAC Using Oracle Universal Installer

Perform the following procedures to install the Oracle Database 10g software with RAC:

1. Start the `runInstaller` command from the DB directory of the Oracle Database 10g Release 2 (10.2) installation media. When OUI displays the Welcome page, click **Next**.
2. Provide information or run scripts as root when prompted by OUI. If you need assistance during installation, click **Help**. If you encounter problems during

installation, then examine the OUI actions recorded in the installation log file. The log file is located in the Oracle Inventory directory (typically, `oinstall`), in the following location:

`OraInventory/logs/installActionsdate_time.log`

Note: The Oracle home name and path that you provide during database installation *must be different* from the home that you used during the Oracle Clusterware installation in phase one. You *must not* install Oracle Database 10g with RAC software into the same home in which you installed the Oracle Clusterware software.

The following is a list of additional information to note about installation:

- If you are not using the ASM library driver (ASMLIB), and you select Automatic Storage Management (ASM) during installation, then ASM default discovery finds all disks that ASMLIB marks as ASM disks.
- If you are not using ASMLIB, and you select ASM during installation, then ASM default discovery finds all disks marked `/dev/raw/*` for which the `oracle` account has read/write permission. You can change the disk discovery string during the install if the disks you want to use for ASM are located elsewhere.

If you are installing RAC from the Standard Edition, then you must use ASM for your database storage.

On the Select Database Management Option page, if you have already completed the Grid Control Management Agent installation, then you can select either Grid or Local Database control. Otherwise, only Local Database control for database management is supported for RAC. When you use the local Database Control, you can choose the E-mail option and enter the outgoing SMTP server name and E-mail address.

If you perform an installation that does not include Oracle Enterprise Manager (for example, a custom software install without Enterprise Manager, an installation with no Enterprise Manager configuration, or a database creation with your own scripts), then you can configure Enterprise Manager later with OUI, DBCA, or the Enterprise Manager Configuration Assistant (EMCA) utility.

See Also: *Enterprise Manager Grid Control Installation and Basic Configuration* for details about installing Grid Control with OUI, and *Enterprise Manager Advanced Configuration Guide* for details about installing Database Control with DBCA and EMCA

When you have completed the second and final phase of the installation, proceed to [Chapter 7, "Oracle Real Application Clusters Post-Installation Procedures"](#) to perform the post-installation tasks.

Caution: After installation is completed and you have created the database, if you decide that you want to install additional Oracle Database 10g products in the 10g Release 2 (10.2) database, then you must stop *all* processes running in the Oracle home before you attempt to install the additional products. For the Oracle Universal Installer to relink certain executables and libraries, all database processes must be down. Refer to [Appendix F, "How to Stop Processes in an Existing Oracle Real Application Clusters Database, and How to Perform Oracle Clusterware Rolling Upgrades"](#) for additional information.

De-Installing Oracle Real Application Clusters Software

If you need to de-install Oracle Real Application Clusters (RAC) software, then you must run OUI to de-install the software on the same node from which you performed the installation, and you must de-install Oracle Database software first before de-installing Oracle Clusterware software.

Perform the following procedures to de-install Oracle Database 10g RAC and Oracle Clusterware software, as described in the following sections:

- [De-Installing Oracle Database 10g RAC Software and ASM](#)
- [De-Installing Oracle Clusterware](#)

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about using RAC scalability features of adding and deleting nodes and instances from RAC databases, and for information about viewing OCR content

De-Installing Oracle Database 10g RAC Software and ASM

This section describes the procedure to de-install the Oracle Database 10g RAC software and Automatic Storage Management (ASM) software. Before you perform these steps, Oracle recommends that you make a backup of any databases that run from the Oracle home you are about to delete.

1. Examine the `oratab` file to identify the instance dependencies on this Oracle home.
2. Start DBCA, select **Oracle Real Application Clusters Database**, select Delete a database, and select the database that you want to delete. Repeat this step to delete all databases.
3. If you do not use ASM, then proceed to step 4.

If the database is in the Oracle home from which the ASM database runs, then ensure that there are no other database dependencies on these group of ASM instances, and then remove the ASM configuration by logging on as the `oracle` user and completing the following steps:

- a. Connect to the ASM instance and run the following command to determine database instances using this ASM instance:

```
SQL> select INSTANCE_NAME from GV$ASM_CLIENT;
```

Note: This command lists only database instances that are running. It is possible that other instances are associated with the ASM instance, but they are not currently running. If you removed a database from this Oracle home but the output from the command shows that this ASM instance is supporting a database instance in another Oracle home, then do not remove the ASM instance or the Oracle home.

If your RAC database uses a different Oracle home from the Oracle home that your ASM environment uses, and you want to delete the RAC database, then perform step 5 in the RAC database home.

- b. For each instance listed in the output of the statement you run in step a, stop the respective databases.
- c. Oracle recommends that you back up the database files for all the databases that are currently using this ASM instance.
- d. Using your connection to the ASM instance, run the following command:

```
SQL> select * from V$ASM_DISKGROUP;
```

- e. For each disk group listed in the output of the statement you run in step d, run the following command:

```
SQL> drop diskgroup diskgroup_name including contents;
```

The variable *diskgroup_name* is the name of the disk group that you want to delete.

- f. Shut down ASM on all RAC nodes, and verify that all ASM instances are stopped.
- g. If you are de-installing from a system with ASMLIB, then run the following procedure. First, run this command to list the disks that you need to delete:

```
oracleasm listdisks
```

Second, run the following command to delete every disk listed by the previous command:

```
oracleasm deletedisks
```

Third, re-run the `oracleasm listdisks` command to confirm that the disks are all deleted. Repeat this command on each of the RAC cluster nodes to confirm that the disks have been deleted from all the nodes.

Fourth, as root, run the following commands on all nodes of your RAC cluster:

```
/etc/init.d/oracleasm stop  
/etc/init.d/oracleasm disable
```

- h. Deconfigure ASM, using either DBCA in silent mode, or performing deconfiguration manually.

To deconfigure ASM manually, complete steps i through l.

To deconfigure ASM using DBCA, run DBCA in silent mode to deconfigure ASM. To run DBCA in silent mode, navigate to the directory `$ORACLE_HOME/bin` and use the following command syntax:

```
dbca -silent -deleteASM -nodelist node1,node2,...
```

for the variables *node1*, *node2*, and so on, provide a list of all the nodes where ASM is configured. When DBCA completes de-installation, proceed to step 4.

- i. To remove the ASM entry from the OCR, run the following command for all nodes on which this Oracle home exists:

```
srvctl remove asm -n nodename
```

where *nodename* is the name of a node from which you want to remove the ASM instance.

- j. If you are using a shared cluster file system for your Oracle home, then run the following commands on the local node:

```
rm -f $ORACLE_HOME/dbs/*ASM*
rm -r $ORACLE_BASE/admin/+ASM
```

You may need to remove subordinate files or directories before these commands complete successfully.

- k. If you are not using a shared cluster file system for your Oracle home, then run the commands from the previous step, step j, on *each* node on which the Oracle home exists.
 - l. Remove `oratab` entries for the deleted Oracle home databases.
4. If there are no outstanding dependencies, then change directory to the `$ORACLE_HOME/bin` directory, and use the following NETCA command syntax to remove the listener and its Oracle Clusterware resources.

```
$ ./netca /deinst /nodeinfo node1,node2,...
```

In the preceding syntax example, replace the variables *node1*, *node2*, and so on, with all the member nodes of the RAC database.

Note: You cannot perform a RAC installation from the same OUI session in which you perform a RAC de-installation. In other words, if you de-install RAC with OUI and want to perform another RAC installation, then you must start a new OUI session.

5. Start OUI, and remove any existing Oracle Database 10g with RAC software by selecting **Deinstall Products**, and selecting the Oracle home that you want to remove. If any of these databases is an ASM database, then de-install the Oracle home with ASM where you want to de-install the Oracle Database software, and then de-install the Oracle Database. Removing ASM does not remove the ASM data or disk groups.

De-Installing Oracle Clusterware

De-install each Oracle Database 10g RAC home by running the procedure in the previous section, ["De-Installing Oracle Database 10g RAC Software and ASM"](#). Then complete the de-installation by removing the Oracle Clusterware software using the following procedures:

1. Run the command `CRS_home/install/rootdelete.sh` to disable the Oracle Clusterware applications that are running on the cluster node. The

`rootdelete.sh` script requires three arguments. If you are running this command on a remote node of the cluster, then use `remote` as the first argument, otherwise use `local` as the first argument. If the `ocr.loc` file is on a shared file system, then use `sharedvar`. Otherwise use `nosharedvar` as the second argument. If the Oracle Clusterware home is on a shared file system, then use `sharedhome`. Otherwise, use `nosharedhome` as the third argument. Repeat this step on each node of the cluster from which you want to de-install Oracle Clusterware.

Note: A node is a local node if you plan to run step 2 and step 3 on that node. Removing shared OCR contents and the Oracle Clusterware home is done on the local node after you complete removal of other nodes in the cluster.

2. Run the script `CRS_home/install/rootdeinstall.sh` on a local node to remove the OCR. You only need to run this script once.
3. Start OUI. In the Welcome page, click **Deinstall Products** to display the list of installed products. Select the Oracle Clusterware home to de-install.

Creating Oracle Real Application Clusters Databases with Database Configuration Assistant

This chapter describes how to use Database Configuration Assistant (DBCA) in standalone mode to create and delete Real Application Clusters (RAC) databases. The topics in this chapter include the following:

- [Using Database Configuration Assistant in Oracle Real Application Clusters](#)
- [Benefits of Using Database Configuration Assistant](#)
- [Oracle Real Application Clusters High Availability Services](#)
- [Automatic Listener Migration from Release 10.1 to 10.2](#)
- [Verifying Requirements for DBCA](#)
- [Creating an Oracle Real Application Clusters Database with DBCA](#)
- [Deleting an Oracle Real Application Clusters Database with DBCA](#)

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for procedures on using Database Configuration Assistant (DBCA) to add and delete instances

Using Database Configuration Assistant in Oracle Real Application Clusters

DBCA has the following primary functions:

- Create the database and its instances
- Set up network configuration for database, instances and database services
- Register the database in Oracle Enterprise Manager Grid Control or configure Database Control
- Configure Automatic Storage Management (ASM)
- Start up the database, its instances, services, and any other node applications

See Also:

- ["Creating an Oracle Real Application Clusters Database with DBCA"](#) on page 6-4 for more information about using DBCA in standalone mode
- *Oracle Database Net Services Administrator's Guide* to resolve problems—for example, with the listener configuration—and for further information about Lightweight Directory Access Protocol (LDAP)-compliant directory support

Benefits of Using Database Configuration Assistant

Oracle recommends that you use Database Configuration Assistant (DBCA) to create your RAC database, because preconfigured databases optimize your environment for features such as Automatic Storage Management (ASM), the server parameter file (SPFILE), and automatic undo management. DBCA also provides pages to create new ASM disk groups if they are needed. If you use ASM or cluster file system storage, then DBCA also configures automated backup, which uses the flash recovery area.

With DBCA, you can create site-specific tablespaces as part of database creation. If you have data file requirements that differ from those offered by DBCA templates, then create your database with DBCA and modify the data files later. You can also run user-specified scripts as part of your database creation process.

DBCA also configures your RAC environment for various Oracle high availability features, such as services and cluster administration tools. It also starts any database instances required to support your defined configuration.

Oracle Real Application Clusters High Availability Services

When you configure high availability services with the DBCA Database Services page, you can also configure service instance preferences and Transparent Application Failover (TAF) policies.

Service Configuration and Instance Preferences

Use the Database Services page button in the column labeled Not Used, Preferred, or Available to configure service instance preferences as described in the following list:

- Preferred—The service runs primarily on the selected instance.
- Available—The service may run on the instance if a preferred instance fails.
- Not Used—The service never runs on the instance.

Note: You can assign services to run on multiple preferred instances, and fail over to multiple available instances.

After you have created the database, you can configure service instance preferences through Oracle Enterprise Manager Database Control or Grid Control.

Transparent Application Failover Policies

Use the DBCA Database Services page to configure TAF failover policies. The DBCA Database Services page also has a TAF policy selector row under the instance

preference display. Select one of the following options in this row for your failover and reconnection policy preference:

- None—Do not use TAF.
- Basic—Establish connections at failover time.

Automatic Listener Migration from Release 10.1 to 10.2

If your system has an Oracle Database Release 10g Release 10.1 installation, and you install an Oracle Database 10g Release 2 (10.2) either to coexist with or to upgrade the Oracle Database 10.1 installation, then most installation types automatically migrate the Oracle Database 10.1 listener to the 10g Release 2 (10.2) Oracle home. During migration, they configure and start a default Oracle Net listener using the same TCP/IP port as the existing listener, with the IPC key value EXTPROC. This process occurs through one of the following scenarios:

- During a coexisting installation, Database Configuration Assistant (DBCA) automatically migrates the listener and related files from the 10.1 Oracle home to the 10.2 Oracle home.
- During an upgrade, Oracle Database Upgrade Assistant (DBUA) automatically locates the Oracle 10g release 1 (10.1) listener, and migrates it to Oracle 10g release 2.

The listener migration process stops the listener in the existing Oracle home, and restarts the listener from the new Oracle home. During migration, client applications may not be able to connect to any databases that are registered to the listener that is being migrated.

Verifying Requirements for DBCA

To help to verify that your system is prepared to create Oracle Database with RAC successfully, enter a Cluster Verification Utility (CVU) command using the following command syntax:

```
/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh stage -pre dbcfg -n node_list -d
oracle_home [-verbose]
```

In the preceding syntax example, the variable *mountpoint* is the mountpoint of the installation media, the variable *node_list* is the list of nodes in your cluster, separated by commas, and the variable *oracle_home* is the path for the Oracle home directory where OUI creates or modifies the database.

For example, to perform a check to determine if your system is prepared for an Oracle Database with RAC on a two-node cluster with nodes *node1* and *node2*, with the mountpoint */dev/dvdrom/*, and with the Oracle home path */oracle/product/10.2.0*, enter the following command:

```
/dev/dvdrom/crs/Disk1/cluvfy/runcluvfy.sh stage -pre dbcfg -n node1,node2 -d
/oracle/product/10.2.0/
```

You can select the option *-verbose* to receive progress updates as the CVU performs its system checks, and detailed reporting of the test results.

If the CVU summary indicates that the cluster verification check fails, then review and correct the relevant system configuration steps, and run the test again.

The command `runcluvfy.sh stage -pre dbcfg` verifies the following:

- Node Reachability: All the specified nodes are reachable from the local node.

- User Equivalence: User equivalence exists on all the specified nodes.
- Node Connectivity: Connectivity exists between all the specified nodes through the available public and private network interfaces.
- Administrative Privileges: The `oracle` user has proper administrative privileges on the specified nodes for creating a RAC database.
- Oracle Clusterware Integrity: All the components of the Oracle Clusterware stack are fully operational.

Creating an Oracle Real Application Clusters Database with DBCA

To create a database with DBCA in standalone mode without ASM or a cluster file system, you must have configured shared storage as described in [Chapter 3](#). In addition, you must have run the Oracle Net Configuration Assistant (NETCA) to configure your Oracle Net `listener.ora` file.

If you select DBCA templates that use preconfigured data files and if you do not use ASM or a cluster file system, then during database creation, DBCA first verifies that you created the raw devices for each tablespace. If you have not configured the raw devices, then you must configure the raw devices and replace the default data file names that DBCA provides with raw device names on the DBCA Storage page to continue database creation.

To start DBCA, connect as the `oracle` user to one of your nodes where RAC is installed, and enter the command `dbca` command from the `$ORACLE_HOME/bin` directory.

When you start DBCA, the first page it displays is the Welcome page for RAC, which includes the option to select an Oracle Real Application Clusters (RAC) database. DBCA displays this RAC-specific Welcome page only if the Oracle home from which it is started was cluster-installed.

If DBCA does not display the Welcome page for RAC, then DBCA was unable to detect if the Oracle home is cluster-installed. In this case, check that the OUI inventory is correctly located in the directory `/var/opt/oracle/oraInst.loc`, and that the `oraInventory` file is not corrupted. Also, perform clusterware diagnostics by running the CVU command `/mountpoint/crs/Disk1/cluvfy/runcluvfy.sh stage -post crsinst -n nodename`.

If the RAC Welcome page opens, then provide information as prompted by DBCA. Click **Help** if you need assistance.

Note the following important information when using DBCA:

- If nodes that are part of your cluster installation do not appear on the Node Selection page, then run the `olsnodes` command to perform inventory diagnostics and clusterware diagnostics.
- The global database name can be up to 30 characters in length, and must begin with an alphabetic character. The SID prefix must begin with an alphabetic character.
- The maximum number of characters you can use for the SID prefix is 8 characters. DBCA uses the SID prefix to generate a unique value for the variable `ORACLE_SID` for each instance.
- On the Management Options page, if you select the option **Enterprise Manager with the Grid Control**, and DBCA discovers agents. If you select the option **Database Control**, then you can set up e-mail notification and enable daily backup

operations. For e-mail notifications, you provide the outgoing mail server and e-mail address. For daily backups, you enter the backup time and operating system credentials for the user that performs backup operations.

- To use a flash recovery area, Oracle recommends that you create two separate ASM disk groups: one for the database area and one for the recovery area.

See Also: *Oracle Database Concepts* for more information about using a flash recovery area

- On the ASM Disk Groups page, if you do not see the disks that you want to add, then click **Change Disk Discovery Path** to alter the search path used by DBCA to find available disks. You can select disks with a status of `Candidate` or `Former` (never used in an ASM disk group or no longer in a group) by selecting the check box. If you want to add disks that still have ASM disk headers, but the disk group is no longer in use (a case that can occur if you are selecting disks after an aborted install, a de-install performed without dropping the disk group, or other configuration problems), then use the `Force` command.

- If DBCA displays the following message:

The file `oracle_home/bin/oracle` does not exist on node `node_name`.
Make sure that file exists on these nodes before proceeding.

This message means that the Oracle home from which the first ASM instance in the cluster runs is not installed on these cluster nodes. You must extend the ASM Oracle home to these nodes by performing the procedure documented in "Step 4: Adding Nodes at the Oracle RAC Database Layer" in the *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*. However, do not perform Step 5 in that section. OUI extends the ASM Oracle home to the selected nodes and performs any configuration required for running an ASM instance on these nodes.

- If DBCA displays the following message:

Please run the DBCA from one of the nodes that has an existing ASM instance `node_list`.

This message means that you are attempting to create a RAC database using ASM storage, but the ASM instance does not exist on the node from which you ran DBCA. However, ASM instances do exist on the remote nodes that appear in the message node list. In this case, DBCA cannot clone the existing ASM instance from the remote node to the local node. To correct this, start DBCA from one of the nodes shown in the node list to create your RAC database using ASM storage. This copies the local node's ASM instance and modifies its parameters and attributes to create ASM instances on the nodes in your cluster that do not have ASM instances.

- On the Recovery Configuration page, if you are using ASM or cluster file system storage, then you can also select the flash recovery area and size on the Recovery Configuration page. If you are using ASM, then the flash recovery area defaults to the ASM Disk Group. If you are using OCFS, then the flash recovery area defaults to `$ORACLE_BASE/flash_recovery_area`.
- On the Initialization Parameters page, set the value of the `CLUSTER_DATABASE_INSTANCES` parameter to the number of instances you intend to use in the cluster if you are not including all the related nodes during the current execution of DBCA.

In addition, if your global database name is longer than 8 characters, then the database name value (in the `db_name` parameter) is truncated to the first 8 characters, and the `DB_UNIQUE_NAME` parameter value is set to the global name.

After you respond to DBCA prompts, review the Summary dialog information and click **OK**, DBCA does the following:

- Creates an operative RAC database and its instances
- Creates the RAC data dictionary views
- Configures the network for the cluster database
- Migrates Oracle Database 10g Release 1 (10.1) listener and related files to the 10.2 Oracle home
- Starts the listeners and database instances, and then starts the high availability services
- Configures Enterprise Manager Database Control or Grid Control

Caution: After you have created the database, if you decide that you want to install additional Oracle Database 10g products in the 10g Release 2 (10.2) database you have created, then you must stop *all* processes running in the Oracle home before you attempt to install the additional products. For the Oracle Universal Installer to relink certain executables and libraries, all database processes must be down. Refer to [Appendix F, "How to Stop Processes in an Existing Oracle Real Application Clusters Database, and How to Perform Oracle Clusterware Rolling Upgrades"](#) for additional information.

Deleting an Oracle Real Application Clusters Database with DBCA

This section explains how to delete a RAC database with DBCA. This process deletes a database and removes a database's initialization parameter files, instances, OFA structure, and an Oracle network configuration. However, this process does not remove data files if you placed the files on raw devices or on raw partitions.

To delete a database with DBCA:

1. Start DBCA on one of the nodes.
 - Run the DBCA command from the `$ORACLE_HOME/bin` directory.The DBCA Welcome page appears.
2. Select **Oracle Real Application Clusters**, and click **Next**.

After you click **Next**, DBCA displays the Operations page.
3. Select **Delete a database**, and click **Next**. DBCA displays the List of Cluster Databases page.
4. If your user ID and password are not operating-system authenticated, then the List of Cluster Databases page displays the user name and password fields. If these fields appear, then enter a user ID and password that has SYSDBA privileges.
5. Select the database to delete, and click **Finish**.

After you click **Finish**, DBCA displays a dialog box to confirm the database and instances that DBCA is going to delete.

6. Click **OK** to begin the deletion of the database and its associated files, services, and environment settings, or click **Cancel** to stop the operation.

When you click **OK**, DBCA continues the operation and deletes all the associated instances for this database. DBCA also removes the parameter files, password files, and `oratab` entries.

At this point, you have accomplished the following:

- Deleted the selected database from the cluster
- Deleted high availability services that were assigned to the database
- Deleted the Oracle Net configuration for the database
- Deconfigures Database Control
- Deleted the OFA directory structure from the cluster
- Deleted the data files if the data files were not on raw devices

Oracle Real Application Clusters Post-Installation Procedures

This chapter describes how to complete the post-installation tasks after you have installed the Oracle Database 10g with Oracle Real Application Clusters (RAC) software. It contains the following sections:

- [Required Post-Installation Tasks](#)
- [Recommended Post-Installation Tasks](#)
- [Additional Postinstallation Tasks for Tru64](#)

Note: This chapter describes only basic configurations. Refer to *Oracle Database 10g Administrator's Guide for UNIX Systems*, and the product administration and tuning guides for more detailed configuration and tuning information.

Required Post-Installation Tasks

You must perform the following tasks after completing your installation:

- [Back Up the Voting Disk After Installation](#)
- [Download and Install Patch Updates](#)
- [Configure Oracle Products](#)
- [Relocate Instance-related Memory-mapped files from OCFS Using Symbolic Links](#)

Back Up the Voting Disk After Installation

After your Oracle Database 10g with RAC installation is complete and after you are sure that your system is functioning properly, make a backup of the contents of the voting disk. Use the `dd` utility.

Also, make a backup copy of the voting disk contents after you complete any node additions or node deletions, and after running any deinstallation procedures.

Download and Install Patch Updates

Refer to the *OracleMetaLink* Web site for required patch updates for your installation. To download required patch updates:

1. Use a Web browser to view the *OracleMetaLink* Web site:

<http://metalink.oracle.com>

2. Log in to *OracleMetaLink*.

Note: If you are not an *OracleMetaLink* registered user, then click **Register for MetaLink** and register.

3. On the main *OracleMetaLink* page, click **Patches**.
4. On the Select a Patch Search Area page, click **New MetaLink Patch Search**.
5. On the Simple Search page, click **Advanced**.
6. On the Advanced Search page, click the search icon next to the Product or Product Family field.
7. In the Search and Select: Product Family field, enter RDBMS Server in the **For** field, and click **Go**.
8. Select **RDBMS Server** under the Results heading, and click **Select**.
RDBMS Server appears in the Product or Product Family field. The current release appears in the Release field.
9. Select your platform from the list in the Platform field, and click **Go**.
10. Any available patch updates appear under the Results heading.
11. Click the number of the patch that you want to download.
12. On the Patch Set page, click **View README** and read the page that appears. The README page contains information about the patch set and how to apply the patches to your installation.
13. Return to the Patch Set page, click **Download**, and save the file on your system.
14. Use the unzip utility provided with Oracle Database 10g to uncompress the Oracle patch updates that you downloaded from *OracleMetaLink*. The unzip utility is located in the `$ORACLE_HOME/bin` directory.

Configure Oracle Products

Many Oracle products and options must be configured before you use them for the first time. Before using individual Oracle Database 10g database products or options, refer to the manual in the product documentation library which is available in the DOC directory on the 10g Release 2 (10.2) installation media, or on the OTN Web site.

Relocate Instance-related Memory-mapped files from OCFS Using Symbolic Links

If you install RAC on a standard local file system, then this section does not concern you.

If your RAC database is created on Oracle Cluster File System version 1 (OCFS1), and the memory-mapped files `hc_*.dat` (which typically reside in the path `$ORACLE_HOME/dbs`) are placed on an OCFS1 file system, then you must relocate the memory-mapped files to a standard local file system on each node of the cluster after installation. This is because OCFS1 is not a general purpose file system, and cannot hold these memory-mapped instance files.

To relocate the files:

1. Stop the Oracle Database instance.

2. Move the `$ORACLE_HOME/dbs/hc_*.dat` files to a directory on a local file system.
3. Create symbolic links from the `$ORACLE_HOME/dbs` directory to the `hc_*.dat` files on the local file system.
4. Restart the Oracle Database instance

Recommended Post-Installation Tasks

This section explains the tasks that Oracle recommends you perform after completing an installation.

- [Verifying Oracle Enterprise Manager Operations](#)
- [Recommended Post-Installation Tasks](#)
- [Logging in to Oracle Enterprise Manager Database Control](#)

Verifying Oracle Enterprise Manager Operations

Run the following command to verify the Oracle Enterprise Manager configuration in your newly-installed Oracle Real Application Clusters environment:

```
srvctl config database -d db_name
```

SRVCTL displays the name of the node and the instance for the node. The following example shows a node named `db1-server` running an instance named `db1`. Run the following command:

```
srvctl config database -d db
```

The output should be similar to the following:

```
db1-server db1 /private/system/db
db2-server db2 /private/system/db
```

Continue with the following section, "[Recommended Post-Installation Tasks](#)". When you have completed these tasks, you should proceed with the initial configuration tasks described in [Part IV](#).

Recommended Post-Installation Tasks

Oracle recommends that you complete the following tasks after installing RAC:

- [Back Up the root.sh Script](#)
- [Set Up Users Accounts](#)
- [Set the ORACLE_HOME and ORACLE_SID Environments](#)

Back Up the root.sh Script

Oracle recommends that you back up the `root.sh` script after you complete an installation. If you install other products in the same Oracle home directory, then the Oracle Universal Installer (OUI) updates the contents of the existing `root.sh` script during the installation. If you require information contained in the original `root.sh` script, then you can recover it from the `root.sh` file copy.

Set Up Users Accounts

For information about setting up additional optional user accounts, refer to the *Oracle Database 10g Administrator's Guide for UNIX Systems*.

When you complete these procedures, you are ready to perform the initial configuration tasks described in [Part IV](#).

Set the ORACLE_HOME and ORACLE_SID Environments

To ensure that you can use Oracle tools such as SQL*Plus to connect to the database, Oracle recommends that you set the ORACLE_HOME and ORACLE_SID environment variables to the correct Oracle home and Oracle SID that you configured during installation.

Logging in to Oracle Enterprise Manager Database Control

If you configure Oracle Enterprise Manager Database Control during installation, then you can use it to manage your database. Alternatively, you can use Oracle Enterprise Manager Grid Control to manage your database.

To use Database Control, you must access it on the node where you installed the database. If you want to log into Database Control from another cluster node, then you need to reconfigure Enterprise Manager to start the Database Control interface on that other node.

See Also: the emca command line help for instructions to perform reconfiguration

Use the following instructions to log in to Database Control:

1. On the node from which you installed the database, open a Web browser to access the Database Control URL, and use the following URL syntax:

`http://host:port/em`

In the preceding example:

- *host* is the name of the computer on which you installed Oracle Database
- *port* is the port number reserved for the Database Control or Grid Control during installation

If you do not know the correct port number to use, then look for the following line in the file `$ORACLE_HOME/install/portlist.ini`, which lists the assigned port:

```
Enterprise Manager Console HTTP Port (db_name) = 1158
```

The installation reserves the first available port from the range 5500 to 5519.

For example, if you install Oracle Database on host `mgmt42`, and the Database Control uses port 1158, then use the following URL:

`http://mgmt42:1158/em`

Oracle Enterprise Manager displays the Database Control login page.

2. Log in to the database using the user name SYS and connect as SYSDBA.
Use the password that you specified for the SYS account during the installation.

Note: You can also log in to the Database Control using the SYSTEM or SYSMAN accounts, or you can grant login privileges to other database users.

Additional Postinstallation Tasks for Tru64

After installation, to create or add additional raw partitions, use the following procedures.

Creating a New Partitions to a New Database

To create a new partition, from SQL*Plus enter the following command:

Note: The size of an Oracle datafile created in a raw partition must be at least 64 KB plus one Oracle block size smaller than the size of the raw partition.

```
SQL> CREATE DATABASE sid
      2 LOGFILE '/oracle_data/log1.dbf' SIZE 100K
      3 '/oracle_data/log2.dbf' SIZE 100K
      3 DATAFILE '/oracle_data/datafile.dbf' SIZE 10000K REUSE;
```

Adding a Partition to a Tablespace in an Existing Database

To add a partition to a tablespace in an existing Oracle database, from SQL*Plus enter the following command:

```
SQL> ALTER TABLESPACE tablespace_name
      2 ADD DATAFILE '/dev/rdisk/dsk10c' SIZE 10000K REUSE;
```


Part IV

Oracle Real Application Clusters Environment Configuration

Part IV describes how to use the server parameter file (SPFILE) in Oracle Database 10g Real Application Clusters (RAC) and it describes the installed configuration. Part IV contains the following chapters:

- [Chapter 8, "Configuring the Server Parameter File in Oracle Real Application Clusters Environments"](#)
- [Chapter 9, "Understanding the Oracle Real Application Clusters Installed Configuration"](#)

Configuring the Server Parameter File in Oracle Real Application Clusters Environments

This chapter describes server parameter file (SPFILE) placement and configuration in Oracle Real Application Clusters (RAC) environments. This chapter contains the following:

- [Parameter Files and Oracle Real Application Clusters](#)
- [Using Server Parameter Files in Real Application Clusters](#)
- [Parameter File Search Order in Real Application Clusters](#)
- [Migrating to the Server Parameter File in Real Application Clusters Environments](#)
- [Server Parameter File Errors in Real Application Clusters](#)

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about parameters, and for a discussion of parallel execution-related parameters in RAC data warehouse environments

Parameter Files and Oracle Real Application Clusters

Oracle Database uses parameter settings in parameter files to determine how to control various database resources. You can use two types of files for parameter administration: the server parameter file (SPFILE) or one or more traditional client-side parameter files.

Oracle recommends that you manage parameters using an SPFILE. If you use client-side parameter files, then Oracle does not preserve parameter changes made for self-tuning after shutdown.

See Also: Oracle Database 10g Real Application Clusters documentation for more information about using client-side parameter files

Using Server Parameter Files in Real Application Clusters

By default, Oracle creates the server parameter file based on one SPFILE. You can change parameter settings in the server parameter file only by using Oracle Enterprise Manager or `ALTER SYSTEM SET SQL` statements, because the server parameter file is a binary file. Do not try to edit this file manually.

Note: Oracle recommends that you avoid modifying the values for self-tuning parameters; overriding these settings can adversely affect performance.

If you are upgrading from a previous Oracle Database release, then create and configure the server parameter file for RAC using the procedures described in the following section.

Location of the Server Parameter File

The default location of the server parameter file (SPFILE) when the database creates it from a PFILE is platform-dependent.

The default location of the server parameter file is:

```
$ORACLE_HOME/dbs/spfile$ORACLE_sid.ora
```

The default location of the server parameter file is inappropriate for RAC databases and ASM instances if you use raw devices, because all instances must use the same server parameter file.

Instead, Oracle recommends that you use a PFILE in this directory:

```
$ORACLE_HOME/dbs/init$ORACLE_sid.ora
```

This path is valid for each instance and it refers to a single, shared initialization parameter file. If you use raw storage, then the file must contain the following entry:

```
SPFILE=' /dev/vx/rdsk/oracle_dg/dbspfile'
```

However, if you use a cluster file system, then use the following file location:

```
SPFILE=' $ORACLE_HOME/dbs/spfile.ora'
```

If you use ASM, then the SPFILE value will be:

```
SPFILE='+disk_group_name/dbunique_name/spfiledbname.ora'
```

The variable *dbunique_name* is the unique database name, and the variable *dbname* is the database name.

You must use the same value of SPFILE so that all instances use the same server parameter file at startup.

To use DBCA to create your database, and to use the server parameter file, start DBCA. When the Initialization Parameters page appears, select **Create server parameter file (SPFILE)** under the File Locations tab. This option is visible only if you are using raw storage. When you have made this selection, then enter either a shared file system filename, or enter the raw device path name in the **Server Parameters Filename** field.

Note: When you use DBCA to create the server parameter file, the default PFILE file name is
\$ORACLE_HOME/dbs/init\$ORACLE_sid.ora.

Parameter File Search Order in Real Application Clusters

Oracle Database searches for your parameter file in the following order:

1. `$ORACLE_HOME/dbs/spfilesid.ora`
2. `$ORACLE_HOME/dbs/spfile.ora`
3. `$ORACLE_HOME/dbs/initssid.ora`

Migrating to the Server Parameter File in Real Application Clusters Environments

Migrate to the server parameter file by creating and editing the server parameter file using the procedures described in this section.

Server Parameter File Placement in Real Application Clusters

For single-node cluster-enabled configurations, or if you are using ASM disk groups or a cluster file system, place the server parameter file in an ASM disk group or on a file system. Otherwise, place the server parameter file on a shared raw device that is at least 5 MB in size.

Procedures for Migrating to the Server Parameter File

Migrate to the server parameter file (SPFILE) file by completing the following procedures:

1. Combine the initialization parameter files for all instances into one `initdbname.ora` file by copying all shared `IFILE` contents *as is*. All parameters defined in your `IFILE` parameter files are global. Therefore, create them in the format `parameter=value`, without system identifier (sid) prefixes.
2. Copy all instance-specific parameter definitions from `initssid.ora` files using the following syntax, where the variable `sid` is the system identifier (SID) of the instance:

```
sid.parameter=value
```

3. If you are using a cluster file system, then create the server parameter file using the `CREATE SPFILE` statement as in the following example:

```
CREATE SPFILE='?/dbs/spfile_dbname.ora'  
FROM PFILE='?/dbs/initdbname.ora'
```

If you use ASM, then use the following syntax to create the server parameter file:

```
CREATE SPFILE='+disk_group_name/db_uniquename/spfiledbname.ora'  
FROM PFILE='?/dbs/initdbname.ora'
```

These statements read your combined `initdbname.ora` file that you created by merging your `IFILES`, and then transfer the settings for the parameters from the merged file into your server parameter file.

4. Oracle recommends that you use the `SPFILE` by using the `PFILE` as a pointer to the `SPFILE`. Do this by running the `STARTUP` command as in the following example, where the `SID` variable `sid` in the file `initssid.ora` is the `SID` that you use in the `SPFILE` entry from Step 3. For example:

```
STARTUP PFILE=$ORACLE_HOME/dbs/initssid.ora
```

If you use this `STARTUP` command syntax, then Oracle Database uses the server parameter file entry specified in the file `initssid.ora`.

Note: the SPFILE for ASM instance cannot be stored in ASM, as it is used to start the ASM instance. You can place an ASM instance SPFILE in a cluster file system for ASM; or you can use a traditional client-side parameter file for each ASM instance.

Server Parameter File Errors in Real Application Clusters

Oracle Database reports errors that occur during server parameter file creation, or while reading the file during startup. If an error occurs during a parameter update, then Oracle records the error in your `ALERT.LOG` file, and ignores subsequent parameter updates to the file. If this happens, then do either of the following:

- Shut down the instance, recover the server parameter file, and restart the instance.
- Enable the instance to continue running without regard for subsequent parameter updates.

Oracle Database displays errors for parameter changes that you attempt when you incorrectly use the `ALTER SYSTEM SET` statement. Oracle Database does this when an error occurs while reading from or writing to the server parameter file.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about backing up the SPFILE

Understanding the Oracle Real Application Clusters Installed Configuration

This chapter describes the Oracle Real Application Clusters (RAC) installed configuration. The topics in this chapter include the following:

- [Understanding the Configured Environment in Oracle Real Application Clusters](#)
- [Oracle Cluster Registry in Oracle Real Application Clusters](#)
- [Oratab Configuration for Oracle Real Application Clusters](#)
- [Database Components Created Using Database Configuration Assistant](#)
- [Managing Undo Tablespaces in Real Application Clusters](#)
- [Initialization Parameter Files](#)
- [Configuring Service Registration-Related Parameters in Real Application Clusters](#)
- [Configuring the Listener File \(listener.ora\)](#)
- [Directory Server Access \(ldap.ora File\)](#)
- [Net Service Names \(tnsnames.ora File\)](#)
- [Net Services Profile \(sqlnet.ora File\)](#)

Understanding the Configured Environment in Oracle Real Application Clusters

Oracle Net Configuration Assistant (NETCA) and Database Configuration Assistant (DBCA) configure your environment to meet the requirements for database creation and Oracle Enterprise Manager discovery of Oracle Real Application Clusters databases.

Note: Configuration files are created on each node in your cluster database.

Oracle Cluster Registry in Oracle Real Application Clusters

DBCA uses Oracle Cluster Registry (OCR) for storing the configurations for the cluster databases that it creates. The OCR is a shared file in a cluster file system environment. Oracle Universal Installer (OUI) automatically initializes the OCR during the Oracle Clusterware installation.

Oratab Configuration for Oracle Real Application Clusters

Oracle creates an entry for each RAC database in the `oratab` configuration file. Oracle Enterprise Manager uses this file during service discovery to determine the name of the RAC database, and to determine if the database should be automatically started when the system is restarted. The database entry has the following syntax:

```
db_unique_name:$ORACLE_HOME:N
```

The variable *db_unique_name* is the database name for your RAC database, *\$ORACLE_HOME* is the directory path to the database, and *N* indicates that the database should not be started at restart time. The following is an example entry for a database named `db`:

```
db:/private/system/db:N
```

Note: Where the notation *db_name* appears in the previous example and throughout this chapter, it refers to the database name you entered when prompted by DBCA, or it refers to the entry you made for the `DATABASE` keyword of the `CREATE DATABASE` statement.

Database Components Created Using Database Configuration Assistant

This section describes the database components that DBCA creates, which include:

- [Tablespaces and Data files](#)
- [Control Files](#)
- [Redo Log Files](#)

Tablespaces and Data files

For both single-instance and cluster database environments, an Oracle Database is divided into smaller logical areas of space known as tablespaces. Each tablespace corresponds to one or more data files stored on a disk. [Table 9–1](#) shows the tablespace names used by a RAC database and the types of data they contain.

Table 9–1 Tablespace Names Used with Real Application Clusters Databases

Tablespace Name	Contents
SYSTEM	Consists of the data dictionary, including definitions of tables, views, and stored procedures needed by the database. Oracle Database automatically maintains information in this tablespace.
SYSAUX	An auxiliary system tablespace that contains the DRSYS (contains data for OracleText), CWMLITE (contains the OLAP schemas), XDB (for XML features), ODM (for Oracle Data Mining), TOOLS (contains Enterprise Manager tables), INDEX, EXAMPLE, and OEM-REPO tablespaces.
USERS	Consists of application data. As you create and enter data into tables, Oracle Database fills this space with your data.

Table 9–1 (Cont.) Tablespace Names Used with Real Application Clusters Databases

Tablespace Name	Contents
TEMP	Contains temporary tables and indexes created during SQL statement processing. You may need to expand this tablespace if you are running a SQL statement that involves significant sorting, such as <code>ANALYZE COMPUTE STATISTICS</code> on a very large table, or the constructs <code>GROUP BY</code> , <code>ORDER BY</code> , or <code>DISTINCT</code> .
UNDOTBS <i>n</i>	These are the undo tablespaces for each instance that DBCA creates for automatic undo management.
RBS	If you do not use automatic undo management, then Oracle Database uses the RBS tablespace for the rollback segments.

You cannot alter these tablespace names when using the preconfigured database configuration options from Oracle Universal Installer. However, you can change the names of the tablespaces if you use the advanced database creation method.

As mentioned, each tablespace has one or more data files. The data file names created by the preconfigured database configuration options vary by storage type such as ASM, OFS, raw devices, and so on.

You can specify different symbolic link names with the Advanced database configuration option.

Control Files

The database is configured with two control files that are stored on shared storage.

Redo Log Files

Each instance is configured with at least two redo log files that are stored in the shared storage. These files are shared file system files on the cluster file system. If you use ASM, then these files are stored on the ASM disk group.

The file names of the redo log files that are created with the preconfigured database configuration options vary by storage type.

When using raw devices, to use the advanced database creation method, locate the redo log files in the Database Storage page and replace their default filenames with the correct raw device names or symbolic link names.

Managing Undo Tablespaces in Real Application Clusters

Oracle Database stores rollback or undo information in undo tablespaces. To manage undo tablespaces, Oracle recommends that you use automatic undo management. Automatic undo management is an automated undo tablespace management mode that is easier to administer than manual undo management.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for more information about managing undo tablespaces

Initialization Parameter Files

Oracle recommends using the server parameter file (SPFILE). This file resides on the server on the shared disk; all instances in a cluster database can access this parameter file.

See Also: [Chapter 8, "Configuring the Server Parameter File in Oracle Real Application Clusters Environments"](#) for more information about the creation and use of parameter files

Configuring Service Registration-Related Parameters in Real Application Clusters

Two key benefits of RAC are connection load balancing and failover. RAC extends the ability of single-instance Oracle Database load balancing, where connections are distributed among local dispatchers, to the balancing of connections among all instances in a cluster database. In addition, RAC provides failover by configuring multiple listeners on multiple nodes to manage client connection requests for the same database service. Connection load balancing and failover increase availability by taking advantage of the redundant resources within a cluster database. These features, however, require cross-instance registration.

Cross-instance registration in RAC occurs when an instance's process monitor (PMON) registers with the local listener, and with all other listeners. Thus, all instances in the cluster database register with all listeners that run on nodes that run instances of the cluster database. This enables all listeners to manage connections across all instances for both load balancing and failover.

Cross-instance registration requires configuring the `LOCAL_LISTENER` and `REMOTE_LISTENER` initialization parameters. The `LOCAL_LISTENER` parameter identifies the local listener, and the `REMOTE_LISTENER` parameter identifies the global list of listeners. The `REMOTE_LISTENER` parameter is dynamic. Oracle Database changes the setting for `REMOTE_LISTENER` dynamically when you reconfigure your cluster database; for example, when you add or delete instances.

By default, DBCA configures your environment with dedicated servers. However, if you select the Shared server option when using DBCA, then Oracle configures the shared server. In this case, Oracle Database uses both dedicated and shared server processing. When shared servers are configured, the `DISPATCHERS` parameter is specified as in the following example:

```
DISPATCHERS=" (protocol=tcp) "
```

If the `DISPATCHERS` initialization parameter does not specify the `LISTENER` attribute as in the previous example, then the PMON process registers information for all dispatchers with the listeners specified by the `LOCAL_LISTENER` and `REMOTE_LISTENER` parameters.

However, when the `LISTENER` attribute is specified, the PMON process registers dispatcher information with the listeners specified by the `LISTENER` attribute. In this case, setting the `LISTENER` attribute overrides `REMOTE_LISTENER` settings for the specified dispatchers as in the following example:

```
DISPATCHERS=" (protocol=tcp) (listener=listeners_db_name) "
```

See Also: *Oracle Database Net Services Administrator's Guide* for further information about cross-instance registration, shared and dedicated server configurations, and connection load balancing

Configuring the Listener File (listener.ora)

You can configure two types of listeners in the `listener.ora` file as described in the following sections:

- [Local Listeners](#)
- [Multiple Listeners](#)
- [How Oracle Database Uses the Listener \(listener.ora File\)](#)

Local Listeners

If you configured the dedicated server mode using the DBCA Connection Mode tab on the Initialization Parameters page, then DBCA automatically configures the `LOCAL_LISTENER` parameter when the listener uses a nondefault address port.

If you configured the dedicated server mode by setting the `REMOTE_LISTENER` initialization parameter, then you must also configure the instance-specific `LOCAL_LISTENER` initialization parameter.

For example, to configure the `LOCAL_LISTENER` parameter, add the following entry to the initialization parameter file, where `listener_sid` is resolved to a listener address through either a `tnsnames.ora` file or through the Oracle Names Server:

```
sid.local_listener=listener_sid
```

The following entry should be in your `tnsnames.ora` file:

```
listener_sid=(address=(protocol=tcp) (host=node1-vip) (port=1522))
```

Multiple Listeners

If DBCA detects more than one listener on the node, it displays a list of the listeners. You can select one or all of these listeners with which to register your database.

How Oracle Database Uses the Listener (listener.ora File)

Services coordinate their sessions using listener file entries by running a process on the server that receives connection requests on behalf of a client application. Listeners are configured to respond to connection requests sent to protocol addresses for a database service or non-database service.

Protocol addresses are configured in the listener configuration file, `listener.ora`, for a database service or a non-database service. Clients configured with the same addresses can connect to a service through the listener.

During a preconfigured database configuration installation, Oracle Net Configuration Assistant creates and starts a default listener called `LISTENER_NODENAME`. The listener is configured with default protocol listening addresses for the database and external procedures. The advanced installation process prompts you to create at least one listener with Oracle Net Configuration Assistant. The listener is configured to respond to connection requests that are directed to one protocol address you specify, as well as an address for external procedures.

Both installation modes configure service information about the RAC database and external procedures. An Oracle Database 10g Release 2 (10.2) database service automatically registers its information with the listener, such as its service name, instance names, and load information.

This feature, called service registration, does not require configuration in the `listener.ora` file. After listener creation, Oracle Net Configuration Assistant starts the listener. The following is an example `listener.ora` file with an entry for an instance named `node1`:

```
listener_node1=
(description=
  (address=(protocol=ipc) (key=extproc))
  (address=(protocol=tcp) (host=node1-vip) (port=1521) (IP=FIRST))
  (address=(protocol=tcp) (host=node1-ip) (port=1521) (IP=FIRST)))
sid_list_listener_node1=
(sid_list=
  (sid_desc=
    (sid_name=plsextproc)
    (oracle_home=/private/system/db)
    (program=extproc)))
```

Listener Registration and PMON Discovery

When a listener starts after the Oracle instance starts, and the listener is listed for service registration, registration does not occur until the next time the Oracle Database process monitor (PMON) discovery routine starts. By default, PMON discovery occurs every 60 seconds.

To override the 60-second delay, use the SQL `ALTER SYSTEM REGISTER` statement. This statement forces the PMON process to register the service immediately.

Oracle recommends that you create a script to run this statement immediately after starting the listener. If you run this statement while the listener is up and the instance is already registered, or while the listener is down, then the statement has no effect.

See Also: *Oracle Database Net Services Administrator's Guide* for further information about the listener and the `listener.ora` file

Directory Server Access (ldap.ora File)

If you configure access to a Lightweight Directory Access Protocol (LDAP)-compliant directory server with Oracle Net Configuration Assistant during a Custom Install or Advanced database configuration, an `ldap.ora` file is created. The `ldap.ora` file contains the following types of information:

- Type of directory
- Location of the directory
- Administrative context from which this server can look up, create, and modify a net service name, and database service entries

See Also: *Oracle Database Net Services Administrator's Guide* for further information about directory naming configuration and directory server access configuration

Net Service Names (tnsnames.ora File)

A `tnsnames.ora` file is created on each node with net service names. A connect identifier is an identifier that maps to a connect descriptor. A connect descriptor contains the following information:

- The network route to the service, including the location of the listener through a protocol address
- The `SERVICE_NAME` for an Oracle release 8.1 or later, or `sid` for pre-8.1 Oracle releases

Note: The `SERVICE_NAME` parameter you use in the `tnsnames.ora` file is singular, because you can specify only one service name.

DBCA creates net service names for connections as shown in [Table 9–2](#).

Table 9–2 Connections for Net Service Names

Net Service Name Type	Description
Database connections	<p>Clients that connect to any instance of the database use the net service name entry for the database. This entry also enables Oracle Enterprise Manager to discover a RAC database.</p> <p>A listener address is configured for each node that runs an instance of the database. The <code>LOAD_BALANCE</code> option causes Oracle to choose the address randomly. If the chosen address fails, then the <code>FAILOVER</code> option causes the connection request to fail over to the next address. Thus, if an instance fails, then clients can still connect using another instance.</p> <p>In the following example, <code>db.us.oracle.com</code> is used by the client to connect to the target database, <code>db.us.oracle.com</code>.</p> <pre>db.us.acme.com= (description= (load_balance=on) (address=(protocol=tcp)(host=node1-vip)(port=1521) (address=(protocol=tcp)(host=node2-vip)(port=1521) (connect_data= (service_name=db.us.acme.com)))</pre> <p>Note: <code>FAILOVER=ON</code> is set by default for a list of addresses. Thus, you do not need to explicitly specify the <code>FAILOVER=ON</code> parameter.</p> <p>When you set <code>DB_UNIQUE_NAME</code> by entering a global database name that is longer than 8 characters, excluding <code>DB_DOMAIN</code>, then a net service entry similar to the following is created:</p> <pre>mydatabase.us.acme.com= (description = (address = (protocol = tcp)(host = node1-vip)(port = 1521)) (address = (protocol = tcp)(host = node2-vip)(port = 1521)) (load_balance = yes) (connect_data = (server = dedicated) (service_name = mydatabase.us.acme.com)))</pre>
Instance connections	<p>Clients that connect to a particular instance of the database use the net service name entry for the instance. This entry, for example, enables Oracle Enterprise Manager to discover the instances in the cluster. These entries are also used to start and stop instances.</p> <p>In the following example, Oracle Enterprise Manager uses <code>db1.us.acme.com</code> to connect to an instance named <code>db1</code> on <code>db1-server</code>:</p> <pre>db1.us.acme.com= (description= (address=(protocol=tcp)(host=node1-vip)(port=1521)) (connect_data= (service_name=db.us.acme.com) (instance_name=db1)))</pre>

Table 9–2 (Cont.) Connections for Net Service Names

Net Service Name Type	Description
Remote listeners	<p>As discussed in "Configuring Service Registration-Related Parameters in Real Application Clusters" on page 9-4, the <code>REMOTE_LISTENER</code> parameter identifies the global list of listeners and it is dynamic. Oracle Database changes the setting for <code>REMOTE_LISTENER</code> when you reconfigure your cluster database.</p> <p>Whether using shared servers or dedicated servers, the list of remote listeners is supplied using the <code>REMOTE_LISTENER</code> parameter. For example:</p> <pre>REMOTE_LISTENER=listeners_db_unique_name</pre> <p>This enables the instance to register with remote listeners on the other nodes; <code>listeners_db_unique_name</code> is resolved through a naming method such as a <code>tnsnames.ora</code> file.</p> <p>In the following example, <code>listeners_db.us.acme.com</code> is resolved to a list of listeners available on the nodes on which the cluster database has instances:</p> <pre>listeners_db.us.acme.com= (address_list= (address=(protocol=tcp) (host=node1-vip) (port=1521)) (address=(protocol=tcp) (host=node2-vip) (port=1521)))</pre> <p>The instance uses this list to determine the addresses of the remote listeners with which to register its information.</p>
Nondefault listeners	<p>As discussed in "Local Listeners" on page 9-5 and "Multiple Listeners" on page 9-5, the <code>LOCAL_LISTENER</code> parameter is set in the <code>init.ora</code> file if a nondefault listener is configured, for example:</p> <pre>sid.local_listener=listener_sid</pre> <p>The variable <code>listener_sid</code> is resolved to a listener address through a naming method such as a <code>tnsnames.ora</code> file.</p> <p>In the following example, <code>listener_db1.us.acme.com</code> is resolved to the nondefault listener address:</p> <pre>listener_db1.us.acme.com= (address=(protocol=tcp) (host=node1-vip) (port=1522))</pre>

Table 9–2 (Cont.) Connections for Net Service Names

Net Service Name Type	Description
Services Entries	<p>When you configure high availability services using the DBCA Services page, then DBCA creates net service entries similar to the following. The three services in the following examples, db_svc1, db_svc2, and db_svc3, have TAF policies of NONE, BASIC and PRECONNECT respectively.</p> <pre> db_svc1.us.acme.com= (description = (address=(protocol=tcp) (host=node1-vip) (port=1521)) (address=(protocol=tcp) (host=node2-vip) (port=1521)) (load_balance=yes) (connect_data= (server = dedicated) (service_name = db_svc1.us.acme.com))) db_svc2.us.acme.com= (description= (address=(protocol=tcp) (host=node1-vip) (port=1521)) (address=(protocol=tcp) (host=node2-vip) (port=1521)) (load_balance=yes) (connect_data = (server = dedicated) (service_name=db_svc2.us.acme.com) (failover_mode = (type=select) (method=basic) (retries=180) (delay=5)))) db_svc3.us.acme.com= (description= (address=(protocol=tcp) (host=node1-vip) (port=1521)) (address=(protocol=tcp) (host=node2-vip) (port=1521)) (load_balance=yes) (connect_data= (server=dedicated) (service_name=db_svc3.us.acme.com) (failover_mode= (backup=db_svc3_preconnect.us.acme.com) (type=select) (method=preconnect) (retries=180) (delay=5)))) </pre>

Table 9–2 (Cont.) Connections for Net Service Names

Net Service Name Type	Description
Services Entries (continued)	<p>When a service has a TAF policy of PRECONNECT, then a <code>service_name_preconnect</code> net service entry is also created as in the following example:</p> <pre>db_svc3_preconnect.us.acme.com = (description = (address = (protocol = tcp) (host = node1-vip) (port = 1521)) (address = (protocol = tcp) (host = node2-vip) (port = 1521)) (load_balance = yes) (connect_data = (server = dedicated) (service_name = db_svc3_preconnect.us.amce.com) (failover_mode = (backup = db_svc3.us.acme.com) (type = select) (method = basic) (retries = 180) (delay = 5)))))</pre>
External procedures	<p>The following is an entry for connections to external procedures. This entry enables Oracle Database to connect to external procedures.</p> <pre>extproc_connection_data.us.acme.com= (description= (address_list= (address=(protocol=ipc) (key=extproc0))) (connect_data= (sid=plsextproc)))</pre>

Example 9–1 Example tnsnames.ora File

This example is a sample `tnsnames.ora` file that is created during a preconfigured database configuration installation.

```
db.us.acme.com=
  (description=
    (load_balance=on)
    (address=(protocol=tcp) (host=node1-vip) (port=1521))
    (address=(protocol=tcp) (host=node2-vip) (port=1521))
    (connect_data=
      (service_name=db.us.acme.com))
  )

db1.us.acme.com=
  (description=
    (address=(protocol=tcp) (host=node1-vip) (port=1521))
    (connect_data=
      (service_name=db.us.acme.com)
      (instance_name=db1))
  )

db2.us.acme.com=
  (description=
    (address=(protocol=tcp) (host=node2-vip) (port=1521))
    (connect_data=
      (service_name=db.us.acme.com)
      (instance_name=db2))
  )

listeners_db.us.acme.com=
  (address_list=
```

```

(address=(protocol=tcp) (host=node1-vip) (port=1521))
(address=(protocol=tcp) (host=node2-vip) (port=1521)))

extproc_connection_data.us.acme.com=
(description=
(address_list=
(address=(protocol=ipc) (key=extproc)))
(connect_data=
(sid=plsextproc)
(presentation=RO)))

```

See Also: *Oracle Database Net Services Administrator's Guide* for further information about the `tnsnames.ora` file

Net Services Profile (sqlnet.ora File)

Oracle Universal Installer starts Oracle Net Configuration Assistant after the database is installed, and creates the Net Services profile, or `sqlnet.ora` file.

By default, the `sqlnet.ora` file is located in the following directory:

```
$ORACLE_HOME/network/admin
```

In this directory, in addition to the default `sqlnet.ora` file generated during installation, you also can find a sample `sqlnet.ora` file in the directory `sample`.

During installation, Oracle Net Configuration Assistant creates the following entries in the `sqlnet.ora` file:

```
NAMES.DIRECTORY_PATH= (TNSNAMES, EZCONNECT)
```

The parameter `NAMES.DIRECTORY_PATH` specifies the priority order of the naming methods to use to resolve connect identifiers to connect descriptors.

The order of naming methods is as follows: directory naming (for Custom Install or Advanced database configuration options only), `tnsnames.ora` file, Easy Connect, and host naming.

The Easy Connect naming method eliminates the need for service name lookup in the `tnsnames.ora` files for TCP/IP environments. With Easy Connect, clients use a connect string for a simple TCP/IP address, consisting of a host name and optional port and service name. If you use this method, then no naming or directory system is required.

See Also: *Oracle Database Net Services Administrator's Guide* for further information about the `sqlnet.ora` file

Part V

Oracle Clusterware and Oracle Real Application Clusters Installation and Configuration Reference Information

Part V provides Oracle Clusterware and Oracle Real Application Clusters (RAC) installation and configuration reference information. Part V contains the following appendixes:

- [Appendix A, "Troubleshooting the Oracle Clusterware and Oracle Real Application Clusters Installation Process"](#)
- [Appendix B, "Using Scripts to Create Oracle Real Application Clusters Databases"](#)
- [Appendix C, "Configuring Raw Devices for Oracle Real Application Clusters"](#)
- [Appendix D, "Converting to Oracle Real Application Clusters from Single-Instance Oracle Databases"](#)
- [Appendix E, "Directory Structure for Oracle Database 10g Oracle Real Application Clusters Environments"](#)
- [Appendix F, "How to Stop Processes in an Existing Oracle Real Application Clusters Database, and How to Perform Oracle Clusterware Rolling Upgrades"](#)
- [Appendix G, "Managing Oracle Database Port Numbers"](#)

Troubleshooting the Oracle Clusterware and Oracle Real Application Clusters Installation Process

This appendix provides troubleshooting information for installing Oracle Clusterware and Oracle Real Application Clusters (RAC).

See Also: The Oracle Database 10g Oracle Real Application Clusters documentation set included with the installation media in the Documentation directory:

- *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*

Troubleshooting the Oracle Real Application Clusters Installation

This section contains these topics:

- [General Installation Issues](#)
- [Real Application Clusters Installation Error Messages](#)
- [Performing Cluster Diagnostics During Real Application Clusters Installations](#)

General Installation Issues

The following is a list of examples of types of errors that can occur during installation:

An error occurred while trying to get the disks

Cause: There is an entry in `/etc/oratab` pointing to a non-existent Oracle home. The OUI error file should show the following error: "java.io.IOException: /home/oracle/OraHome//bin/kfod: not found" (Oracle*Metalink* bulletin 276454.1)

Action: Remove the entry in `/etc/oratab` pointing to a non-existing Oracle home.

Nodes unavailable for selection from the OUI Node Selection screen

Cause: Oracle Clusterware is either not installed, or the Oracle Clusterware services are not up and running.

Action: Install Oracle Clusterware, or review the status of your Oracle Clusterware. Consider restarting the nodes, as doing so may resolve the problem.

Node *nodename* is unreachable

Cause: Unavailable IP host

Action: Attempt the following:

1. Run the shell command `ifconfig -a`. Compare the output of this command with the contents of the `/etc/hosts` file to ensure that the node IP is listed.
2. Run the shell command `nslookup` to see if the host is reachable.
3. As the `oracle` user, attempt to connect to the node with `ssh` or `rsh`. If you are prompted for a password, then user equivalence is not set up properly. Review the section "[Configuring SSH on All Cluster Nodes](#)" on page 2-11.

Time stamp is in the future

Cause: One or more nodes has a different clock time than the local node. If this is the case, then you may see output similar to the following:

```
time stamp 2005-04-04 14:49:49 is 106 s in the future
```

Action: Ensure that all member nodes of the cluster have the same clock time.

YPBINDPROC_DOMAIN: Domain not bound

Cause: This error has been seen during post-installation testing when a node public network interconnect is pulled out, and the VIP does not fail over. Instead, the node hangs, and users are unable to log in to the system. This error occurs when the Oracle home, listener.ora, Oracle log files, or any action scripts are located on an NAS device or NFS mount, and the name service cache daemon `nscd` has not been activated.

Action: Enter the following command on all nodes in the cluster to start the `nscd` service:

```
/sbin/service nscd start
```

Real Application Clusters Installation Error Messages

Oracle Real Application Clusters Management Tools Error Messages are in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*.

Performing Cluster Diagnostics During Real Application Clusters Installations

If Oracle Universal Installer (OUI) does not display the Node Selection page, then perform clusterware diagnostics by running the `olsnodes -v` command from the binary directory in your Oracle Clusterware home (`CRS_home/bin`) and analyzing its output. Refer to your clusterware documentation if the detailed output indicates that your clusterware is not running.

In addition, use the following command syntax to check the integrity of the Cluster Manager:

```
cluvfy comp clumgr -n node_list -verbose
```

In the preceding syntax example, the variable `node_list` is the list of nodes in your cluster, separated by commas.

Using Scripts to Create Oracle Real Application Clusters Databases

This chapter describes the steps required to create an Oracle Real Application Clusters (RAC) database using scripts to perform noninteractive installations.

Note: The scripts generated by DBCA are for reference purposes only. Oracle strongly recommends that you use DBCA to create a database.

See Also: *Oracle Universal Installer and OPatch User's Guide* for detailed information about generating scripts

Creating a Database Using Scripts

To generate scripts to create a Real Application Clusters database, create a database using the scripts, and prepare the database for use, complete the following steps:

1. Start Database Configuration Assistant (DBCA) and select your preferred options to build the RAC database. Note: you must select the **Custom Database** template on the Database Templates page for DBCA to provide the script generation option.

On the Creation Options page of your DBCA session, deselect Create Database and select **Generate Database Creation Scripts** before you click **Finish**. You can accept the default destination directory for the scripts, or browse for a different location. In either case, you should note the path name for use in the next step.

See Also: [Chapter 6, "Creating Oracle Real Application Clusters Databases with Database Configuration Assistant"](#) for additional information about running a DBCA session

2. Navigate to the directory, which you noted in step 1, where DBCA created the scripts, and review the SQL scripts to ensure that they contain the statements to build a database with the characteristics you require. If they do not, then Oracle recommends that you rerun DBCA to create scripts with the desired configuration rather than editing the scripts yourself.
3. On each cluster node you identified during your DBCA session, run the script `sid.sh`, where `sid` is the SID prefix that you entered on the DBCA Database Name page.

4. Set the initialization parameter, `cluster_database`, to the value `TRUE` in your SPFILE by issuing an `ALTER SYSTEM` command, or by uncommenting it in your PFILE for each instance.
5. Configure Oracle Net Services to support your new database and instances as described in [Chapter 9, "Understanding the Oracle Real Application Clusters Installed Configuration"](#).
6. Set the `local_listener` and `remote_listener` parameters in your SPFILE by issuing an `ALTER SYSTEM` command, or by uncommenting it in your PFILE for each instance.
7. Run `SRVCTL` to configure and start database and instance applications as described in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*.

See Also: *Oracle Universal Installer and OPatch User's Guide* for additional information about creating and using scripts to install Oracle software with OUI

Configuring Raw Devices for Oracle Real Application Clusters

This appendix provides additional information about configuring raw devices to deploy Real Application Clusters (RAC) using Oracle Database Configuration Assistant (DBCA). You must configure raw devices if you do not use Automatic Storage Management (ASM), or Oracle Cluster File System.

Raw Devices Required by DBCA for Non-OCFS Environments

If you want to use DBCA to create a database on raw storage, then configure the raw devices, as described in this section. These devices are in addition to the Oracle Cluster Registry (OCR) and voting disk required to install Oracle Clusterware. Create these devices before running Oracle Universal Installer (OUI) to install the Oracle Database 10g software. DBCA cannot create a RAC database unless you have properly configured the following devices:

- Four raw devices for four tablespace data files
- At least two raw devices for control files
- One raw device for each instance for its own tablespace for automatic undo management
- At least two raw devices for redo log files for each instance
- One raw device for the server parameter file

Note: Each instance has its own redo log files, but all instances in a cluster share the control files and data files. In addition, each instance's online redo log files must be readable by all other instances to enable recovery.

Planning Your Raw Device Creation Strategy

Before installing the Oracle Database 10g software with Oracle Real Application Clusters, create enough partitions of specific sizes to support your database, and also leave a few spare partitions of the same size for future expansion. For example, if you have space on your shared disk array, then select a limited set of standard partition sizes for your entire database. Partition sizes of 50 MB, 100 MB, 500 MB, and 1 GB are suitable for most databases. Also, create a few very small and a few very large spare partitions that are (for example) 1 MB and perhaps 5 GB or greater in size. Based on your plans for using each partition, determine the placement of these spare partitions

by combining different sizes on one disk, or by segmenting each disk into same-sized partitions.

Note: Ensure that there are spare partitions enables you to perform emergency file relocations or additions if a tablespace data file becomes full.

Converting to Oracle Real Application Clusters from Single-Instance Oracle Databases

This chapter describes the procedures for converting from Oracle Database 10g single-instance databases to Oracle Real Application Clusters (RAC) databases. This appendix contains the following topics:

- [Single-Instance to Cluster-Enabled Conversion Administrative Issues](#)
- [Converting with DBCA](#)
- [Converting with rconfig and Oracle Enterprise Manager](#)
- [Post-Conversion Steps](#)

If you are upgrading from Oracle Parallel Server to RAC, or from an earlier version of RAC, then use Oracle Database Upgrade Assistant (DBUA). In other words, the procedures in this chapter assume that your original single-instance database and the target RAC database are the same release of Oracle 10g, and running on the same platform.

Note: You must use clustered ASM instances for RAC databases.

See Also: You must comply with the restrictions of the license you have purchased. To understand the restrictions of your license, please refer to the *Database Licensing Information* manual

Single-Instance to Cluster-Enabled Conversion Administrative Issues

Note the following administrative considerations before conversion:

- Backup procedures should be available before converting from a single-instance Oracle Database to RAC.
- Additional archiving considerations apply in RAC environments. In particular, the archive file format requires a thread number. In addition, the archived logs from all instances of a RAC database are required for media recovery. If you archive to a file and you do not use a cluster file system, then a method of accessing the archive logs from all nodes on which the cluster database has instances is required where file systems are not shared.

Converting with DBCA

You can use Database Configuration Assistant to convert from single-instance Oracle databases to RAC. DBCA automates the configuration of the control file attributes, creates the undo tablespaces and the redo logs, and makes the initialization parameter file entries for cluster-enabled environments. It also configures Oracle Net Services, Oracle Clusterware resources, and the configuration for RAC database management for use by Oracle Enterprise Manager or the SRVCTL utility.

Before you use DBCA to convert a single-instance database to a RAC database, ensure that your system meets the following conditions:

- It is a supported hardware and operating system software configuration.
- It has shared storage: either Oracle Cluster File System or ASM is available and accessible from all nodes.
- Your applications have no design characteristics that preclude their use with cluster database processing.

If your platform supports a cluster file system, then you can use it for RAC. You can also convert to RAC and use a non-shared file system. In either case, Oracle strongly recommends that you use Oracle Universal Installer (OUI) to perform an Oracle Database 10g installation that sets up the Oracle home and inventory in an identical location on each of the selected nodes in your cluster.

This section describes the following scenarios:

- [Single Instance on a Non-Cluster Computer to Oracle Database 10g with RAC](#)
- [Single Instance on a Cluster to Oracle Database 10g RAC](#)

Single Instance on a Non-Cluster Computer to Oracle Database 10g with RAC

To convert from a single-instance Oracle Database that is on a non-cluster computer to RAC, perform the procedures described in the following sections, and in the order shown:

- [Back Up the Original Single-Instance Database](#)
- [Perform the Pre-Installation Steps](#)
- [Set Up the Cluster](#)
- [Validate the Cluster](#)
- [Copy the Preconfigured Database Image](#)
- [Install Oracle Database 10g Software with Real Application Clusters](#)

Back Up the Original Single-Instance Database

Use DBCA to create a preconfigured image of your single-instance database by using the following procedure:

1. Navigate to the `bin` directory in `$ORACLE_HOME`, and start DBCA.
2. At the Welcome page, click **Next**.
3. On the Operations page, select **Manage Templates**, and click **Next**.
4. On the Template Management page, select **Create a database template** and **From an existing database (structure as well as data)**, and click **Next**.

5. On the Source Database page, enter the database name in the **Database instance** field, and click **Next**.
6. On the Template Properties page, enter a name for your template in the **Name** field. Oracle recommends that you use the database name.

By default, the template files are generated in the directory `ORACLE_HOME/assistants/dbca/templates`. If you choose to do so, you can enter a description of the file in the **Description** field, and change the template file location in the **Template data file** field.

When you have completed entries, click **Next**.

7. On the Location of Database Related Files page, select **Maintain the file locations**, so that you can restore the database to the current directory structure, and click **Finish**.

DBCA generates two files: a database structure file (`template_name.dbc`), and a database preconfigured image file (`template_name.dfb`).

Perform the Pre-Installation Steps

Perform the pre-installation steps as documented in [Part II](#) of this book. Then set up shared storage by referring to the "Configure Disk Storage for Oracle Database and Recovery Files" sections in the pre-installation chapter in [Part II](#).

See Also: Storage vendor-specific documentation for setting up the shared disk subsystem and for information about how to mirror and stripe disks

Set Up the Cluster

To use vendor clusterware, form a cluster with the required number of nodes according to your hardware vendor's documentation. When you have configured all of the nodes in your cluster, install Oracle Clusterware and validate cluster components by referring to the procedures in [Chapter 4, "Installing Oracle Clusterware"](#).

Validate the Cluster

Validate the cluster configuration using the Cluster Verification Utility, as described in [Chapter 5, "Installing Oracle Database 10g with Oracle Real Application Clusters"](#).

Copy the Preconfigured Database Image

Copy the preconfigured database image. This includes copying the database structure `*.dbc` file and the database preconfigured image `*.dfb` file that DBCA created in the previous procedure "[Back Up the Original Single-Instance Database](#)" on page D-2 to a temporary location on the node in the cluster from which you plan to run DBCA.

Install Oracle Database 10g Software with Real Application Clusters

1. Run the Oracle Universal Installer (OUI) to perform an Oracle Database installation with RAC.
2. Select **Cluster Installation Mode** on the Specify Hardware Cluster Installation page of the Oracle Universal Installer (OUI), and select the nodes to include in your RAC database.
3. On the OUI Database Configuration Types page, select the **Advanced** install type.

After installing the Oracle Database software, OUI runs post-installation configuration tools, such as Network Configuration Assistant (NETCA), DBCA, and so on.

4. On the DBCA Template Selection page, use the template that you copied to a temporary location in the ["Copy the Preconfigured Database Image"](#) procedure. Use the browse option to select the template location.
5. If you selected raw storage on the OUI Storage Options page, then on the DBCA File Locations Tab on the Initialization Parameters page, replace the data files, control files, and log files, and so on, with the corresponding raw device files if you have not set up the `DBCA_RAW_CONFIG` environment variable. You must also replace default database files with raw devices on the Storage page.

See Also: [Chapter 6, "Creating Oracle Real Application Clusters Databases with Database Configuration Assistant"](#)

6. After creating the RAC database, DBCA displays the Password Management page on which you must change the passwords for database privileged users who have `SYSDBA` and `SYSOPER` roles. When DBCA exits, the conversion process is complete.

Single Instance on a Cluster to Oracle Database 10g RAC

There are three scenarios in which a single-instance database can exist on a cluster computer:

- Scenario 1: The Oracle home from which the single-instance database is running is cluster-installed. The steps to perform a conversion to RAC in this scenario are described in ["Single Instance on a Cluster Running from a Cluster-Enabled Oracle Home"](#) on page D-4.
- Scenario 2: The Oracle home from which the single-instance database is running is cluster-installed, but the RAC feature is disabled. Refer to ["Single Instance on a Cluster Running from a RAC-Disabled Oracle Home"](#) on page D-7 for instructions on how to convert the database to RAC in this environment.
- Scenario 3: The Oracle home from which the single-instance database is running is not cluster-installed. The procedure to convert the single-instance database to RAC in this scenario is described in ["Single Instance on a Cluster Running from a Single-Instance Installed Oracle Home"](#) on page D-7.

Use the following procedures to convert your single-instance database on a cluster computer to RAC for all of these scenarios.

Single Instance on a Cluster Running from a Cluster-Enabled Oracle Home

Perform the following procedures to convert a single-instance database on a cluster running from a cluster-installed (Oracle Database 10g with RAC) Oracle home.

1. Use DBCA to create a preconfigured image of your single-instance database as described in the section ["Back Up the Original Single-Instance Database"](#) on page D-2. To perform the conversion manually, shut down the single-instance database.
2. To add nodes to your cluster, add and connect these nodes to the cluster as described in the section ["Perform the Pre-Installation Steps"](#) on page D-3. Ensure that all of these nodes can access the shared storage. Also, extend the Oracle Clusterware home to the new nodes using the procedures for ["Extending Clusterware and Oracle Software to New Nodes"](#) as described in *Oracle Database*

Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide.

3. From the existing Oracle home, extend this home to the new nodes using the procedure "Adding Nodes at the Oracle RAC Database Layer" as described in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*.
4. From one of the newly added nodes, configure the listeners on the additional nodes using NETCA. Choose the same port number and protocol that you used on the existing node. If NETCA displays the existing node in the node list page, then do not select this node, because the listener is already configured on it.
5. Convert the database using one of the following procedures:
 - [Automated Conversion Procedure](#)
 - [Manual Conversion Procedure](#)

Automated Conversion Procedure 1.If you created the preconfigured image of the single instance database as described in the section "[Back Up the Original Single-Instance Database](#)" on page D-2, then use DBCA to complete the conversion to a RAC database.

2. Start DBCA from the initial node. Select the names of the nodes that you want to include as part of your cluster database. On the Template Selection page, select the preconfigured template that you created in Step 1 on page D-4. Enter the database name and respond to the remaining DBCA prompts.
3. To use raw devices for the cluster database files: When the Initialization Parameters page appears, enter the raw device name for the SPFILE on the File Locations tab. On the Storage page, replace the default database file names with the raw devices for the control files, redo logs, and data files to create the cluster database. Click **Finish**, and create the database.

After creating the RAC database, DBCA displays the Password Management page on which you must change the passwords for the database privileged users who have SYSDBA and SYSOPER roles. When DBCA exits, the conversion process is complete.

Manual Conversion Procedure Because you did not use DBCA to create a preconfigured image of your single-instance database in step 1 on page D-4, perform the following steps to complete the conversion:

1. Create the Optimal Flexible Architecture (OFA) directory structure on each of the nodes that you have added.

See Also: "[Directory Structures for Real Application Clusters](#)" on page E-1 for more information about OFA

2. If you are converting single-instance database files on a file system to raw devices, then copy the database data files, control files, redo logs, and server parameter file to their corresponding raw devices using the `dd` command. Otherwise, continue to the next step.
3. Re-create the control files by running the `CREATE CONTROLFILE SQL` statement with the `REUSE` keyword and specify `MAXINSTANCES` and `MAXLOGFILES`, and so on, as needed for your RAC configuration. The `MAXINSTANCES` recommended default is 32.
4. Shut down the database instance.

5. If your single-instance database was using an SPFILE parameter file, then create a temporary PFILE from the SPFILE using the following SQL statement:

```
CREATE PFILE='pfile_name' from spfile='spfile_name'
```

6. Set the `CLUSTER_DATABASE` parameter to `TRUE`, set the `INSTANCE_NUMBER` parameter to a unique value for each instance, using a `sid.parameter=value` syntax.

If you optimized memory usage on your single-instance database, then adjust the size of the system global area (SGA) to avoid swapping and paging when you convert to RAC. you should make this adjustment because RAC requires about 350 bytes for each buffer to accommodate the Global Cache Service (GCS). For example, if you have 10,000 buffers, then RAC requires about 350 multiplied by 10,000 bytes more memory. Therefore, adjust the size of the SGA by changing the `DB_CACHE_SIZE` and `DB_nK_CACHE_SIZE` parameters accordingly.

7. Start up the database instance using the PFILE created in step 5.
8. If your single-instance database was using automatic undo management, then create an undo tablespace for each additional instance using the `CREATE UNDO TABLESPACE` SQL statement. If you are using raw devices, then ensure that the data file for the undo tablespace is on the raw device.
9. Create redo threads that have at least two redo logs for each additional instance. If you are using raw devices, then ensure that the redo log files are on raw devices. Enable the new redo threads by using an `ALTER DATABASE` SQL statement. Then, shut down the database instance.
10. Copy the Oracle password file from the initial node, or from the node from which you are working, to the corresponding location on the additional nodes on which the cluster database will have an instance. Replace the `ORACLE_SID` name in each password file appropriately for each additional instance.
11. Add `REMOTE_LISTENER=LISTENER_DB_NAME` and `sid.LOCAL_LISTENER=LISTENER_SID` parameters to the PFILE.
12. Configure the net service entries for the database and instances, and address entries for the `LOCAL_LISTENER` for each instance and for the `REMOTE_LISTENER` in the `tnsnames.ora` file. When you have done this, copy these to all nodes.
13. Create the SPFILE from the PFILE using the procedures in the section ["Procedures for Migrating to the Server Parameter File"](#) on page 8-3. If you are not using a cluster file system, then ensure that the SPFILE is on a raw device.
14. Create the `$ORACLE_HOME/dbs/initsid.ora` file that contains the following entry:

```
spfile='spfile_path_name'
```

The variable `spfile_path_name` is the complete path name of the SPFILE.

15. Add the configuration for the RAC database and its instance-to-node mapping using `SRVCTL`.
16. Start the RAC database using `SRVCTL`.

After starting the database with `SRVCTL`, your conversion process is complete and, for example, you can run the following SQL statement to see the status of all the instances in your RAC database:

```
select * from v$active_instances
```

Single Instance on a Cluster Running from a RAC-Disabled Oracle Home

You can install a single instance on a cluster running from a RAC-disabled Oracle home if you performed a one-node cluster (with RAC) installation, but later disabled the RAC feature by unlinking it from the `oracle` binary before creating the single instance database. (However, you can also select the **local** and **non-cluster** selection on the Node Selection Page to create a non-RAC-enabled single-instance home on a cluster.) Perform the following procedures to convert this type of single-instance database to a RAC database:

1. Use DBCA to create a preconfigured image of your single-instance database as described in the section ["Back Up the Original Single-Instance Database"](#) on page D-2. To perform the conversion manually, shut down the single-instance database.
2. Change the directory to the `lib` subdirectory in the `rdbms` directory under the Oracle home.
3. Relink the `oracle` binary by running the following commands:

```
make -f ins_rdbms.mk rac_on
make -f ins_rdbms.mk ioracle
```

4. Continue with step 2 on page D-4.

Single Instance on a Cluster Running from a Single-Instance Installed Oracle Home

You can only install a single instance on a cluster running from a single-instance installed Oracle home if you selected the local installation option on the OUI Specify Hardware Cluster Installation page during the single-instance Oracle Database 10g installation.

To convert this type of database to a RAC database, perform the procedures described in the following sections:

1. ["Back Up the Original Single-Instance Database"](#) on page D-2.
2. ["Perform the Pre-Installation Steps"](#) on page D-3.
3. ["Set Up the Cluster"](#) on page D-3.
4. ["Install Oracle Database 10g Software with Real Application Clusters"](#) on page D-3. In this step, make sure that you select a new Oracle home other than the one from which the single-instance database was running.

Converting with rconfig and Oracle Enterprise Manager

You can use `rconfig`, or Oracle Enterprise Manager to assist you with the task of converting a single-instance database installation to a RAC database. The first of these, `rconfig`, is a command line utility. Oracle Enterprise Manager Grid Control database administration option, Convert to Cluster Database, provides a GUI conversion tool. The following sections describe how to use these conversion tools:

- [Prerequisites for Converting to RAC Databases](#)
- [Single-Instance to RAC Conversion Scenarios](#)
- [Converting Single-Instance Databases to RAC Using rconfig](#)
- [Example of an rconfig XML Input File](#)

- [Converting Single-Instance Databases to RAC Using Oracle Enterprise Manager](#)
- [Converting Single-Instance ASM to Cluster ASM](#)

Note: Before you start the conversion, as is always true before you start any major change to your database, always back up your existing database.

Prerequisites for Converting to RAC Databases

Before you convert a single-instance database to a RAC database, ensure that the following conditions are met for each cluster node that you intend to make a RAC database node:

- Oracle Clusterware 10g Release 2 (10.2) is installed, configured, and running.
- Oracle Real Application Clusters 10g Release 2 (10.2) software is installed.
- The Oracle binary is enabled for RAC.
- Shared storage, either Oracle Cluster File System or ASM, is available and accessible from all nodes.
- User equivalence exists for the `oracle` account.
- If you intend to use Oracle Enterprise Manager, then all Enterprise Manager agents are configured and running, and are configured with cluster and host information.

Note: You must use clustered ASM instances for RAC databases. If your single-instance database uses ASM Storage, then before you use `rconfig` to convert the Oracle Database with RAC, convert your ASM installation to a cluster-enabled ASM as described in ["Converting Single-Instance ASM to Cluster ASM"](#) on page D-12.

Single-Instance to RAC Conversion Scenarios

The following is a list of scenarios for converting a single-instance Oracle database to an Oracle Real Application Clusters (RAC) database:

- Converting a single-instance Oracle Database 10g Release 2 (10.2) to an Oracle 10g Release 2 (10.2) RAC database, running out of the *same* Oracle home and using the same data files as the single-instance database.

In this scenario, either use the `rconfig` utility, or use the **Convert to RAC** option on the single-instance database target of Oracle Enterprise Manager Grid Control.

- Converting a single-instance Oracle Database version previous to Oracle Database 10g Release 2 (10.2), running out of the same Oracle home and using the same data files as the single-instance database

In this scenario, use OUI and Database Upgrade Assistant (DBUA) to update the single-instance database to Oracle Database 10g Release 2 (10.2). Then use `rconfig` or the Enterprise Manager **Convert to RAC** option, as described in the preceding scenario.

- Converting a single-instance Oracle Database 10g Release 2 (10.2) to an Oracle 10g Release 2 (10.2) RAC database, running out of a *different* Oracle home and using the same data files as the single-instance database.

In this scenario, either use the `rconfig` utility in the source database home (the database that you are converting), or use the **Convert to RAC** option in the single-instance database target of Oracle Enterprise Manager Grid Control. Provide the file storage location when prompted.

- Converting a single-instance Oracle Database 10g Release 2 (10.2) to an 10g Release 2 (10.2) RAC database, running out of a *different* Oracle home, and where the host where the single-instance database is running is *not* one of the nodes of the RAC database

In this scenario, create a clone image of the single-instance database, and move the clone image to a host that is one of the nodes of the cluster. Then use `rconfig` or the Enterprise Manager **Convert to RAC** option, as described in the preceding scenario.

Converting Single-Instance Databases to RAC Using rconfig

You can use the command line utility `rconfig` to convert a single-instance database to RAC. To use this feature, complete the following steps:

See Also: *Oracle Database Upgrade Guide* for information about upgrading existing Oracle Database installations

1. As the `oracle` user, navigate to the directory `$ORACLE_HOME/assistants/rconfig/sampleXMLs`, and open the file `ConvertToRAC.xml` using a text editor, such as `vi`.
2. Review the `ConvertToRAC.xml` file, and modify the parameters as required for your system. The XML sample file contains comment lines that provide instructions for how to configure the file.

When you have completed making changes, save the file with the syntax `filename.xml`. Make a note of the name you select.

3. Navigate to the directory `$ORACLE_HOME/bin`, and use the following syntax to run the command `rconfig`:

```
rconfig input.xml
```

where `input.xml` is the name of the XML input file you configured in step 2.

For example if you create an input XML file called `convert.xml`, then enter the following command

```
$ ./rconfig convert.xml
```

Note: The `Convert verify` option in the `ConvertToRAC.xml` file has three options:

- `Convert verify="YES"`: `rconfig` performs checks to ensure that the prerequisites for single-instance to RAC conversion have been met before it starts conversion
 - `Convert verify="NO"`: `rconfig` does not perform prerequisite checks, and starts conversion
 - `Convert verify="ONLY"`: `rconfig` only performs prerequisite checks; it does not start conversion after completing prerequisite checks
-

Example of an rconfig XML Input File

The following is an example of an XML input file for the rconfig utility. In the example, the XML input file is for converting a single-instance database with ASM to a RAC database with ASM in the same Oracle home.

```
<n:RConfig xsi:schemaLocation="http://www.oracle.com/rconfig">
-
<n:ConvertToRAC>
-
<!--
  Verify does a precheck to ensure all pre-requisites are met, before the
  conversion is attempted. Allowable values are: YES|NO|ONLY
-->
-
<n:Convert verify="YES">
-
<!--
Specify current OracleHome of non-rac database for SourceDBHome
-->
<n:SourceDBHome>/oracle/product/10.2.0/db_1</n:SourceDBHome>
-
<!--
Specify OracleHome where the rac database should be configured. It can be same as
SourceDBHome
-->
<n:TargetDBHome>/oracle/product/10.2.0/db_1</n:TargetDBHome>
-
<!--
Specify SID of non-rac database and credential. User with sysdba role is required
to perform conversion
-->
-
<n:SourceDBInfo SID="sales">
-
  <n:Credentials>
    <n:User>sys</n:User>
    <n>Password>oracle</n>Password>
    <n:Role>sysdba</n:Role>
  </n:Credentials>
</n:SourceDBInfo>
-
<!--
ASMInfo element is required only if the current non-rac database uses ASM Storage
-->
-
<n:ASMInfo SID="+ASM1">
-
  <n:Credentials>
    <n:User>sys</n:User>
    <n>Password>welcome</n>Password>
    <n:Role>sysdba</n:Role>
  </n:Credentials>
</n:ASMInfo>
-
<!--
Specify the list of nodes that should have rac instances running. LocalNode should
be the first node in this nodelist.
-->
-
<n:NodeList>
```

```

<n:Node name="node1"/>
<n:Node name="node2"/>
</n:NodeList>
-
<!--
Specify prefix for rac instances. It can be same as the instance name for non-rac
database or different. The instance number will be attached to this prefix.
-->
<n:InstancePrefix>sales</n:InstancePrefix>
-
<!--
Specify port for the listener to be configured for rac database.If port="",
alistener existing on localhost will be used for rac database.The listener will be
extended to all nodes in the nodelist
-->
<n:Listener port="1551"/>
-
<!--
Specify the type of storage to be used by rac database. Allowable values are
CFS|ASM. The non-rac database should have same storage type.
-->
-
<n:SharedStorage type="ASM">
-
<!--
Specify Database Area Location to be configured for rac database.If this field is
left empty, current storage will be used for rac database. For CFS, this field
will have directory path.
-->
<n:TargetDatabaseArea>+ASMDG</n:TargetDatabaseArea>
-
<!--
Specify Flash Recovery Area to be configured for rac database. If this field is
left empty, current recovery area of non-rac database will be configured for rac
database. If current database is not using recovery Area, the resulting rac
database will not have a recovery area.
-->
<n:TargetFlashRecoveryArea>+ASMDG</n:TargetFlashRecoveryArea>
</n:SharedStorage>
</n:Convert>
</n:ConvertToRAC>
</n:RConfig>

```

Converting Single-Instance Databases to RAC Using Oracle Enterprise Manager

You can use Oracle Enterprise Manager Grid Control to convert a single-instance database to RAC. To use this feature, complete the following steps:

See Also: *Oracle Database Upgrade Guide* for information about upgrading existing Oracle Database installations

1. Log in to Grid Control. From the Grid Control Home page, click the **Targets** tab.
2. On the Targets page, click the **Databases** secondary tab, and click the link in the Names column of the database that you want to convert to RAC.
3. On the Database Instance Home page, click the **Administration** secondary tab.
4. On the Administration page, in the Database Administration Change Database section, click **Convert to Cluster Database**.

5. Log in as the database user SYS with SYSDBA privileges to the database you want to convert, and click **Next**.
6. On the Convert to Cluster Database: Cluster Credentials page, provide a user name and password for the `oracle` user and password of the target database that you want to convert. If the target database is using ASM, then also provide the ASM SYS user and password, and click **Next**.
7. On the Hosts screen, select the host nodes in the cluster that you want to be cluster members in the RAC database installed. When you have completed your selection, click **Next**.
8. On the Convert to Database: Options page, select whether you want to use the existing listener and port number, or specify a new listener and port number for the cluster. Also provide a prefix for cluster database instances on the cluster.

When you have finished entering information, click **Next**, or click **Help** if you need assistance in deciding how to enter information.
9. On the Convert to Cluster Database: Shared Storage page, either select the option to use your existing shared storage area, or select the option to have your database files copied to a new shared storage location. Also, decide if you want to use your existing Flash Recovery area, or if you want to copy your Flash Recovery files to a new Flash Recovery area using files managed by Oracle Database.

When you have finished entering information, click **Next**, or click **Help** if you need assistance in deciding how to enter information.
10. On the Convert to Cluster Database: Review page, review the options you have selected. Click **Submit Job** if you want to proceed to conversion. If you want to change options you have selected, click **Back**. To cancel the conversion, click **Cancel**.
11. On the Confirmation page, click View Job to check the status of the conversion.

Converting Single-Instance ASM to Cluster ASM

To convert a single-instance node using ASM to a RAC node using ASM:

1. Shut down the database instance, the ASM instance, and the listener.
2. Follow the instructions in [Chapter 2](#) and [Chapter 3](#) to configure each node that you want to have as a cluster member.
3. If any cluster member node has had previous versions of Oracle clusterware (Cluster Ready Services or Oracle Clusterware) installed, then ensure that you remove the file `ocr.loc` on any node that has been labeled previously as a cluster node. The file `ocr.loc` is in `/etc/oracle`.
4. log in as the `oracle` user, and run DBCA in silent mode to deconfigure ASM. To run DBCA in silent mode, navigate to the directory `$ORACLE_HOME/bin` and use the following command syntax on the local node:

```
dbca -silent -deleteASM
```

You can de-install the single-instance ASM without losing data.

5. Install Oracle Clusterware on all nodes you intend to have as cluster members, following the directions in [Chapter 4](#).
6. Install Cluster ASM using DBCA. At the Node Selection page, select all the cluster member nodes for which you intend to use ASM to manage storage. When the

ASM Disk Groups page prompts you to select disk groups, select the existing disk groups you used with the single-instance ASM instance that you deleted in step 4.

7. Start up the single-instance Oracle Database.

Post-Conversion Steps

After completing the conversion, note the following recommendations for RAC environments, as described in the RAC documentation:

- Follow the recommendations for using load balancing and transparent application failover, as described in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*
- Use locally managed tablespaces instead of dictionary managed tablespaces to reduce contention and manage sequences in RAC as described in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*
- Follow the guidelines for configuring an interconnect, for using automatic segment space management and for using SRVCTL to administer multiple instances, as described in *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide*

The buffer cache and shared pool capacity requirements in RAC are slightly greater than the requirements for single-instance Oracle databases. Therefore, you should increase the size of the buffer cache by about 10%, and the size of the shared pool by about 15%.

Directory Structure for Oracle Database 10g Oracle Real Application Clusters Environments

This appendix describes the directory structures for Oracle Real Application Clusters (RAC) software environments. This appendix contains the following topics:

- [Understanding the Real Application Clusters Directory Structure](#)
- [Directory Structures for Real Application Clusters](#)

Understanding the Real Application Clusters Directory Structure

When you install Oracle Database 10g with RAC, all subdirectories are under a top-level ORACLE_BASE directory. The ORACLE_HOME and admin directories are also located under ORACLE_BASE.

See Also: *Oracle Database Oracle Clusterware and Oracle Real Application Clusters Administration and Deployment Guide* for further information about the \$ORACLE_HOME and /admin directories

Directory Structures for Real Application Clusters

[Table E-1](#) shows the hierarchical directory tree of a sample optimal flexible architecture (OFA) compliant database for RAC:

Table E-1 Directory Structure for A Sample OFA-Compliant Environment

Root	Second-Level	Third-Level	Fourth-Level	Description
\$ORACLE_BASE				/u01/app/oracle The default ORACLE_BASE directory.
	ORACLE_HOME			/product/10.2.0 The default name of the Oracle home.
	/admin			The administrative directory.
		/db_unique_name		The database unique name; this is the same as dbname when the database name is 8 or fewer characters in length.

Table E-1 (Cont.) Directory Structure for A Sample OFA-Compliant Environment

Root	Second-Level	Third-Level	Fourth-Level	Description
			/bdump /cdump /hdump /pfile /udump	The dump destinations for database server.
\$CRS_home				/u01/crs/oracle/product/10.2.0/app The default name of the Oracle Clusterware home. After you install the software, you must change the permissions of all of the parent directories of the Oracle Clusterware home directory to grant write access only to the root user. Because of this, the Oracle Clusterware home directory must not be a subdirectory of the 10g Release 2 (10.2) Oracle base directory.
		/bin		The subtree for Oracle binaries.
		/network		The subtree for Oracle Net.

See Also: *Oracle Database Administrator's Reference for UNIX-Based Operating Systems* for further information about the \$ORACLE_HOME and /admin directories

How to Stop Processes in an Existing Oracle Real Application Clusters Database, and How to Perform Oracle Clusterware Rolling Upgrades

This appendix describes how to stop processes in an Oracle Real Application Clusters (RAC) database, for one of the following two scenarios:

Scenario One: Stopping processes in an entire database, in preparation for adding additional products to an existing database, or in preparation for patch updates.

Scenario Two: Stopping processes on selected nodes in a database, in preparation for performing a rolling upgrade of Oracle Clusterware from any 10.2 installation to the latest patch set update; for example, you can perform a rolling upgrade from 10.2.0.1 to 10.2.0.3.

This appendix contains the following topics:

- [Back Up the Oracle Software](#)
- [Verify System Readiness for Patches and Upgrades](#)
- [How to Stop Processes in an Existing Oracle Database](#)
- [How to Perform Oracle Clusterware Rolling Upgrades](#)

Back Up the Oracle Software

Before you make any changes to the Oracle software, whether you intend to upgrade or patch part of the database or clusterware, or all of your cluster installation, Oracle recommends that you create a backup of the Oracle software.

Verify System Readiness for Patches and Upgrades

If you are completing a patch update of your database or clusterware, then after you download the patch software, and before you start to patch or upgrade your database, review the Patch Set Release Notes that accompany the patch to determine if your system meets the system requirements for the operating system and the hardware platform.

Use the Cluster Verification Utility to assist you with system checks in preparation for starting a database patch or upgrade.

See Also: *Oracle Database Upgrade Guide*

How to Stop Processes in an Existing Oracle Database

To stop process in an existing Oracle Real Application Clusters Database, where you want to shut down the entire database, complete the following steps.

Shut Down Oracle Real Application Clusters Databases

Shut down any existing Oracle Database instances on each node, with normal or immediate priority.

If Automatic Storage Management (ASM) is running, then shut down all databases that use ASM, and then shut down the ASM instance on each node of the cluster.

Note: To upgrade using Oracle Clusterware or Cluster Ready Services, you must shut down all Oracle Database instances on all cluster nodes before modifying the Oracle software. If you are performing a patch update, review the instructions in the Patch Set Notes for detailed instructions.

Stop All Oracle Processes

Stop all listener and other processes running in the Oracle home directories where you want to modify the database software.

Note: If you shut down ASM instances, then you must first shut down all database instances that use ASM, even if these databases run from different Oracle homes.

Stop Oracle Clusterware or Cluster Ready Services Processes

If you are modifying an Oracle Clusterware or Oracle Cluster Ready Services (CRS) installation, then shut down the following Oracle Database 10g services.

Note: You must perform these steps in the order listed.

1. Shut down any processes in the Oracle home on each node that might be accessing a database; for example, shut down Oracle Enterprise Manager Database Control.

Note: Before you shut down any processes that are monitored by Enterprise Manager Grid Control, set a blackout in Grid Control for the processes that you intend to shut down. This is necessary so that the availability records for these processes indicate that the shutdown was planned downtime, rather than an unplanned system outage.

2. Shut down all Oracle RAC instances on all nodes. To shut down all Oracle RAC instances for a database, enter the following command, where *db_name* is the name of the database:

```
$ oracle_home/bin/srvctl stop database -d db_name
```

3. Shut down all ASM instances on all nodes. To shut down an ASM instance, enter the following command, where *node* is the name of the node where the ASM instance is running:

```
$ oracle_home/bin/srvctl stop asm -n node
```

4. Stop all node applications on all nodes. To stop node applications running on a node, enter the following command, where *node* is the name of the node where the applications are running

```
$ oracle_home/bin/srvctl stop nodeapps -n node
```

5. Log in as the root user, and shut down the Oracle Clusterware or CRS process by entering the following command on all nodes:

```
# CRS_home/bin/crsctl stop crs
```

Stop Oracle Database 10g Processes Before Adding Products or Upgrading

This section provides an overview of what needs to be done before adding additional products to Oracle Database 10g Release 2 (10.2). If you are performing a patch upgrade, then refer to the Database Patch Set Notes for the patch for additional instructions.

Note: You must perform these steps in the order listed.

1. Shut down any processes in the Oracle home on each node that can access a database; for example, shut down Oracle Enterprise Manager Database Control.

Note: Before you shut down any processes that are monitored by Enterprise Manager Grid Control, set a blackout in Grid Control for the processes that you intend to shut down. This is necessary so that the availability records for these processes indicate that the shutdown was planned downtime, rather than an unplanned system outage.

2. Shut down all Oracle RAC instances on all nodes. To shut down all Oracle RAC instances for a database, enter the following command, where *db_name* is the name of the database:

```
$ oracle_home/bin/srvctl stop database -d db_name
```

3. Shut down all ASM instances on all nodes. To shut down an ASM instance, enter the following command, where *node* is the name of the node where the ASM instance is running:

```
$ oracle_home/bin/srvctl stop asm -n node
```

How to Perform Oracle Clusterware Rolling Upgrades

To perform a rolling upgrade, complete all of the following steps in sequence.

- [Copy Patch Software to the Primary Upgrade Node](#)
- [Shut Down Oracle Real Application Clusters Instances on Upgrade Nodes](#)
- [Stop All Oracle Processes on Upgrade Nodes](#)
- [Start OUI and Complete Upgrade Processes on Upgrade Nodes](#)

Note: To perform rolling upgrades, the existing Oracle Clusterware home directory, commonly referred to in Oracle documentation as CRS home, must be located on local directories on the node. You cannot perform rolling upgrades on a shared CRS home directory.

Copy Patch Software to the Primary Upgrade Node

Download the patch software to the primary node on the cluster (the node where you performed initial Oracle Clusterware and Oracle Database installation). Review the patch set Readme to confirm that your system meets the system requirements for the patch set updates, and complete any special instructions for particular environments or configurations.

To download patches, or download the patch note Readme:

1. Log in to OracleMetaLink (<https://metalink.oracle.com>)
2. Click the **Patches & Updates** tab.
3. Search for the patch that you want to install.
4. Click the patch number to open the patch page
From this location, you can download the patch binary, download the patch Readme, and obtain other information regarding the patch update.
5. Download the patch set installation archive to a directory inside the Oracle base directory that meets the following requirements:
 - It is not the existing Oracle home directory, or CRS home directory
 - It is not under an existing Oracle home directory, or CRS home directory
6. Extract the patch set installation archive

Shut Down Oracle Real Application Clusters Instances on Upgrade Nodes

On each node on which you want to perform a rolling upgrade, shut down the Oracle Database instance, with normal or immediate priority.

If Automatic Storage Management (ASM) is running, then for each node that you intend to perform a rolling upgrade, shut down the database that uses ASM, and then shut down the ASM instance on the node.

Note: To upgrade Oracle Clusterware or Cluster Ready Services, you must shut down all Oracle Database instances on all cluster nodes that you intend to upgrade before modifying the Oracle software. If you are performing a patch update, review the instructions in the Patch Set Notes for detailed instructions.

Stop All Oracle Processes on Upgrade Nodes

On each node on which you want to perform a rolling upgrade, before you upgrade Oracle Clusterware or Oracle Cluster Ready Services installations, you must shut down Oracle Database services that use clusterware processes.

Complete the following steps:

Note: You must perform these steps in the order listed.

1. Shut down any processes on each node you intend to upgrade that might be accessing a database, such as Oracle Enterprise Manager Database Control.

Note: Before you shut down any processes that are monitored by Enterprise Manager Grid Control, set a blackout in Grid Control for the processes that you intend to shut down. This is necessary so that the availability records for these processes indicate that the shutdown was planned downtime, rather than an unplanned system outage.

2. Shut down all Oracle RAC instances on each node you intend to upgrade. To shut down Oracle RAC instances on individual nodes in the database, enter the following command, where *db_name* is the name of the database, and *instance_name* is the name of the instance:

```
$ oracle_home/bin/srvctl stop instance -d db_name -i instnce_name
```

Repeat this process on each node of the cluster on which you intend to perform the rolling upgrade.

3. Shut down ASM instances on each node on which you intend to perform the rolling upgrade.

Note: If you shut down ASM instances, then you must first shut down all database instances on the nodes you intend to upgrade that use ASM, even if these databases run from different Oracle homes.

To shut down an ASM instance, enter the following command, where *node* is the name of the node where the ASM instance is running:

```
$ oracle_home/bin/srvctl stop asm -n node
```

4. Stop all node applications on each node on which you intend to perform the rolling upgrade. To stop node applications running on a node, enter the following command, where *node* is the name of the node where the applications are running

```
$ oracle_home/bin/srvctl stop nodeapps -n node
```

5. On each node where you intend to perform the rolling upgrade, shut down the Oracle Clusterware or CRS process by entering the following command as the root user:

```
# CRS_home/bin/crsctl stop crs
```

Start OUI and Complete Upgrade Processes on Upgrade Nodes

To complete the patch upgrade, use the Oracle Universal Installer (OUI) downloaded with the patch update.

Complete the following steps:

1. Start the patch set OUI. At the Welcome window, click **Next**.

2. On the Specify Home Details window, select the CRS home directory, and click **Next**.
3. On the Specify Hardware Cluster Installation Nodes window, select the nodes where you want to perform the upgrade, and click **Next**.
4. Follow further instructions as directed from the OUI windows.
5. At the end of the install, OUI instructs you to run the command to stop Oracle Clusterware.

Open a terminal window, log in as the root user, and enter a command similar to the following on the first node to stop the CRS daemons in the existing Oracle home:

```
# CRS_home/bin/crsctl stop crs
```

6. When you are prompted by OUI, from the terminal window you opened in the previous step, enter a command similar to the following:

```
# CRS_home/install/root102.sh
```

7. When the install script completes, it displays text similar to the following, where *patch_version* displays the patch version you are installing:

```
patch_version patch successfully applied.  
clscfg -upgrade completed successfully
```

This indicates that the upgrade process is complete. The upgraded Oracle Clusterware stack and AUTOSTART resources are started on the node.

Repeat steps 4 and 5 for each node on which you are performing a rolling upgrade.

Managing Oracle Database Port Numbers

This appendix lists the default port numbers and describes how to change the assigned port after installation. It contains the following topics:

- [About Managing Ports](#)
- [Viewing Port Numbers and Access URLs](#)
- [Port Numbers and Protocols of Oracle Components](#)
- [Changing the Oracle Enterprise Management Agent Port](#)
- [Changing the Oracle Enterprise Manager Database Console Ports](#)
- [Changing the iSQL*Plus Ports](#)
- [Changing the Oracle XML DB Ports](#)

About Managing Ports

During installation, Oracle Universal Installer assigns port numbers to components from a set of default port numbers. Many Oracle Database components and services use ports. As an administrator, it is important to know the port numbers used by these services, and to make sure that the same port number is not used by two services on your host.

Most port numbers are assigned during installation. Every component and service has an allotted port range, which is the set of port numbers Oracle Database attempts to use when assigning a port. Oracle Database starts with the lowest number in the range and performs the following checks:

- Is the port used by another Oracle Database installation on the host?
The installation may be up or down at the time; Oracle Database can still detect if the port is used.
- Is the port used by a process that is currently running?
This could be any process on the host, even a non-Oracle Database process.

If the answer to any of the preceding questions is yes, then Oracle Database moves to the next highest port in the allotted port range and continues checking until it finds a free port.

Viewing Port Numbers and Access URLs

In most cases, the Oracle Database component's port number is listed in the tool used to configure the port. In addition, ports for some Oracle Database applications are

listed in the `portlist.ini` file. This file is located in the directory `$ORACLE_HOME/install`.

If you change a port number, it is not updated in the `portlist.ini` file, so you can only rely on this file immediately after installation. To find or change a port number, use the methods described in this appendix.

Port Numbers and Protocols of Oracle Components

The following table lists the port numbers and protocols used by components that are configured during the installation. By default, the first port in the range is assigned to the component, if it is available.

Table G-1 Ports Used in Oracle Components

Component and Description	Default Port Number	Port Range	Protocol
Oracle SQL*Net Listener Allows Oracle client connections to the database over Oracle's SQL*Net protocol. You can configure it during installation. To reconfigure this port, use Net Configuration Assistant.	1521	1521	TCP
Data Guard Shares the SQL*Net port and is configured during installation. To reconfigure this port, use Net Configuration Assistant to reconfigure the Oracle SQL*Net listener.	1521 (same value as the listener)	1521	TCP
Connection Manager Listening port for Oracle client connections to Oracle Connection Manager. It is not configured during installation, but can be configured using Net Configuration Assistant.	1630	1630	TCP
Oracle Management Agent HTTP port for Oracle Management Agent, which is part of Oracle Enterprise Manager. It is configured during installation. "Changing the Oracle Enterprise Management Agent Port" on page G-4 explains how to modify its port number	3938	1830–1849	HTTP
Oracle Enterprise Manager Database Console HTTP port for Enterprise Manager Database Control. It is configured during installation. "Changing the Oracle Enterprise Manager Database Console Ports" on page G-4 explains how to modify its port number.	1158	5500–5519	TCP/HTTP
Oracle Enterprise Manager Database Console RMI port for Enterprise Manager Database Control. It is configured during installation. "Changing the Oracle Enterprise Manager Database Console Ports" on page G-4 explains how to modify its port number.	5520	5520–5539	TCP
Enterprise Manager Database Console JMS port for Enterprise Manager Database Control. It is configured during installation. "Changing the Oracle Enterprise Manager Database Console Ports" on page G-4 explains how to modify its port number.	5540	5540–5559	TCP

Table G–1 (Cont.) Ports Used in Oracle Components

Component and Description	Default Port Number	Port Range	Protocol
<i>i</i> SQL*Plus HTTP port for <i>i</i> SQL*Plus. The port number is automatically assigned during installation. " Changing the <i>i</i>SQL*Plus Ports " on page G-5 explains how to change its port number.	5560	5560–5579	TCP/HTTP
<i>i</i> SQL*Plus RMI port for <i>i</i> SQL*Plus. The port number is automatically assigned during installation. " Changing the <i>i</i>SQL*Plus Ports " on page G-5 explains how to change its port number.	5580	5580–5599	TCP
<i>i</i> SQL*Plus JMS port for <i>i</i> SQL*Plus. The port number is automatically assigned during installation. " Changing the <i>i</i>SQL*Plus Ports " on page G-5 explains how to change its port number.	5600	5600–5619	TCP
Oracle Ultra Search HTTP port for Oracle Ultra Search. Its port number is assigned automatically when you install Oracle Ultra Search, by using the Custom installation type. " Changing the Oracle Ultra Search Ports " explains how to change its port number.	5620	5620–5639	TCP/HTTP
Oracle Ultra Search RMI port for Oracle Ultra Search. Its port number is assigned automatically when you install Oracle Ultra Search, by using the Custom installation type. " Changing the Oracle Ultra Search Ports " explains how to change its port number.	5640	5640–5659	TCP
Oracle Ultra Search JMS port for Oracle Ultra Search. Its port number is assigned automatically when you install Oracle Ultra Search, by using the Custom installation type. " Changing the Oracle Ultra Search Ports " explains how to change its port number.	5660	5660–5679	TCP
Oracle XML DB The Oracle XML DB HTTP port is used if Web-based applications need to access an Oracle database from an HTTP listener. It is configured during installation, but you cannot view it afterward. " Changing the Oracle XML DB Ports " explains how to change its port number.	Dynamic	Dynamic	HTTP
Oracle XML DB The Oracle XML DB FTP is used when applications need to access an Oracle database from an FTP listener. It is configured during installation, but you cannot view it afterward. " Changing the Oracle XML DB Ports " explains how to change its port number.	Dynamic	Dynamic	FTP
Oracle Real Application Clusters The port number is assigned automatically during installation. You cannot view or modify it afterward.	Dynamic	Dynamic	UDP

Table G–1 (Cont.) Ports Used in Oracle Components

Component and Description	Default Port Number	Port Range	Protocol
Oracle Clusterware CRS daemon (Oracle Cluster Ready Services Daemon) internode connection. The port number is assigned automatically during installation. You cannot view or modify it afterward.	49896	49896	TCP
Cluster Synchronization Service (CSS) CSS daemon internode connection for the GM layer. The port number is assigned automatically during installation. You cannot view or modify it afterward.	49895	49895	TCP
Oracle Cluster Registry The port number is assigned automatically during installation. You cannot view or modify it afterward.	Dynamic	Dynamic	TCP
Oracle Event Manager The port number is assigned automatically during installation. You cannot view or modify it afterward.	49897	49897–49898	TCP
Cluster Manager The port number is assigned automatically during installation. You cannot view or modify it afterward.	Dynamic	Dynamic	TCP

Changing the Oracle Enterprise Management Agent Port

To find the current setting for the Oracle Management agent port, search for `EMD_URL` in the `ORACLE_BASE/ORACLE_HOME/host_sid/sysman/config/emd.properties` file.

To change the Oracle Management Agent HTTP port, use the `emca -reconfig ports` command:

```
emca -reconfig ports -AGENT_PORT 1831
```

Changing the Oracle Enterprise Manager Database Console Ports

To find the current HTTP, RMI, and JMS port settings, search in the following files:

- **HTTP port:** Search for `REPOSITORY_URL` in the `ORACLE_BASE/ORACLE_HOME/host_sid/sysman/config/emd.properties` file.
- **RMI port:** Search for the port attribute in the `rmi-server` tag in the `ORACLE_BASE/ORACLE_HOME/oc4j/j2ee/OC4J_DBConsole_host_sid/config/rmi.xml` file.
- **JMS port:** Search for the port attribute in the `jms-server` tag in the `ORACLE_BASE/ORACLE_HOME/oc4j/j2ee/OC4J_DBConsole_host_sid/config/jms.xml` file.

To change the Oracle Enterprise Manager Database Console ports, use the `emca -reconfig ports` command:

```
ORACLE_BASE/ORACLE_HOME/bin> emca -reconfig ports option setting
```

where *option* can be:

- `DBCONTROL_HTTP_PORT`: Sets the HTTP port, for example:

```
emca -reconfig ports -DBCONTROL_HTTP_PORT 1820
```

- **RMI_PORT:** Sets the RMI port, for example:

```
emca -reconfig ports -RMI_PORT 5520
```

- **JMS_PORT:** Sets the JMS port, for example:

```
emca -reconfig ports -JMS_PORT 5521
```

You can enter multiple `-reconfig port` settings in one line, for example:

```
emca -reconfig ports -DBCONTROL_HTTP_PORT 1820 -AGENT_PORT 1821 -RMI_PORT 5520
```

Changing the iSQL*Plus Ports

The following sections describe how to change the iSQL*Plus ports.

Changing the HTTP Port

To change the HTTP port, edit the following files:

- `ORACLE_BASE/ORACLE_HOME/host_sid/sysman/config/emoms.properties`

Modify the following port parameters (for example, 5560) in the file:

```
oracle.sysman.db.isqlplusUrl=http://host.domain:5560/isqlplus/dynamic
oracle.sysman.db.isqlplusWebDBAUrl=http://host.domain:5560/isqlplus/dynamic
```

- `ORACLE_BASE/ORACLE_HOME/oc4j/j2ee/isqlplus/config/http-web-site.xml`

Modify the port attribute of the web-site element:

```
<web-site port="5560" ...>
```

Changing the RMI Port

To change the RMI port, modify the port attribute of the `rmi-server` element in the `ORACLE_BASE/ORACLE_HOME/oc4j/j2ee/isqlplus/config/rmi.xml` file:

```
<rmi-server port="5580" ...>
```

Changing the JMS Port

To change the JMS port, modify the port attribute of the `jms-server` element in the `ORACLE_BASE/ORACLE_HOME/oc4j/j2ee/isqlplus/config/jms.xml` file:

```
<jms-server port="5600" ...>
```

Changing the Oracle Ultra Search Ports

The following sections describe how to change the Oracle Ultra Search Ports.

Changing the HTTP Port

To change the HTTP port, modify the port attribute of the web-site element in the `$ORACLE_HOME/oc4j/j2ee/OC4J_SEARCH/config/http-web-site.xml` file:

```
<web-site port="5620" ...>
```

Changing the RMI Port

To change the RMI port, modify the `port` attribute of the `rmi-server` element in the `$ORACLE_HOME/oc4j/j2ee/OC4J_SEARCH/config/rmi.xml` file:

```
<rmi-server port="5640"...>
```

Changing the JMS Port

To change the JMS port, modify the `port` attribute of the `jms-server` element in the `$ORACLE_HOME/oc4j/j2ee/OC4J_SEARCH/config/jms.xml` file:

```
<jms-server port="5660"...>
```

Changing the Oracle XML DB Ports

To change the Oracle XML FTP and HTTP ports, you need to run the `catxdbdbca.sql` script, which in a default installation is located in `$ORACLE_HOME/rdbms/admin`.

To change the Oracle XML DB ports:

1. Check that the Oracle listener is running. To do so, in the Windows **Services** utility, make sure that the Oracle TNS Listener service (for example, `OracleOraDb10g_home1TNSListener`) is set to **Started**.

If you cannot start the listener, then refer to *Oracle Database Net Services Administrator's Guide*.

2. log in to SQL*Plus or iSQL*Plus as SYS or XDB using the SYSDBA role.

For example, to log in to SQL*Plus as SYS using the password `welcome`:

```
SQL> sqlplus sys/welcome as sysdba
```

3. Run the `catxdbdbca.sql` script.

For example, to use 2200 for the FTP port and 8200 for the HTTP port, and assuming your Oracle home is in the following location, enter the following command:

```
SQL> /oracle/product/10.20.0/db_1/rdbms/admin/catxdbdbca.sql 2200 8200
```

4. Exit SQL*Plus or iSQL*Plus.

Index

A

- Additional Real Application Clusters
 - documentation, 1-1
- Advanced
 - configuration type, 5-4, 5-5
- aio_task_max_num subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- API libraries
 - for Oracle Clusterware, xvii
- architecture
 - Optimal Flexible Architecture (OFA), 5-5
- archive logs
 - destinations, converting to cluster database, D-1
- ASM
 - and OFA, xvii
 - benefits of, 1-9
 - characteristics of failure groups, 1-9
 - compared to logical volume managers, 1-9
 - compared to RAID, 1-9
 - database recovery area for, 1-11
 - disk groups, 1-9
 - failure groups, 1-9
 - overview, 1-9
 - recommendations for disk groups, 1-9
 - redundancy levels, 1-10
- ASM only installation, 1-10
- Automatic Storage Management
 - characteristics of failure groups, 3-14
 - disk groups, 3-13
 - failure groups, 3-13
 - examples, 3-14
 - identifying, 3-14
 - recommendations for disk groups, 3-13
 - space required for preconfigured database, 3-14
 - storage option for data files, 3-2
- automatic undo management, 9-3
- Available
 - service configuration policy, 6-2

B

- background process
 - crsd, 4-10
 - evmd, 4-10
 - ocssd, 4-10

- backups
 - and converting to cluster database, D-1
- base directory
 - See* Oracle base directory
- Bash shell
 - default user startup file, 2-15
- .bash_profile file, 2-15
- Basic
 - TAF failover policy, 6-3
- Bourne shell
 - default user startup file, 2-15

C

- C compiler
 - requirement on Tru64 UNIX, 2-23
- C shell
 - default user startup file, 2-15
- C++ compiler
 - requirement on Tru64 UNIX, 2-23
- checking existence of the nobody user, 2-9
- checking kernel parameters, 2-25
- checking Tru64 version, 2-23
- chmod command, 2-33, 2-34, 3-7
- chown command, 2-33, 2-34, 3-7
- cluster configuration file, 4-8
- cluster database
 - installed configuration, 9-2
- cluster file system
 - database recovery area and, 1-11
 - single-instance storage option for data files, 3-3
 - storage option for data files, 3-2
- Cluster Manager
 - ports, ranges and protocol, G-4
- cluster name
 - requirements for, 4-6
- cluster nodes
 - private node names, 4-6
 - public node names, 4-6
 - specifying uids and gids, 2-9
 - virtual node names, 4-6
- Cluster Ready Services
 - upgrading, 4-4
- Cluster Synchronization Service Daemon, xvii, 1-12
- Cluster Synchronization Services, xvii, 1-6, 1-12, 4-4
- Cluster Synchronization Services (CSS)

- ports, ranges and protocol, G-4
- Cluster Verification Utility
 - about, xv, 1-2
 - DBCA database creation stage readiness check, 6-3
 - hardware and operating system setup stage verification, 2-28
 - Oracle Clusterware configuration check, 4-1
 - shared storage area check, 3-5
 - user equivalency troubleshooting, 4-2
 - verifying readiness for database installation, 5-1
- clusterware diagnostics, A-2
- commands, 2-34
 - chmod, 2-33, 2-34, 3-7
 - chown, 2-33, 2-34, 3-7
 - emca, 7-4
 - env, 2-34
 - groupadd, 2-7
 - gsdctl, 2-37
 - id, 2-9
 - mkdir, 2-33, 2-34, 3-7
 - passwd, 2-10
 - ps, 2-36
 - swap, 2-17
 - swapon, 2-17
 - sysconfig, 2-25
 - umask, 2-15
 - unset, 2-34
 - unsetenv, 2-34
 - useradd, 2-8, 2-10
 - xhost, 2-4
 - xterm, 2-4
- components
 - created when using DBCA, 9-2
- configuration types
 - Advanced, 5-4
 - Data Warehouse, 5-4
 - Do not create a starter database, 5-4
 - General Purpose, 5-4
 - Transaction Processing, 5-4
- configuring kernel subsystem attributes, 2-25
- connection load balancing, 9-4
- Connection Manager
 - ports, ranges and protocol, G-2
- control file
 - installed configuration, 9-3
- control files, 1-12
 - described, 9-3
 - raw devices for, 3-17
- convert to cluster database
 - administrative considerations, D-1
 - from non-cluster system, D-2
 - from single-instance, D-4
 - from single-instance to Real Application Clusters, D-1
 - post-conversion, D-13
 - reasons not to convert, D-2
 - to Real Application Clusters from single-instance Oracle databases, D-1
- converting

- from single instance to Oracle Real Application Clusters, D-7
- from single-instance to Real Application Clusters, B-1, D-11
- to Real Application Clusters from single-instance Oracle databases, B-1
- with rconfig, D-7
- create database
 - using scripts, B-1
- creating
 - Real Application Clusters database
 - with Database Configuration Assistant, 5-5, 6-1, 6-4
- cross-node registration, 9-4
- CRSD, 4-10
- CSD
 - download location for MQSeries
 - on Tru64 UNIX, 2-24
 - requirements
 - on Tru64 UNIX, 2-24
- CSS, xvii, 1-6, 1-12, 4-4
 - CCSD, xvii
 - OCCSD, 1-12, 4-4
- CSSD, xvii
- custom database
 - failure groups for Automatic Storage Management, 3-14
 - requirements when using ASM, 1-10
 - requirements when using Automatic Storage Management, 3-14
- Custom installation type
 - reasons for choosing, 2-5
- CVU
 - See* Cluster Verification Utility

D

- data files
 - creating separate directories for, 3-7
 - setting permissions on data file directories, 3-7
 - single-instance database storage options, 3-3
 - storage options, 3-2
- Data Guard
 - ports, ranges and protocol, G-2
- data loss
 - minimizing with ASM, 1-9
 - minimizing with Automatic Storage Management, 3-14
- Data Warehouse
 - configuration type, 5-4
- database
 - ASM requirements, 1-10
 - components, created when using DBCA, 9-2
- Database Configuration Assistant
 - and symbolic link to scp, 2-11
 - ASM Disk Groups page, 6-5
 - components created by, 9-2
 - control files, 9-3
 - creating Real Application Clusters database
 - after installation, 6-4

- during installation, 5-5, 6-1
- datafiles, 9-2
- deleting databases with, 6-6
- deleting Real Application Clusters databases, 6-6
- initialization parameter files, 9-3
- Initialization Parameters page, 6-5
- List of Cluster Databases page, 6-6
- Operations page, 6-6
- raw storage requirements, C-1
- Recovery Configuration page, 6-5
- redo log files, 9-3
- rollback segments, 9-3
- Summary dialog, 6-6
- tablespaces, 9-2
- using, 6-1
- Welcome page, 6-4
- database configuration type
 - selecting, 5-4
- database creation using scripts, B-1
- database recovery area
 - shared storage requirement for, 1-11
- databases
 - Automatic Storage Management requirements, 3-14
- datafiles, 1-12
 - and DBCA, 9-2
 - described, 9-2
 - managing with ASM, 1-9
 - minimum disk space for, 3-11
 - recommendations for file system, 3-11
- dba group
 - and SYSDBA privilege, 2-5
 - creating, 2-7
 - creating on other nodes, 2-9
 - description, 2-5
- DBCA
 - delete database, 6-6
- DBCA_RAW_CONFIG environment variable, 3-19
- dedicated servers, 9-4
- default file mode creation mask
 - setting, 2-15
- de-install Oracle Clusterware software, 5-9
- de-install Oracle Database software, 5-7
- delete database with DBCA, 6-6
- df command, 2-16, 2-17, 2-18
- diagnostics, A-2
- directory
 - creating separate data file directories, 3-7
 - database file directory, 3-11
 - Oracle base directory, 2-29
 - Oracle home directory, 2-31
 - Oracle Inventory directory, 2-30
 - oraInventory, 2-30
 - permission for data file directories, 3-7
- directory structure, E-1
- disk devices
 - managing with ASM, 1-9
- disk group
 - ASM, 1-9
 - Automatic Storage Management, 3-13

- recommendations for ASM disk groups, 1-9
- recommendations for Automatic Storage Management disk groups, 3-13
- disk space
 - checking, 2-18
 - requirements for preconfigured database in Automatic Storage Management, 3-14
- disks
 - raw voting disk, 3-8
- DISPLAY environment variable
 - setting, 2-15, 2-16
- Do not create a database
 - configuration type, 5-4
- documentation
 - Oracle Clusterware, 1-1
 - Oracle Real Application Clusters Administration and Deployment Guide, 1-2
 - Real Application Clusters, 1-1
- dupatch command, 2-24

E

- Easy Connect, 9-11
- emulator
 - installing from X emulator, 2-4
- env command, 2-34
- environment
 - checking settings, 2-34
 - configuring for oracle user, 2-15
- environment variables
 - DBCA_RAW_CONFIG, 3-19
 - DISPLAY, 2-15, 2-16
 - ORACLE_BASE, 2-15, 2-30, 2-33
 - ORACLE_HOME, 2-15, 2-34, 2-36
 - ORACLE_SID, 2-15
 - PATH, 2-15
 - removing from shell startup file, 2-15
 - SHELL, 2-15
 - TEMP and TMPDIR, 2-16, 2-17
 - TNS_ADMIN, 2-34
- error messages
 - Real Application Clusters management tools, A-2
 - /etc/sysconfigtab file, 2-26
- EVMD, 4-10
- EXAMPLE tablespace
 - raw device for, 3-17
- examples
 - Automatic Storage Management failure groups, 3-14
 - Oracle base directories, 2-29
- exec_disable_arg_limit subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- external jobs
 - user required for, 2-5
- external redundancy
 - ASM redundancy level, 1-10
- extjob executable
 - user required for, 2-5

F

- failover
 - and service registration, 9-4
 - of single-instance databases using Oracle Clusterware, 3-3
- failure group
 - ASM, 1-9
 - Automatic Storage Management, 3-13
 - characteristics of ASM failure group, 1-9
 - characteristics of Automatic Storage Management failure group, 3-14
 - examples of Automatic Storage Management failure groups, 3-14
- features, new, xv
- fifo_do_adaptive subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- file mode creation mask
 - setting, 2-15
- file system
 - appropriate for Oracle base directory, 2-32, 2-33
 - storage option for data files, 3-2
 - storage option for single instance data files, 3-3
 - using for datafiles, 3-11
- files
 - .bash_profile, 2-15
 - control files
 - raw devices for, 3-17
 - editing shell startup file, 2-15
 - /etc/sysconfigtab, 2-26
 - .login, 2-15
 - oraInst.loc, 2-31
 - oratab, 2-32
 - password file
 - raw device for, 3-17
 - .profile, 2-15
 - raw device mapping file, 3-18
 - redo log files
 - raw devices for, 3-17
 - server parameter file
 - raw devices for, 3-17
 - SPFILE
 - raw devices for, 3-17
- filesets, 2-22
- Flash Recovery
 - and files managed by Oracle, D-12

G

- General Purpose
 - configuration type, 5-4
- gh_chunks subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- gid
 - identifying existing, 2-9
 - specifying, 2-10
 - specifying on other nodes, 2-9
- Global Services Daemon
 - shutting down, 2-37
- group IDs
 - identifying existing, 2-9

- specifying, 2-10
 - specifying on other nodes, 2-9
- groups
 - checking for existing oinstall group, 2-6
 - creating identical groups on other nodes, 2-9
 - creating the dba group, 2-7
 - creating the oinstall group, 2-6
 - creating the oper group, 2-7
 - oinstall, 2-5
 - OSDBA group (dba), 2-5
 - OSOPER group (oper), 2-5
 - required for oracle user, 2-5
 - specifying when creating users, 2-10
 - using NIS, 2-6, 2-9
- gsd
 - shutting down, 2-37

H

- hardware requirements, 2-17
- high redundancy
 - ASM redundancy level, 1-10
- home directory
 - See* Oracle home directory
- HP Tru64
 - software requirements for, 2-22

I

- id command, 2-9
- initialization parameter files, 9-3
 - for instances, 8-1
 - listener parameters, 9-5
- initialization parameters
 - DISPATCHERS, 9-4
 - LOCAL_LISTENER, 9-4
 - REMOTE_LISTENER, 9-4, 9-8
- installation
 - directory structure, E-1
 - ldap.ora file, 9-6
 - listener.ora file, 9-5
 - non-interactive, 1-7, B-1
 - of additional products after installation is completed, 6-6
 - overview, 1-7
 - requirements, hardware, 1-2
 - requirements, software, 1-2
 - tnsnames.ora file, 9-6
 - using cluster configuration file, 4-8
 - verifying raw devices, 6-4
- installation types
 - and ASM requirements, 1-10
 - and Automatic Storage Management requirements, 3-14
- instance
 - instance identifier (SID), 2-15
 - preferences, 6-2
- instances
 - initialization parameter files, 8-1
- ipc

- kernel subsystem on Tru64 UNIX, 2-26
- iSQL*Plus
- ports
 - changing, G-5
 - ranges and protocol, G-3

J

- JDK requirements, 2-22

K

- kernel
 - subsystem attributes, 2-25
- kernel parameters
 - checking, 2-25
 - making changes persist on Tru64 UNIX, 2-26
- kernel subsystem
 - configuring on HP Tru64, 2-25
- Korn shell
 - default user startup file, 2-15

L

- ldap.ora file, 9-6
 - creating, 9-6
 - default configuration, 9-6
- Lightweight Directory Access Protocol (LDAP), 9-6
- List of Cluster Databases page, 6-6
- listener
 - automatic migration from 10.1 to 10.2, 6-3
 - identifying Oracle home for, 2-36
 - local, 9-4
 - lsnrctl command, 2-37
 - registration, 9-6
 - stopping, 2-36, 2-37
 - stopping existing listener process, 2-35
- listener.ora file, 9-5
 - configuring, 9-4
 - default configuration, 9-5
- listeners
 - listener.ora file, 9-5
- load balancing
 - and service registration, 9-4
- local device
 - using for datafiles, 3-11
- local listener, 9-4
- logical volume manager
 - See LVM
- .login file, 2-15
- lsnrctl command, 2-37
- LVM
 - compared to ASM, 1-9
 - recommendations for ASM, 1-9
 - recommendations for Automatic Storage Management, 3-13

M

- mapping file
 - for raw devices, 3-18

- mask
 - setting default file mode creation mask, 2-15
- max_async_req subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- max_objs subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- max_per_proc_address_space subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- max_per_proc_data_size subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- max_per_proc_stack_size subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- max_sessions subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- memory requirements, 2-17
- MetaLink
 - Oracle patch updates, 7-1
- migration
 - from single-instance, D-2
- mkdir command, 2-33, 2-34, 3-7
- mode
 - setting default file mode creation mask, 2-15
- Motif
 - requirement on Tru64 UNIX, 2-22
- mount point
 - for Oracle base directory, 2-29
- MQSeries
 - checking requirements on Tru64 UNIX, 2-24
 - CSD download location
 - for Tru64 UNIX, 2-24
 - CSDs required
 - on Tru64 UNIX, 2-24
- msg_size subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- multiple oracle homes, 1-7, 2-8, 3-8
- multiple voting disks, xvii, 1-6

N

- Net naming methods, 9-11
- net service names, 9-7
- network configuration files
 - ldap.ora.ora, 9-6
 - listener.ora, 9-5
 - sqlnet.ora, 9-11
 - tnsnames.ora, 9-6
- network directory, E-2
- Network Information Services
 - See NIS
- new features, xv
- new_wire_method
 - obsoleted, 2-26
- NIS
 - alternative to local users and groups, 2-6
- nobody user
 - checking existence of, 2-9
 - description, 2-5
- node applications, 6-1
- None
 - TAF failover policy, 6-3

- non-interactive installation, 1-7
- normal redundancy
 - ASM redundancy level, 1-10
- Not used
 - service configuration policy, 6-2

O

- OCCSD, 4-4, 4-10
- OCR
 - installed configuration, 9-1
 - mirroring, 3-6
 - raw device for, 3-8
- OCR contents, 9-1
- OCR. *See* Oracle Cluster Registry
- OCSSD, 1-12
- OCSSD. *See* CSSD
- OFA
 - and ASM, xvii
 - and Oracle Clusterware, xvi
 - recommendations for Oracle base directory, 2-29
 - recommended path for Oracle base directory, 2-29
 - recommended path for Oracle home directory, 2-31
 - recommended path for Oracle Inventory directory, 2-30
- oinstall group
 - checking for existing, 2-6
 - creating, 2-6
 - creating on other nodes, 2-9
 - description, 2-5
- olsnodes command, A-2
- oper group
 - and SYSOPER privilege, 2-5
 - creating, 2-7
 - creating on other nodes, 2-9
 - description, 2-5
- operating system
 - checking version of Tru64, 2-23
- operating system account users
 - requirements, 2-5
- operating system groups
 - OSDBA (dba), 2-5
 - OSOPER (oper), 2-5
 - requirements, 2-5
- operating system requirements, 2-22
- operating system subsets
 - requirement for Tru64 UNIX, 2-22
- operating system version
 - requirement for Tru64 UNIX, 2-22
- Optimal Flexible Architecture
 - and ASM, xvii
 - and Oracle Clusterware, xvi
 - See* OFA
- Optimal Flexible Architecture (OFA), 5-5
- Oracle base directory
 - and ORACLE_BASE environment variable, 2-30
 - creating, 2-33, 2-34
 - creating new, 2-32
 - description, 2-29
 - determining disk space on, 2-32
 - equivalent directory on Windows, 2-29
 - examples, 2-29
 - identifying appropriate file system, 2-32, 2-33
 - identifying existing, 2-31
 - mount point for, 2-29
 - recommended path, 2-29
 - relationship with Oracle Software Owner user, 2-29
 - requirement for, 2-29
 - requirement for RAC installations, 2-33
 - requirements for existing directory, 2-32
- Oracle Cluster Registry
 - configuration of, 4-7
 - See* OCR
- Oracle Cluster Registry port, G-4
- Oracle Clusterware
 - and OFA, xvi
 - and single-instance databases, 3-3
 - API libraries for, xvii
 - documentation, 1-1
 - installing, 4-1
 - installing with Oracle Universal Installer, 4-7
 - ports, ranges and protocol, G-4
 - raw device for OCR, 3-8
 - raw device for voting disk, 3-8
 - rolling upgrade of, 4-4
- Oracle Database
 - creating data file directories, 3-7
 - data file storage options, 3-2
 - minimum disk space requirements, 3-11
 - privileged groups, 2-5
 - requirements with ASM, 1-10
 - requirements with Automatic Storage Management, 3-14
 - setting ORACLE_SID environment variable, 2-15
 - single instance data file storage options, 3-3
- Oracle Database Upgrade Assistant, 6-3, D-1
- Oracle Enterprise Management Agent
 - ports
 - changing, G-4
 - ranges and protocol, G-2
- Oracle Enterprise Manager
 - Database Control, 7-4
 - post-installation configuration, 7-3
 - using to convert single-instance databases to Real Application Clusters, D-11
- Oracle Enterprise Manager Database Console
 - ports
 - changing, G-4
 - ranges and protocol, G-2
- Oracle Event Manager
 - ports, ranges and protocol, G-4
- Oracle home directory
 - description, 2-31
 - identifying for listener, 2-36
 - recommended path, 2-31
 - requirement for, 2-31
 - requirements, 2-31

- using to identify Oracle base directory, 2-32
- Oracle home name, 2-31
- Oracle Inventory
 - description, 2-30
- Oracle Inventory directory
 - description, 2-30
 - recommended path, 2-30
- Oracle Inventory group
 - checking for existing, 2-6
 - creating, 2-6, 2-7
 - creating on other nodes, 2-9
 - description, 2-5
- Oracle Messaging Gateway
 - checking requirements on Tru64 UNIX, 2-24
 - CSD requirements
 - on Tru64 UNIX, 2-24
- Oracle Net
 - identifying Oracle home for listener, 2-36
 - lsnrctl command, 2-37
 - stopping existing listener, 2-35
 - stopping listener, 2-36
 - stopping the listener, 2-37
- Oracle Net Configuration Assistant
 - and symbolic link to scp, 2-11
- Oracle Notification Server Configuration Assistant, 4-7
- Oracle Private Interconnect Configuration Assistant, 4-7
- Oracle Real Application Clusters
 - ports
 - ranges and protocol, G-3
- Oracle Software Owner user
 - configuring environment for, 2-15
 - creating, 2-8
 - creating on other nodes, 2-9
 - description, 2-5
 - determining default shell, 2-15
 - relationship with Oracle base directory, 2-29
 - required group membership, 2-5
- Oracle Spatial
 - Motif requirement on Tru64 UNIX, 2-22
 - requirement for example programs
 - on Tru64 UNIX, 2-22
- Oracle SQL*Net Listener
 - ports
 - ranges and protocol, G-2
- Oracle Ultra Search
 - ports
 - changing, G-5
 - ranges and protocol, G-3
- Oracle Universal Installer
 - and Oracle Clusterware, 4-7
 - overview of processing, 1-7
 - Welcome page, 4-7, 5-5, 5-10
- oracle user
 - configuring environment for, 2-15
 - creating, 2-8
 - creating on other nodes, 2-9
 - description, 2-5
 - determining default shell, 2-15

- relationship with Oracle base directory, 2-29
 - required group membership, 2-5
- Oracle XML DB
 - ports
 - changing, G-6
 - ranges and protocol, G-3
- ORACLE_BASE environment variable, 2-30, 2-33
 - removing from shell startup file, 2-15
 - setting, 2-15
- ORACLE_HOME environment variable
 - removing from shell startup file, 2-15
 - setting, 2-36, 7-4
 - unsetting, 2-34
- ORACLE_SID environment variable
 - removing from shell startup file, 2-15
 - setting, 2-15, 7-4
- Oracle9i
 - checking for listener, 2-36
- Oracle9i upgrades
 - stopping processes, 2-35
- OracleMetaLink, 7-1
- oraInst.loc file, 2-31
- oraInventory
 - creating, 2-7
- oraInventory directory
 - See* Oracle Inventory directory
- oratab file, 9-2
 - format, 2-32
 - location of oratab file, 2-32
- OSDBA group
 - and SYSDBA privilege, 2-5
 - creating, 2-7
 - creating on other nodes, 2-9
 - description, 2-5
- OSOPER group
 - and SYSOPER privilege, 2-5
 - creating, 2-7
 - creating on other nodes, 2-9
 - description, 2-5
- OUI
 - see* Oracle Universal Installer

P

- parameter file search order, 8-2
- parameters
 - initialization, 8-1
- partition
 - using with ASM, 1-9
 - using with Automatic Storage Management, 3-13
- partitions
 - adding to an existing database, 7-5
 - creating raw partitions, 3-8, 3-17, 7-5
 - required sizes for raw devices, 3-8
- passwd command, 2-10
- password file
 - raw device for, 3-17
- patch updates
 - download, 7-1
 - install, 7-1

- OracleMetaLink, 7-1
- patch upgrades, F-3
 - rolling upgrades, F-3
- patches
 - download location for Tru64 UNIX, 2-24
 - requirements on Tru64 UNIX, 2-24
- PATH environment variable
 - setting, 2-15
- PC X server
 - installing from, 2-4
- per_proc_address_space subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- per_proc_data_size subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- per_proc_stack_size subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- permissions
 - for data file directories, 3-7
 - for Oracle base directory, 2-33, 2-34
- physical RAM requirements, 2-17
- portlist.ini file, G-1
- ports
 - access URLs, G-1
 - Cluster Manager, ranges and protocol, G-4
 - Cluster Synchronization Services, ranges and protocol, G-4
 - configured for applications, G-1
 - Connection Manager, ranges and protocol, G-2
 - Data Guard, ranges and protocol, G-2
 - default ranges, G-1
 - iSQL*Plus
 - changing, G-5
 - ranges and protocol, G-3
 - Oracle Cluster Registry, G-4
 - Oracle Clusterware, ranges and protocol, G-4
 - Oracle Enterprise Management Agent
 - changing, G-4
 - ranges and protocol, G-2
 - Oracle Enterprise Manager Database Console
 - changing, G-4
 - ranges and protocol, G-2
 - Oracle Event Manager, ranges and protocol, G-4
 - Oracle Real Application Clusters
 - ranges and protocol, G-3
 - Oracle SQL*Net Listener
 - ranges and protocol, G-2
 - Oracle Ultra Search
 - changing, G-5
 - ranges and protocol, G-3
 - Oracle XML DB
 - changing, G-6
 - ranges and protocol, G-3
- post-installation
 - Oracle Enterprise Manager configuration, 7-3
 - patch download and install, 7-1
 - product configuration, 7-2
 - root.sh back up, 7-3
 - user accounts setup, 7-4
- Precompilers
 - requirements on Tru64 UNIX, 2-23

- preconfigured database
 - Automatic Storage Management disk space requirements, 3-14
 - requirements when using ASM, 1-10
 - requirements when using Automatic Storage Management, 3-14
- preconfigured database installation types, 5-4
- Preferred
 - service configuration policy, 6-2
- pre-installation
 - raw device creation, C-1
- privileged groups
 - for Oracle Database, 2-5
- Pro*C/C++
 - requirements on Tru64 UNIX, 2-23
- proc
 - kernel subsystem on Tru64 UNIX, 2-26
- process
 - stopping existing, 2-35
 - stopping existing listener process, 2-35
 - stopping listener process, 2-36
- .profile file, 2-15
- ps command, 2-36

R

- RAC
 - configuring disks for raw devices, 3-17
 - requirements for Oracle base directory, 2-33
- RAC high availability extensions
 - configuring services for, 6-2
 - TAF policies for, 6-2
- rad_gh_regions attribute
 - recommended value on Tru64 UNIX, 2-26
- RAID
 - and mirroring OCR and voting disk, 3-6
 - compared to ASM, 1-9
 - recommended ASM redundancy level, 1-10
 - recommended Automatic Storage Management redundancy level, 3-13
 - using for Oracle datafiles, 3-11
- RAM requirements, 2-17
- raw device
 - for OCR, 3-8
 - for password file, 3-17
 - for server parameter file, 3-17
 - for SPFILE, 3-17
 - for voting disk, 3-8
- raw device sizes, 3-8
- raw devices
 - creating a raw device mapping file, 3-18
 - creating raw partitions, 3-8, 3-17
 - Database Configuration Assistant, C-1
 - for control files, 3-17
 - for EXAMPLE tablespace, 3-17
 - for redo log files, 3-17
 - for SYSAUX tablespace, 3-17
 - for SYSTEM tablespace, 3-17
 - for TEMP tablespace, 3-17
 - for UNDOTBS tablespace, 3-17

- for USER tablespace, 3-17
- required sizes, 3-8
- setting up, C-1
- storage option for data files, 3-2
- value for DBCA_RAW_CONFIG environment variable, 3-19
- verification, 6-4
- raw storage
 - Database Configuration Assistant requirements, C-1
- RBS tablespace
 - description, 9-3
- rconfig, D-7
- rdg
 - kernel subsystem on Tru64 UNIX, 2-26
- rdg_auto_msg_wires subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- rdg_max_auto_msg_wires subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- readme.txt file, G-1
- Real Application Clusters
 - components, 1-11
 - databases, deleting, 6-6
 - installation requirements, 1-2
 - installed components of, 1-12
 - management tools error messages, A-2
 - overview, 1-1, 6-1, 9-1
 - raw device setup, C-1
- recovery files
 - shared storage requirement for, 1-11
- redo log file
 - installed configuration, 9-3
- redo log files, 1-12
 - described, 9-3
 - raw devices for, 3-17
- redundancy level
 - and space requirements for preconfigured database, 3-14
 - for ASM, 1-10
- redundant array of independent disks
 - See* RAID
- registration
 - cross-node, 9-4
- requirements
 - hardware, 2-17
- rollback segments
 - described, 9-3
- rolling upgrade
 - of Oracle Database with patch, F-3
 - Oracle Clusterware, 4-4
- root user
 - logging in as, 2-4
- root.sh, 4-7
 - back up, 7-3
- rt
 - kernel subsystem on Tru64 UNIX, 2-26

S

scp

- symbolic link to, 2-11
- scripts to create a Real Application Clusters database, B-1
- server parameter file
 - raw device for, 3-17
- server parameter files, 1-12, 8-1, 9-3
 - errors, 8-4
- Service Management
 - using, 6-2
- service registration
 - configuring, 9-4
- services, 6-2
- setld command, 2-23
- shared configuration file, 9-1
- shared server, 9-4
- shared storage
 - requirement for recovery area, 1-11
- shell
 - determining default shell for oracle user, 2-15
- SHELL environment variable
 - checking value of, 2-15
- shell startup file
 - editing, 2-15
 - removing environment variables, 2-15
- shm_max subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- shm_min subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- shm_mni subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- shm_seg subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- shutdown command, 2-27
- SID
 - setting ORACLE_SID environment variable, 2-15
- silent installation. *See* installation
 - non-interactive
- single-instance databases
 - converting, D-11
- software requirements, 2-22
 - checking software requirements, 2-23
- SPFILE
 - default creation, 8-1
 - default location, 8-2
 - managing on raw device, 8-2
 - migrating to, 8-3
 - raw device for, 3-17
- Spike optimization tool, 2-34
- sqlnet.ora file, 9-11
- ssm_threshold subsystem attribute
 - recommended value on Tru64 UNIX, 2-26
- startup file
 - for shell, 2-15
- subsets
 - checking on Tru64 UNIX, 2-23
- subsystem attributes, 2-25
- Summary dialog, 6-6
- swap space
 - requirements, 2-17
- symbolic link

- for scp, 2-11
- SYSAUX tablespace
 - raw device for, 3-17
- sysconfig command, 2-25
- sysconfigdb command, 2-27
- sysconfigtab file, 2-26
- SYSDBA privilege
 - associated OS group, 2-5
- SYSOPER privilege
 - associated OS group, 2-5
- SYSTEM tablespace
 - description, 9-2
 - raw device for, 3-17

T

- tablespaces
 - and DBCA, 9-2
 - expanding for large sorts, 9-3
 - RBS, 9-3
 - SYSTEM, 9-2
 - TEMP, 9-3
 - undo tablespaces for automatic undo management, 9-3
 - USERS, 9-2
- TAF failover policies
 - Basic, 6-3
 - None, 6-3
- TEMP environment variable, 2-17
 - setting, 2-16
- TEMP tablespace
 - described, 9-3
 - raw device for, 3-17
- temporary directory, 2-17
- temporary disk space
 - checking, 2-17
 - freeing, 2-17
 - requirements, 2-17
- /tmp directory
 - checking space in, 2-17
 - freeing space in, 2-17
- TMPDIR environment variable, 2-17
 - setting, 2-16
- TNS_ADMIN environment variable
 - unsetting, 2-34
- tnsnames.ora file, 9-6
 - default configuration, 9-6
- Transaction Processing
 - configuration type, 5-4
- Transparent Application Failover (TAF) policies, 6-2
- troubleshooting
 - user equivalency, 4-2
- Tru64 UNIX
 - checking version, 2-23
 - making subsystem attribute value changes persist, 2-26
 - operating system subsets for, 2-22
 - operating system version for, 2-22
 - patch download location, 2-24
 - patch requirements, 2-24
 - TruCluster requirement, 2-22
- TruCluster
 - requirement for Tru64 UNIX, 2-22

U

- uid
 - identifying existing, 2-9
 - specifying, 2-10
 - specifying on other nodes, 2-9
- umask, 2-34
- umask command, 2-15, 2-34
- undo management, 9-3
- UNDOTBS tablespace
 - raw device for, 3-17
- UNIX commands
 - dupatch, 2-24
 - setld, 2-23
 - shutdown, 2-27
 - sysconfigdb, 2-27
- unprivileged user
 - nobody user, 2-5
- unset command, 2-34
- unsetenv command, 2-34
- upgrade
 - of Cluster Ready Services, xvi, 4-4
 - of existing Oracle Databases, 6-3
 - of listener, 6-3
 - of Oracle Clusterware, 4-4
 - of Oracle Database with patch, F-3
 - rolling upgrades enabled, xvi
- user accounts
 - post-installation setup, 7-4
- user equivalence
 - testing, 4-2
- user IDs
 - identifying existing, 2-9
 - specifying, 2-10
 - specifying on other nodes, 2-9
- USER tablespace
 - raw device for, 3-17
- useradd command, 2-8, 2-10
- users
 - checking existence of the nobody user, 2-9
 - creating identical users on other nodes, 2-9
 - creating the oracle user, 2-8
 - nobody, 2-5
 - nobody user, 2-5
 - oracle, 2-5
 - Oracle Software Owner user (oracle), 2-5
 - required for external jobs, 2-5
 - specifying groups when creating, 2-10
 - unprivileged user, 2-5
 - using NIS, 2-6, 2-9
- USERS tablespace
 - described, 9-2

V

- vfs

- kernel subsystem on Tru64 UNIX, 2-26
- VIP, 1-4
- virtual IP. *See* VIP
- vm
 - kernel subsystem on Tru64 UNIX, 2-26
- voting disk
 - configuration of, 4-7
 - mirroring, 3-6
 - raw device for, 3-8
- voting disks, 3-2
 - configuring multiple, xvii, 1-6
 - requirement of absolute majority of, 3-2

W

- WebSphere MQ
 - checking requirements on Tru64 UNIX, 2-24
 - CSDs required
 - on Tru64 UNIX, 2-24
- Welcome page
 - Oracle Universal Installer, 4-7, 5-5, 5-10
- Windows
 - analogy for Oracle base directory, 2-29
- workstation
 - installing from, 2-4

X

- X emulator
 - installing from, 2-4
- X Window and X/Motif Software development
 - Motif requirement, 2-22
- X window system
 - enabling remote hosts, 2-4
- xhost command, 2-4
- xterm command, 2-4

