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- Did you find any errors?
- Is the information clearly presented?
- Do you need more information? If so, where?
- Are the examples correct? Do you need more examples?
- What features did you like most about this manual?

If you find any errors or have any other suggestions for improvement, please indicate the title and part number of the documentation and the chapter, section, and page number (if available). You can send comments to us in the following ways:

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  Redwood Shores, CA  94065
  USA

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If you have problems with the software, please contact your local Oracle Support Services.
Preface

The Oracle Real Application Clusters Installation and Configuration Guide explains how to install and configure Oracle Real Application Clusters (RAC). Information in this manual applies to Oracle Database 10g RAC running on Linux x86-64 systems. This preface contains the following topics:

- Intended Audience
- Documentation Accessibility
- Structure
- Related Documents
- Conventions

Intended Audience

The Oracle Real Application Clusters Installation and Configuration Guide is primarily for network or Database Administrators (DBAs) who install and configure RAC.

Documentation Accessibility

Our goal is to make Oracle products, services, and supporting documentation accessible, with good usability, to the disabled community. To that end, our documentation includes features that make information available to users of assistive technology. This documentation is available in HTML format, and contains markup to facilitate access by the disabled community. Standards will continue to evolve over time, and Oracle is actively engaged with other market-leading technology vendors to address technical obstacles so that our documentation can be accessible to all of our customers. For additional information, visit the Oracle Accessibility Program Web site at

http://www.oracle.com/accessibility/

Accessibility of Code Examples in Documentation  JAWS, a Windows screen reader, may not always correctly read the code examples in this document. The conventions for writing code require that closing braces should appear on an otherwise empty line; however, JAWS may not always read a line of text that consists solely of a bracket or brace.

Accessibility of Links to External Web Sites in Documentation  This documentation may contain links to Web sites of other companies or organizations that Oracle does not own or control. Oracle neither evaluates nor makes any representations regarding the accessibility of these Web sites.
Structure

This document contains the following five parts:

Part I: "Oracle Database 10g Real Application Clusters Installation Planning and Requirements"
Part I introduces the RAC installation process.

Chapter 1, "Introduction to Installing and Configuring Oracle Database 10g RAC"
This chapter describes the RAC installation process and provides RAC installation planning information.

Part II: Real Application Clusters Pre-Installation Procedures
Part II describes the platform-specific pre-installation procedures for installing RAC.

Chapter 2, "Pre-Installation Tasks for Installing RAC on Linux-Based Systems"
This chapter describes the pre-installation procedures for installing RAC on Linux x86-64-based systems.

Part III: "Installing CRS and Oracle Database 10g with RAC, Creating RAC Databases, and Performing Post-Installation Tasks"
Part III describes how to install Cluster Ready Services and Oracle Database 10g with Real Application Clusters on UNIX-based systems.

Chapter 3, "Installing Cluster Ready Services on Linux Systems"
This chapter describes how to install Cluster Ready Services on Linux systems.

Chapter 4, "Installing Oracle Database 10g with Real Application Clusters"
This chapter describes how to install Oracle Database 10g with Real Application Clusters on all operating systems.

Chapter 5, "Creating RAC Databases with the Database Configuration Assistant"
This chapter explains how to use the Database Configuration Assistant to create RAC databases.

Chapter 6, "Real Application Clusters Post-Installation Procedures"
This chapter describes the post-installation tasks for RAC.

Part IV: Real Application Clusters Environment Configuration
Part IV provides Oracle Database 10g Real Application Clusters environment configuration information.

Chapter 7, "Configuring the Server Parameter File in Real Application Clusters Environments"
This chapter describes the use of the server parameter file (SPFILE) in Real Application Clusters.

Chapter 8, "Understanding the Real Application Clusters Installed Configuration"
This chapter describes the Oracle Database 10g Real Application Clusters installed configuration.
Part V: Real Application Clusters Installation and Configuration Reference Information

Part V provides reference information for the installation and configuration of RAC.

Appendix A, "Troubleshooting the Real Application Clusters Installation Process"
This appendix provides RAC installation and configuration troubleshooting information.

Appendix B, "Using Scripts to Create Real Application Clusters Databases"
This appendix explains how to use scripts in RAC.

Appendix C, "Configuring Raw Devices for Real Application Clusters"
This appendix explains how to configure shared disk subsystems using raw devices in RAC environments.

Appendix D, "Converting to Real Application Clusters from Single-Instance Oracle Databases"
This appendix describes how to convert to Oracle Database 10g RAC from single-instance Oracle databases.

Appendix E, "Directory Structure for Oracle Database 10g Real Application Clusters Environments"
This appendix describes the directory structure for the installed RAC software on both UNIX-based systems.

Related Documents

For more information, refer to these Oracle resources:

- Oracle Real Application Clusters Administrator’s Guide
- Oracle Real Application Clusters Deployment and Performance Guide

Error messages are only available online or by using Tahiti, the Oracle documentation search tool.

Installation Guides

- Oracle Diagnostics Pack Installation

Operating System-Specific Administrative Guides

- Oracle Database Administrator’s Reference for UNIX Systems
- Oracle Database Platform Guide for Windows

Oracle Database 10g Real Application Clusters Management

- Oracle Real Application Clusters Administrator’s Guide
- Oracle Database 2 Day DBA
- Getting Started with the Oracle Diagnostics Pack

Generic Documentation

- Oracle Database New Features
- Oracle Database Concepts
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.

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bold</strong></td>
<td>Bold typeface indicates terms that are defined in the text or terms that appear in a glossary, or both.</td>
<td>When you specify this clause, you create an index-organized table.</td>
</tr>
<tr>
<td><strong>Italics</strong></td>
<td>Italic typeface indicates book titles or emphasis.</td>
<td>Oracle Database Concepts</td>
</tr>
<tr>
<td><strong>UPPERCASE</strong></td>
<td>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.</td>
<td>Ensure that the recovery catalog and target database do not reside on the same disk.</td>
</tr>
<tr>
<td><strong>font</strong></td>
<td></td>
<td>You can specify this clause only for a NUMBER column.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>You can back up the database by using the BACKUP command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Query the TABLE_NAME column in the USER_TABLES data dictionary view.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use the DBMS_STATS.GENERATE_STATS procedure.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>lowercase monospace (fixed-width) font</td>
<td>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.</td>
<td>Enter sqlplus to start SQL*Plus. The password is specified in the orapwd file. Back up the datafiles 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.</td>
</tr>
<tr>
<td>lowercase italic monospace (fixed-width) font</td>
<td>Lowercase italic monospace font represents placeholders or variables.</td>
<td>You can specify the parallel_clause. Run old_release.SQL where old_release refers to the release you installed prior to upgrading.</td>
</tr>
</tbody>
</table>

Conventions in Code Examples

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>Brackets enclose one or more optional items. Do not enter the brackets.</td>
<td>DECIMAL (digits [ , precision ])</td>
</tr>
<tr>
<td>{ }</td>
<td>Braces enclose two or more items, one of which is required. Do not enter the braces.</td>
<td>{ENABLE</td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>{ENABLE</td>
</tr>
<tr>
<td>...</td>
<td>Horizontal ellipsis points indicate either:</td>
<td>CREATE TABLE ... AS subquery; SELECT col1, col2, ..., coln FROM employees;</td>
</tr>
<tr>
<td>■</td>
<td>That we have omitted parts of the code that are not directly related to the example</td>
<td></td>
</tr>
<tr>
<td>■</td>
<td>That you can repeat a portion of the code</td>
<td></td>
</tr>
<tr>
<td>Convention</td>
<td>Meaning</td>
<td>Example</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>. . .</td>
<td>Vertical ellipsis points indicate that we have omitted several lines of code not directly related to the example.</td>
<td>SQL&gt; SELECT NAME FROM V$DATAFILE; NAME ------------------------------------ /fs1/dbs/tbs_01.dbf /fs1/dbs/tbs_02.dbf . . /fs1/dbs/tbs_09.dbf 9 rows selected.</td>
</tr>
<tr>
<td>Other notation</td>
<td>You must enter symbols other than brackets, braces, vertical bars, and ellipsis points as shown.</td>
<td>acctbal NUMBER(11,2); acct CONSTANT NUMBER(4) := 3;</td>
</tr>
<tr>
<td>Italics</td>
<td>Italicized text indicates placeholders or variables for which you must supply particular values.</td>
<td>CONNECT SYSTEM/system_password DB_NAME = database_name</td>
</tr>
<tr>
<td>UPPERCASE</td>
<td>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.</td>
<td>SELECT last_name, employee_id FROM employees; SELECT * FROM USER_TABLES; DROP TABLE hr.employees;</td>
</tr>
<tr>
<td>lowercase</td>
<td>Lowercase typeface indicates programmatic elements that you supply. For example, lowercase indicates names of tables, columns, or files. <strong>Note:</strong> Some programmatic elements use a mixture of UPPERCASE and lowercase. Enter these elements as shown.</td>
<td>SELECT last_name, employee_id FROM employees; sqlplus hr/hr CREATE USER mjones IDENTIFIED BY ty3MU9;</td>
</tr>
</tbody>
</table>
What's New in Oracle Database 10g RAC Installation and Configuration?

This section describes the Oracle Database 10g release 1 (10.1.0.3) features as they pertain to the installation and configuration of Real Application Clusters (RAC). The topic in this section is:

- Oracle Database 10g Release 1 (10.1.0.3) New Features for RAC Installation and Configuration

Oracle Database 10g Release 1 (10.1.0.3) New Features for RAC Installation and Configuration

- This book contains Oracle Database 10g pre-installation and installation instructions for Linux x86-64 platform on which RAC operates.

- The Oracle Database 10g with RAC is available on both the Standard Edition and the Enterprise Edition.

- The Oracle Database 10g installation requires you to perform a two-phase process in which you run the Oracle Universal Installer (OUI) twice. The first phase installs Oracle Cluster Ready Services Release 1 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. If you have a previous Oracle cluster database version, then the OUI activates the Database Upgrade Assistant (DBUA) to automatically upgrade your pre-Oracle Database 10g cluster database. The Oracle Database 10g installation process provides single system image, ease of use, and accuracy for RAC installations and patches.

- Cluster Ready Services (CRS) contains the cluster management software required to support Oracle Database 10g RAC databases. CRS also provides high availability components that provide many system management features. The components of CRS interact with vendor clusterware, if present, to coordinate cluster membership information.

- There are new and changed pages and dialogs for the Oracle Universal Installer (OUI), the Database Configuration Assistant (DBCA), and the Database Upgrade Assistant. The Virtual Internet Protocol Configuration Assistant (VIPCA) is a new tool for this release. These enhancements are described in the following:
  - OUI Cluster Installation Mode Page: This page enables you to select whether to perform a cluster or a single-instance Oracle Database 10g installation.
– 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.

– Storage Options Page: This page has storage options for selecting the storage type for the database files such as control files, datafiles, and redo logs.

– DBCA Services Page: This page enables you to create and configure services for your RAC environment.

– DBCA Initialization Parameters Page: This page has two dialogs to display both Basic and Advanced parameter settings.

– VIPCA: The pages for this assistant enable you to configure virtual internet protocol addresses for your RAC database.

- 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.

- The gsdctl commands should only be used with Oracle9i databases. The CRS installation process stops any existing GSD processes. To start or stop the GSD processed manually, use srvctl start nodeapps or srvctl stop nodeapps respectively.

- Pre-Oracle Database 10g cluster manager implementations on some platforms were referred to as "Cluster Manager". The cluster manager on all platforms in Oracle Database 10g is known as Cluster Synchronization Services (CSS).

- Oracle Database 10g provides cluster file system support for Linux-based platforms.

  See Also:  http://www.oracle.com/technology/ for more information about Oracle Cluster File System on Linux

- RAC and the DBCA support Automatic Storage Management (ASM) and Oracle Managed Files (OMF).

  See Also:
  
  - The Oracle Database Administrator’s Guide for information about Automatic Storage Management, a new database file management feature
  
  - The Oracle Real Application Clusters Administrator’s Guide for more information about administering services and storage in RAC
  
  - The Oracle Database Upgrade Guide for information about using the DBUA

- 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.
Part I describes how to plan your Real Application Clusters (RAC) installation and describes the RAC installation requirements. The chapter in Part I is:

Chapter 1, "Introduction to Installing and Configuring Oracle Database 10g RAC"
Introduction to Installing and Configuring Oracle Database 10g RAC

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

- Real Application Clusters Documentation Overview
- General System Installation Requirements for Real Application Clusters
- Cluster Setup and Pre-Installation Configuration Tasks for Real Application Clusters
- Pre-Installation, Installation, and Post-Installation Overview
- The Oracle Universal Installer and Real Application Clusters
- Storage Considerations for Installing Oracle Database 10g Real Application Clusters
- Additional Considerations for Using Oracle Database 10g Features in RAC
- Oracle Database 10g and Real Application Clusters Components
- Oracle Database 10g Real Application Clusters Version Compatibility
- Required UNIX Groups

Real Application Clusters Documentation Overview

This section describes the RAC documentation set. The Oracle Database 10g CD contains a copy of this book, the Oracle Real Application Clusters Installation and Configuration Guide in both HTML and PDF formats. This book contains the pre-installation, installation, and post-installation information for Linux x86-64 platform.

The Server Documentation CD contains the following additional documentation about RAC administration and deployment: the Oracle Real Application Clusters Administrator’s Guide and the Oracle Real Application Clusters Deployment and Performance Guide as described under the following headings:

- Oracle Real Application Clusters Administrator’s Guide
- Oracle Real Application Clusters Deployment and Performance Guide

Oracle Real Application Clusters Administrator’s Guide

The Oracle Real Application Clusters Administrator’s Guide provides RAC-specific administration information. Some of the topics described in this book include the use
of Oracle Enterprise Manager in RAC environments. The book also describes how to administer services and storage and how to use RAC scalability features to add and delete instances and nodes in RAC environments. The book also discusses how to use Recovery Manager (RMAN) and how to perform backup and recovery in RAC.

The *Oracle Real Application Clusters Administrator’s Guide* also describes how to use the Server Control (SRVCTL) utility to start and stop the database and instances, manage configuration information, and to delete or move instances and services. You can also use the appendix to resolve various RAC tools messages. A troubleshooting section describes how to interpret the content of RAC-specific log files.

**Oracle Real Application Clusters Deployment and Performance Guide**

The *Oracle Real Application Clusters Deployment and Performance Guide* highlights the main deployment topics for RAC by briefly describing Cluster Ready Services (CRS), storage, database creation, and services deployment in RAC. Design and deployment topics in this book describe service topologies and workload management in RAC. Specifically, the book describes how the Automatic Workload Repository tracks and reports service levels and how you can use service level thresholds and alerts to improve high availability in your RAC environment. There is also a services deployment example in the appendix of this book that you can use to learn more about how to deploy and manage services in RAC environments.

The *Oracle Real Application Clusters Deployment and Performance Guide* provides a high-level description of interconnect protocols, as well as information about how to monitor and tune performance in RAC environments using both Oracle Enterprise Manager and using information in the Automated Workload Repository and Oracle performance views. The book also highlights some application-specific deployment techniques for online transaction processing and data warehousing environments.

**General System Installation Requirements for Real Application Clusters**

Each node that is going to be part of your RAC installation must meet the following hardware and software requirements. You will also perform step-by-step tasks for hardware and software verification for Linux x86-64 specific pre-installation procedures in Part II of this book.

Before using this manual, however, you should read the *Oracle Real Application Clusters Deployment and Performance Guide* and the *Oracle Real Application Clusters Administrator’s Guide*.

**Hardware and Network Requirements for Oracle Database 10g Real Application Clusters**

Each node in a cluster requires the following hardware:

- External shared disks for storing the Cluster Ready Service and database files.

Sections in pre-installation chapter that appear under the headings "Choosing a Storage Option for Oracle Database Files" and "Choosing a Storage Option for Oracle Database Recovery Files" describe the disk configuration options that are available for Linux x86-64. Review these options before you decide which storage option to use in your RAC environment. However, note that when the Database Configuration Assistant (DBCA) configures automatic disk backup, it uses a database recovery area which must be shared. If the database files are stored on a cluster file system, 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. If the database files are stored on raw devices, a shared directory should be configured using NFS.

- For increased reliability, you can configure redundant public and private network adapters for each node.

- One private internet protocol (IP) address for each node to serve as the private interconnect. This IP address must be separate from the public network and it must have the same interface name on every node that is part of your cluster.

During an Oracle RAC 10g installation, the Installer displays two screens on which you specify the IP addresses of the private interconnect. The private interconnect is used for inter-node communication by both Oracle CRS and RAC.

On the Cluster Configuration screen, you must specify a private node name to be associated with each public node name. The public node name is the host name of each node, specified as either an alias or an IP address, and the private node name is the private interconnect address that will be used by Oracle CRS. In the Private Node Name field, enter the name of the private interconnect if it is available from a network name server or system hosts file, or else enter the private IP address, unique to each node.

The information on the Private Interconnect Enforcement screen is used to determine which private interconnect will be used by RAC database instances. RAC will use all interconnects identified as private in this page. They must all be in an up state, just as if their IP addresses were specified in the initialization parameter, CLUSTER_INTERCONNECTS. RAC does not fail over between cluster interconnects; if one is down then the instances using them will not start.

- One public IP address for each node to serve as the Virtual IP address for client connections and for connection failover. This is in addition to the operating-system managed public host IP address that is already assigned to the node by the operating system. This public Virtual IP must be associated with the same interface name on every node that is part of your cluster. In addition, the IP addresses that you use for all of the nodes that are part of a cluster must be from the same subnet. The host names for the VIP must be registered with the domain name server (DNS). The Virtual IP address should not be in use at the time of the installation because this is a Virtual IP address that Oracle manages.

While installing and using Real Application Clusters software, you should attempt to keep the system clocks on all of your 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.

Software Requirements for Oracle Database 10g Real Application Clusters

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

Cluster Setup and Pre-Installation Configuration Tasks for Real Application Clusters

Before installing RAC, perform the following procedures:
1. Ensure that you have a certified combination of operating system and Oracle software version by referring to the OracleMetaLink certification information under "Availability & Certification" > "1.View Certifications by Product" at the following site:

http://metalink.oracle.com

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

2. Configure a high-speed interconnect that uses a private network. Configure a second interconnect for redundancy, if the interconnect redundancy is supported by the platform, to avoid making the interconnect a single point of failure. Some platforms support automatic failover to the alternate interconnect. To enable this, you must configure the operating system-provided failover mechanism.

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 the Oracle Database 10g Standard Edition, then you must use ASM.

**Note:** If you use ASM, Oracle recommends that you install ASM in a separate home from the CRS home and the Oracle home, particularly if the ASM instance is to manage storage for more than one RAC database. This reduces downtime when upgrading or de-installing different versions of the software. However, you must create the ASM instance manually because the OUI and DBCA do not support a separate install of ASM.

4. Install the operating system patches that are listed in the pre-installation chapters in this book in Part II.

---

**Pre-Installation, Installation, and Post-Installation Overview**

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, as well as how to set directory and file permissions. Complete all of the pre-installation procedures and verify that your system meets all of the pre-installation requirements before proceeding to the install phase.

**Installation Overview for Oracle Database 10g Real Application Clusters**

The Oracle Database 10g Real Application Clusters installation is a two-phase installation. In phase one, use the Oracle Universal Installer (OUI) to install CRS as described in Chapter 3, "Installing Cluster Ready Services on Linux Systems". Note that the Oracle home that you use in phase one is a home for the CRS 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 CRS pre-installation starts the CRS processes in preparation for installing Oracle Database 10g with RAC as described in Chapter 4, "Installing Oracle Database 10g with Real Application Clusters". You use the OUI in this phase to install the RAC software.

If the OUI detects Oracle cluster software from a previous release, then the OUI starts the Database Upgrade Assistant (DBUA) to upgrade your database to Oracle Database 10g release 1 (10.1.0.3). In addition, the DBUA displays a Service Configuration page for configuring services in your RAC database.

After the installation completes, the OUI starts the Oracle assistants, such as the 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 5, "Creating RAC Databases with the 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 sets for your Oracle Database 10g version as described in Chapter 6, "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 products such as the Sample Schema, Oracle Net Services, or Oracle Messaging Gateway. You must also configure Oracle pre-compilers for your operating system and if desired, configure Oracle Advanced Security.

Use the Companion CD to install additional Oracle Database 10g software that may improve performance or extend database capabilities, for example, Oracle JVM, Oracle interMedia or Oracle Text.

See Also: Oracle Real Application Clusters Administrator’s Guide for more information about using RAC scalability features of adding and deleting nodes and instances from RAC databases

The Oracle Universal Installer and Real Application Clusters

The Oracle Universal Installer (OUI) facilitates the installation of Cluster Ready Services (CRS) and Oracle Database 10g software. In most cases, you use the graphical user interface (GUI) provided by the OUI to install the software. However, you can also use the OUI to complete non-interactive installations, without using the GUI. See Appendix B for information about non-interactive installations.

When the OUI installs the Oracle software, Oracle recommends that you select a preconfigured database or use the Database Configuration Assistant (DBCA) interactively to create your cluster database. You can also manually create your database as described in procedures posted at http://www.oracle.com/technology/. Oracle recommends that you use Automatic Storage Management (ASM). If you are not using ASM or if you are not using a cluster file system, then configure shared raw devices before you create your database.

When you install CRS or RAC, the OUI copies the Oracle software onto the node from which you are running it. If your Oracle home is not on a cluster file system, then the OUI propagates the software onto the other nodes that you have selected to be part of your OUI installation session.
When you create your RAC database using the OUI, or if you do it later using the DBCA, or if you use the Enterprise Manager Configuration Assistant to configure Enterprise Manager, Enterprise Manager is configured for your cluster database. Database control can manage your RAC database, all of 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 clustered, which means you need to perform the install on only one of the cluster nodes.

See Also:
- The Oracle Universal Installer Concepts Guide for more details about the OUI
- The Oracle Real Application Clusters Administrator’s Guide for information about using Enterprise Manager to administer RAC environments

Storage Considerations for Installing Oracle Database 10g Real Application Clusters

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 the Oracle Database Standard Edition must use ASM for database file storage.

Overview of Automatic Storage Management

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 will automatically allocate storage for, create, or delete, the files associated with the appropriate database object. When administering the database, you need only refer to database objects 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. This prevents the accidental removal of ASM instances that are in use by databases from other homes during the de-installation of a database Oracle home.

Benefits of Automatic Storage Management

ASM provides many of the same benefits as storage technologies such as RAID or logical volume managers (LVMs). Like these technologies, ASM enables you to create a single disk group from a collection of individual disk devices. It balances I/O 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 enables you to specify different storage attributes for individual files in the same disk group.

**Disk Groups and Failure Groups**

A disk group can include any number of 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 specify more than one partition on a single physical disk as a disk group device. ASM expects each disk group device to be on a separate physical disk.

Although you can specify a logical volume as a device in an ASM disk group, Oracle does not recommend their use. Because logical volume managers can hide the physical disk architecture, ASM may not operate effectively when logical volumes are specified as disk group devices.

When you add a device to a disk group, you can specify a failure group for that device. Failure groups identify disk devices that have common failure characteristics, for example, devices that are attached to the same controller. If the controller fails, then all devices attached to it become unavailable. By default, each device also belongs to its own failure group. By using the failure groups you specify, ASM can distribute data among the devices in the disk group to help minimize the risk of data loss caused by component failures.

**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. You might 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, in a development environment where you have a suitable back-up 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 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**

**Note:** Do not specify more than one partition on a single physical disk as a disk group device. ASM expects each disk group device to be on a separate physical disk.

Although you can specify a logical volume as a device in an ASM disk group, Oracle does not recommend their use. Because logical volume managers can hide the physical disk architecture, ASM may not operate effectively when logical volumes are specified as disk group devices.
In disk groups created with high redundancy, the contents of the disk group are three-way mirrored by default. However, you can choose to create certain files that are only two-way mirrored, or that are not mirrored. 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.

**ASM and Installation Types**

The type and number of disk groups that you can create when installing Oracle 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, the OUI prompts you to specify two disk device names, which it uses to create a disk group named DATA, with normal redundancy.

- **Advanced database**
  
  If you choose to create an advanced database that uses ASM, 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.

The following table lists the total disk space required in all disk group devices for a typical preconfigured database, depending on the redundancy level you choose to use for the disk group:

<table>
<thead>
<tr>
<th>Redundancy Level</th>
<th>Total Disk Space Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>1 GB</td>
</tr>
<tr>
<td>Normal</td>
<td>2 GB (on a minimum of two devices)</td>
</tr>
<tr>
<td>High</td>
<td>3 GB (on a minimum of three devices)</td>
</tr>
</tbody>
</table>

**Additional Considerations for Using Oracle Database 10g Features in RAC**

Oracle recommends using the following Oracle Database 10g features to simplify RAC database management:

- **Enterprise Manager**: Use Enterprise Manager to administer your entire processing environment, not just the RAC database. Enterprise Manager enables you to 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**: Automatically manages undo processing.

- **Automatic segment-space management**: Automatically manages segment freelists and freelist groups.

- **Locally managed tablespaces**: Enhances space management performance.

**See Also**: The Oracle Real Application Clusters Administrator's 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:

- Cluster Ready Services (CRS)
- A RAC-enabled Oracle home

The Cluster Ready Services Clusterware

The OUI installs CRS on each node on which the OUI detects that Oracle9i cluster manager is present. If vendor clusterware is not present, then you must use the OUI to enter the nodes on which to install CRS. The CRS home can be either shared by all nodes or private to each node depending on your responses when you run the OUI. The home that you select for CRS must be different from the RAC-enabled Oracle home.

For Oracle Database 10g on Linux, CRS coexists with but does not interact with previous Oracle clusterware versions.

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**Note:** On Linux, pre-Oracle Database 10g cluster manager implementations were referred to as “Cluster Manager”. In Oracle Database 10g, the cluster manager role is performed by Cluster Synchronization Services (CSS), a component of CRS. The OCSSD performs this function.

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The Installed Real Application Clusters Components

All instances in RAC environments share the control file, server parameter file, redo log files, and all datafiles. 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 Version Compatibility

You can install and operate different versions of Oracle cluster database software on the same computer as described in the following points:

- If you run the OUI to install RAC on a system that already has an Oracle Database 10g RAC installation, then the OUI prompts you to install additional Oracle Database 10g products if you have not already installed all of them.

- You can also install multiple Oracle Database 10g RAC homes on the same node. The multiple homes feature enables you to install one or more releases on the same machine in multiple Oracle home directories. However, each node can have only one CRS home.

- The OUI also enables you to de-install and re-install Oracle Database 10g Real Application Clusters if needed.

- In addition, you cannot install Oracle Database 10g RAC into an existing Oracle home. If you have an Oracle home for Oracle Database 10g, then use a different Oracle home, and one that is available across the entire cluster for your new installation. Similarly, if you have an Oracle home for an earlier Oracle cluster
Required UNIX Groups

This section describes information specific to RAC on UNIX-based platforms. Depending on whether this is the first time you are installing the Oracle server software on your Linux system, you may need to create several UNIX groups and a UNIX user as described later in the pre-installation procedures. The required UNIX 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**. This group owns the Oracle inventory which is a catalog of all of the Oracle software installed on the system.

- The OSDBA group (**dba**)
  You must create this group the first time you install Oracle software on the system. It identifies users that have database administrative privileges (the **SYSDBA** and **SYSOPER** privileges). The default name for this group is **dba**. To specify a group name other than the default, choose the **Custom** installation type to install the software. You must also create an OSDBA group if an OSBDA group exists but you want to give a different group of users database administrative privileges in a new Oracle server installation.

- The OSOPER group (**oper**)
  This is an optional group. Create this group if you want a separate group of users to have a limited set of database administrative privileges (the **SYSDBA** privilege). 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 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 for this user is **oracle**. This 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, 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. Using different groups enables you to 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: The Oracle Database Administrator’s Reference, 10g Release 1 (10.1) for UNIX Systems and the Oracle Database 10g Administrator’s Guide contain more information about the OSDBA and OSOPER groups and the SYSDBA and SYSOPER privileges.
Part II describes the pre-installation procedures for Oracle Database 10g Real Application Clusters (RAC). The chapters in Part II are:

- Chapter 2, "Pre-Installation Tasks for Installing RAC on Linux-Based Systems"
This chapter describes the tasks that you must complete before you start the Oracle Universal Installer (OUI). It includes information about the following tasks:

- Log In to the System as root
- Check the Hardware Requirements
- Check the Network Requirements
- Check the Software Requirements
- Create Required UNIX Groups and User
- Configure Kernel Parameters and Shell Limits
- Identify Required Software Directories
- Identify or Create an Oracle Base Directory
- Create the CRS Home Directory
- Choose a Storage Option for Oracle CRS, Database, and Recovery Files
- Create Directories for Oracle CRS, Database, or Recovery Files
- Configure Disks for Automatic Storage Management
- Configure Raw Partitions
- Verify that the Required Software is Running
- Stop Existing Oracle Processes
- Configure the Oracle User’s Environment

Log 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:

Note: Unless you intend to complete a silent-mode installation, you must install the software from an X Window System workstation, an X terminal, or a PC or other system with X server software installed.

For more information about silent-mode installations, see Appendix B.
Check the Hardware Requirements

- If you are installing the software from an X Window System workstation or X terminal:
  1. Start a local terminal session, for example, an X terminal (xterm).
  2. If you are not installing the software on the local system, enter the following command to enable remote hosts to display X applications on the local X server:
     
     $ xhost +
  3. If you are not installing the software on the local system, use the ssh, rlogin, or telnet commands 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, enter the following command to switch user to root:
     
     $ su - root
     password:
     #

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

  Note: If necessary, see 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, enter the following command to switch user to root:
     
     $ su - root
     password:
     #

Check the Hardware Requirements

Each system must meet the following minimum hardware requirements:

- 512 MB of physical RAM
- 1 GB of swap space (or twice the size of RAM)
  
  On systems with 2 GB or more of RAM, the swap space can be between one and two times 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
1.2 GB of disk space for a preconfigured database that uses file system storage (optional)

**Note:** The disk space requirement for databases that use Automatic Storage Management (ASM) or raw device storage is described later in this chapter.

Additional disk space, either on a file system or in an ASM 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:
   
   ```
   # grep MemTotal /proc/meminfo
   ```

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

2. To determine the size of the configured swap space, enter the following command:
   
   ```
   # grep SwapTotal /proc/meminfo
   ```

   If necessary, see 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 -h /tmp
   ```

   If there is less than 400 MB of disk space available in the `/tmp` directory, complete one of the following steps:
   
   - Delete unnecessary files from the `/tmp` directory to achieve the required disk space.
   - 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
   ```

5. To determine whether the system architecture can run the software, enter the following command:
   
   ```
   # grep "model name" /proc/cpuinfo
   ```

   This command displays the processor type. Verify that the processor architecture matches the Oracle software release that you want to install.

   **Note:** If you do not see the expected output, then you cannot install the software on this system.
Check the Network Requirements

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

---

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

http://metalink.oracle.com

---

**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 interface names associated with the network adapters for each network must be the same on all nodes.
- For increased reliability, you can 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, the interconnect must support the user datagram protocol (UDP) using high-speed network adapters and switches that support TCP/IP (Gigabit Ethernet or better recommended).

---

**Note:** UDP is the default interconnect protocol for RAC and TCP is the interconnect protocol for Oracle CRS.

---

**IP Address Requirements**

Before starting the installation, you must identify or obtain the following IP addresses for each node:

- An IP address and an associated host name registered in the domain name service (DNS) for each public network interface
- One unused virtual IP address and an associated virtual host name registered in DNS that you will configure for the primary public network interface
  
  The virtual IP address must be in the same subnet as the associated public interface. After installation, you can configure clients to use the virtual host name or IP address. If a node fails, its virtual IP address fails over to another node.
- A private IP address and optional host name for each private interface
  
  Oracle recommends that you use non-routable IP addresses for the private interfaces, for example: 10.*.*.* or 192.168.*.*. You can use the `/etc/hosts` file on each node to associate private host names with private IP addresses.

For example, if each node has two public and two private interfaces, you might have the following host names and IP addresses on one of the nodes (`rac1`) and similar host names and IP addresses on the other nodes:
Checking 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 CRS and RAC, you will require this information.

Check the Software Requirements

Refer to the following section for information about checking the software requirements.

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

Checking the Software Requirements

Check that the required software and patches are installed on the system.

**Check for Required Software**

Depending on the products that you intend to install, verify that the following software is installed on the system. The procedure following the table describes how to check these requirements.
<table>
<thead>
<tr>
<th>Installation Type or Product</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>All installations</td>
<td>One of the following operating system versions:</td>
</tr>
<tr>
<td></td>
<td>■ Red Hat Enterprise Linux 3 (update 2)</td>
</tr>
<tr>
<td></td>
<td>■ SuSE Linux Enterprise Server (SLES) 8 with service pack 3 or later</td>
</tr>
<tr>
<td></td>
<td>■ SuSE Linux Enterprise Server 9</td>
</tr>
<tr>
<td>All installations</td>
<td>The system must be running the following kernel version (or a later version):</td>
</tr>
<tr>
<td></td>
<td>Red Hat Enterprise Linux 3 (update 2): 2.4.21-15.EL</td>
</tr>
<tr>
<td></td>
<td>SuSE Linux Enterprise Server 8 (x86-64): 2.4.21-185</td>
</tr>
<tr>
<td></td>
<td>SuSE Linux Enterprise Server 9: 2.6.5-7.97</td>
</tr>
<tr>
<td>All installations</td>
<td>The following packages (or later versions) must be installed:</td>
</tr>
<tr>
<td></td>
<td>Red Hat Enterprise Linux 3 (update 2):</td>
</tr>
<tr>
<td></td>
<td>make=3.79.1</td>
</tr>
<tr>
<td></td>
<td>gcc=3.2.3-34</td>
</tr>
<tr>
<td></td>
<td>glibc-2.3.2-95.20</td>
</tr>
<tr>
<td></td>
<td>glibc-devel-2.3.2-95.20</td>
</tr>
<tr>
<td></td>
<td>glibc-devel-2.3.2-95.20 (32 bit)</td>
</tr>
<tr>
<td></td>
<td>compat-db=4.0.14-5</td>
</tr>
<tr>
<td></td>
<td>compat-gcc-7.3-2.96.128</td>
</tr>
<tr>
<td></td>
<td>compat-gcc-c++-7.3-2.96.128</td>
</tr>
<tr>
<td></td>
<td>compat-libstdc++-7.3-2.96.128</td>
</tr>
<tr>
<td></td>
<td>compat-libstdc++-devel-7.3-2.96.128</td>
</tr>
<tr>
<td></td>
<td>openmotif21=2.1.30-8</td>
</tr>
<tr>
<td></td>
<td>setarch=1.3-1</td>
</tr>
<tr>
<td></td>
<td>gnome-libs-1.4.1.2.90-34.1 (32 bit)</td>
</tr>
<tr>
<td></td>
<td>libaio-0.3.96-3</td>
</tr>
<tr>
<td></td>
<td>libaio-devel-0.3.96-3</td>
</tr>
<tr>
<td></td>
<td>SuSE Linux Enterprise Server 8 (x86-64):</td>
</tr>
<tr>
<td></td>
<td>make=3.79.1</td>
</tr>
<tr>
<td></td>
<td>gcc=3.3-43</td>
</tr>
<tr>
<td></td>
<td>gcc-c++=3.3-43</td>
</tr>
<tr>
<td></td>
<td>glibc-2.2.5-213</td>
</tr>
<tr>
<td></td>
<td>glibc-32bit=8.1-9</td>
</tr>
<tr>
<td></td>
<td>glibc-devel=32bit=8.1-9</td>
</tr>
<tr>
<td></td>
<td>openmotif=2.2.2-124</td>
</tr>
<tr>
<td></td>
<td>libaio-0.3.96-3</td>
</tr>
<tr>
<td></td>
<td>libaio-devel-0.3.96-3</td>
</tr>
<tr>
<td></td>
<td>SuSE Linux Enterprise Server 9:</td>
</tr>
<tr>
<td></td>
<td>gcc=3.3.3-43</td>
</tr>
<tr>
<td></td>
<td>gcc-c++=3.3.3-43</td>
</tr>
<tr>
<td></td>
<td>glibc-2.3.3-98</td>
</tr>
<tr>
<td></td>
<td>libaio-0.3.98-18</td>
</tr>
<tr>
<td></td>
<td>libaio-devel-0.3.98-18</td>
</tr>
<tr>
<td></td>
<td>make=3.80</td>
</tr>
<tr>
<td></td>
<td>openmotif-libs=2.2.2-519.1</td>
</tr>
</tbody>
</table>
Check the Software Requirements

Pre-Installation Tasks for Installing RAC on Linux-Based Systems

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

1. To determine which distribution and version of Linux is installed, enter the following command:

   
   ```
   # cat /etc/issue
   ```

   **Note:** Only the distributions and versions listed in the previous table are supported. Do not install the software on other versions of Linux.

2. To determine whether the required kernel version is installed, enter the following command:

   
   ```
   # uname -r
   ```

   If the kernel version is lower than the required version, download and install the required version or a later version from your Linux vendor’s Web site.

3. To determine whether the required packages are installed, enter commands similar to the following:

   ```
   # rpm -q package_name
   ```

<table>
<thead>
<tr>
<th>Installation Type or Product</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Spatial</td>
<td>X Window System development package:</td>
</tr>
<tr>
<td></td>
<td>■ Red Hat:</td>
</tr>
<tr>
<td></td>
<td>XFree86</td>
</tr>
<tr>
<td></td>
<td>XFree86-devel</td>
</tr>
<tr>
<td></td>
<td>■ SuSE:</td>
</tr>
<tr>
<td></td>
<td>xf86</td>
</tr>
<tr>
<td></td>
<td>xdevel</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This software is required only to build the sample programs.</td>
</tr>
<tr>
<td>Pro*C/C++, Oracle Call Interface,</td>
<td>The version of GNU C and C++ compilers listed previously for your distribution is supported for use with these products.</td>
</tr>
<tr>
<td>Oracle C++ Call Interface,</td>
<td></td>
</tr>
<tr>
<td>Oracle XML Developer’s Kit (XDK)</td>
<td></td>
</tr>
<tr>
<td>Oracle JDBC/OCI Drivers</td>
<td>On x86-64 systems only, you can use the following optional JDK version with the Oracle JDBC/OCI drivers, however it is not required for the installation:</td>
</tr>
<tr>
<td></td>
<td>■ Sun JDK 1.4.2_03 with the JNDI extension</td>
</tr>
<tr>
<td>Real Application Clusters</td>
<td>Oracle Cluster File System (OCFS) version 1.0.11-1 or later:</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> OCFS is required only if you want to use a cluster file system for database file storage. If you want to use Automatic Storage Management or raw devices for database file storage, you do not need to install OCFS.</td>
</tr>
<tr>
<td></td>
<td>ocfs-support</td>
</tr>
<tr>
<td></td>
<td>ocfs-tools</td>
</tr>
<tr>
<td></td>
<td>ocfs-kernel_version</td>
</tr>
</tbody>
</table>

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

1. To determine which distribution and version of Linux is installed, enter the following command:

   ```
   # cat /etc/issue
   ```

   **Note:** Only the distributions and versions listed in the previous table are supported. Do not install the software on other versions of Linux.

2. To determine whether the required kernel version is installed, enter the following command:

   ```
   # uname -r
   ```

   If the kernel version is lower than the required version, download and install the required version or a later version from your Linux vendor’s Web site.

3. To determine whether the required packages are installed, enter commands similar to the following:

   ```
   # rpm -q package_name
   ```
If a package is not installed, install it from your Linux distribution media or download the required package version from your Linux vendor’s Web site.

4. To determine whether OCFS is installed, enter the following command:

```bash
# rpm -qa | grep ocfs
```

If you want to install the Oracle database files on an OCFS file system and the packages are not installed, download them from the following Web site. Follow the instructions listed with the kit to install the packages and configure the file system:

http://oss.oracle.com/projects/ocfs/

5. If you require a CSD for WebSphere MQ, refer to the following Web site for download and installation information:


---

### Create Required UNIX 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 UNIX groups and a UNIX user.

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

- **The OSDBA group (dba)**

  You must create this group the first time you install Oracle Database software on the system. It identifies UNIX users 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, you must choose the Custom installation type to install the software or start the Installer as a user that is not a member of this group. In this case, the Installer prompts you to specify the name of this group.

- **The OSOPER group (oper)**

  This is an optional group. Create this group if you want a separate group of UNIX 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, you must choose the Custom installation type to install the software or start the Installer as a user that is not a member of the `dba` group. In this case, the Installer prompts you to specify the name of this group. The usual name chosen for this group is `oper`.

- **An unprivileged user (nobody)**

  You must 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 UNIX group and user are required for all installations:

- **The Oracle Inventory group (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, the existing Oracle Inventory group must be the primary group of the UNIX 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 (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 a secondary groups.

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:** The Oracle Database Administrator’s Reference for UNIX Systems and the Oracle Database Administrator’s Guide contain more information about the OSDBA and OSOPER groups and the SYSDBA and SYSOPER privileges.

The following sections describe how to create the required UNIX user and groups.

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

### Creating the Oracle Inventory Group

You must create the Oracle Inventory group if it does not already exist. The following subsections describe how to determine the Oracle Inventory group name, if it exists, and how to create it if necessary.

#### Determine Whether the Oracle Inventory Group Exists

When you install Oracle software on the system for the first time, the Installer creates theoraInst.loc file. This file identifies the name of the Oracle Inventory group and the path of the Oracle Inventory directory. To determine whether the Oracle Inventory group exists, enter the following command:

```
# more /etc/oraInst.loc
```
Create Required UNIX Groups and User

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

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

The `inst_group` parameter shows the name of the Oracle Inventory group (oinstall).

**Create the Oracle Inventory Group**

If the `oraInst.loc` file does not exist, enter the following command to create the `oinstall` group:

```
# /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 UNIX users database administrative privileges in a new Oracle installation

If the OSDBA group does not exist or if you require a new OSDBA group, enter the following command to create the `dba` group. 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 UNIX 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, 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 UNIX users database operator privileges in a new Oracle installation

If you require an new OSOPER group, enter the following command to create the `oper` group. 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 UNIX user, with different group membership, to give database administrative privileges to those groups in a new Oracle Database installation
Determine Whether an Existing 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, 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, determine whether you want to use the existing user or create a new user. If you want to use the existing user, 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:

- If you want to use the existing Oracle software owner user, and the user’s primary group is the Oracle Inventory group, refer to the Verifying that the UNIX User nobody Exists section on page 2-12.
- To modify an existing user, refer to the "Modify an Existing Oracle Software Owner User" section on page 2-11.
- To create a new user, refer to the following section.

Create a New Oracle Software Owner User
If the Oracle software owner user does not exist or if you require a new Oracle software owner user, create it as follows. 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 -g oinstall -G dba[,oper] oracle
```

In this command:
- 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 "Verifying that the UNIX User nobody Exists” section on page 2-12 to continue.

Modify 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, enter a command similar to the following to modify it. Specify the primary group using the -g option and any required secondary groups using the -G option:

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

Note: If necessary, contact your system administrator before using or modifying an existing user.
Verifying that the UNIX User nobody Exists

Before installing the software, verify that the UNIX user nobody exists on the system:

1. To determine whether the user exists, enter the following command:
   
   ```
   # id nobody
   ```

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

2. If the nobody user does not exist, enter the following command to create it:
   
   ```
   # /usr/sbin/useradd nobody
   ```

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

Create 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, 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 UID for the oracle user and the GIDs for the
groups to which it belongs.

Create 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
   ```
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 this 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`.

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

```
# passwd oracle
```

**Configure SSH on All Cluster Nodes**

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

```
Note: This section describes how to configure OpenSSH version 3. If SSH is not available, the Installer attempts to use `rsh` and `rcp` instead. However, these services are disabled by default on most Linux systems.
```

To configure SSH, complete the following steps on each cluster node:

1. Log in as the `oracle` user.
2. If necessary, create the `.ssh` directory in the `oracle` user’s home directory and set the correct permissions on it:

```
$ mkdir ~/.ssh
$ chmod 755 ~/.ssh
```
3. Enter the following commands to generate an RSA key for version 2 of the SSH protocol:

```
$ /usr/bin/ssh-keygen -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 `~/.ssh/id_rsa.pub` file and the private key to the `~/.ssh/id_rsa` file. Never distribute the private key to anyone.

4. Enter the following commands to generate a DSA key for version 2 of the SSH protocol:

```
$ /usr/bin/ssh-keygen -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.

5. Copy the contents of the `~/.ssh/id_rsa.pub` and `~/.ssh/id_dsa.pub` files to the `~/.ssh/authorized_keys` file on this node and to the same file on all other cluster nodes.

6. Change the permissions on the `~/.ssh/authorized_keys` file on all cluster nodes:

```
$ chmod 644 ~/.ssh/authorized_keys
```

At this point, if you use `ssh` 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.

To enable the Installer to use the `ssh` and `scp` commands without being prompted for a pass phrase, follow these steps:

1. On the system where you want to install the software, log in as the `oracle` user.

2. Enter the following commands:

```
$ exec /usr/bin/ssh-agent $SHELL
$ /usr/bin/ssh-add
```

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

If you have configured SSH correctly, you can now use the `ssh` or `scp` commands without being prompted for a password or a pass phrase.
4. To test the SSH configuration, enter the following commands from the same terminal session, testing the configuration of each cluster node:

   $ ssh nodename1 date
   $ ssh nodename2 date

   These commands should display the date set on each node. If any node prompts for a password or pass phrase, verify that the `~/.ssh/authorized_keys` file on that node contains the correct public keys.

   **Note:**
   - The first time you use SSH to connect to a node from a particular system, you might see a message stating that the authenticity of the host could not be established. 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, the installation might fail. Make any changes required to ensure that only the date is displayed when you enter these commands.

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

   a. Using any text editor, edit or create the `~oracle/.ssh/config` file.

   b. Make sure that the `ForwardX11` attribute is set to `no`, for example:

   ```plaintext
   Host *
   ForwardX11 no
   ```

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

## Configure Kernel Parameters and Shell Limits

Refer to the following section for information about configuring the system kernel parameters and shell limits:

### Configuring Kernel Parameters

**Note:**
- The kernel parameter and shell limit values shown in the following sections are recommended values only. For production database systems, Oracle recommends that you tune these values to optimize the performance of the system. See your operating system documentation for more information about tuning kernel parameters.

On all cluster nodes, verify that the kernel parameters shown in the following table are set to values greater than or equal to the recommended value shown. The procedure following the table describes how to verify and set the values.
Configure Kernel Parameters and Shell Limits

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

1. Enter the commands shown in the following table to view the current values of the kernel parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>File</th>
</tr>
</thead>
<tbody>
<tr>
<td>semmsl</td>
<td>250</td>
<td>/proc/sys/kernel/sem</td>
</tr>
<tr>
<td>semmns</td>
<td>32000</td>
<td></td>
</tr>
<tr>
<td>semopm</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>semmni</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>shmall</td>
<td>2097152</td>
<td>/proc/sys/kernel/shmall</td>
</tr>
<tr>
<td>shmmmax</td>
<td>Half the size of physical memory (in bytes)</td>
<td>/proc/sys/kernel/shmmmax</td>
</tr>
<tr>
<td>shmmni</td>
<td>4096</td>
<td>/proc/sys/kernel/shmmni</td>
</tr>
<tr>
<td>file-max</td>
<td>65536</td>
<td>/proc/sys/fs/file-max</td>
</tr>
<tr>
<td>ip_local_port_range</td>
<td>1024 65000</td>
<td>/proc/sys/net/ipv4/ip_local_port_range</td>
</tr>
<tr>
<td>rmem_default</td>
<td>262144</td>
<td>/proc/sys/net/core/rmem_default</td>
</tr>
<tr>
<td>rmem_max</td>
<td>262144</td>
<td>/proc/sys/net/core/rmem_max</td>
</tr>
<tr>
<td>wmem_default</td>
<td>262144</td>
<td>/proc/sys/net/core/wmem_default</td>
</tr>
<tr>
<td>wmem_max</td>
<td>262144</td>
<td>/proc/sys/net/core/wmem_max</td>
</tr>
</tbody>
</table>

**Note:** If the current value for any parameter is higher than the value listed in this table, do not change the value of that parameter.

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

1. Enter the commands shown in the following table to view the current values of the kernel parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Command</th>
</tr>
</thead>
</table>
| semmsl, semmns,   | # /sbin/sysctl -a | grep sem
| semopm, and semmni| This command displays the value of the semaphore parameters in the order listed. |
| shmall, shmmmax,  | # /sbin/sysctl -a | grep shm
| shmmni            |                               |
| file-max          | # /sbin/sysctl -a | grep file-max |
| ip_local_port_range | # /sbin/sysctl -a | grep ip_local_port_range |
| This command displays a range of port numbers. |
| rmem_default,     | # /sbin/sysctl -a | grep net.core |
| rmem_max,         |                               |
| wmem_default,     |                               |
| wmem_max          |                               |

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

2. If the value of any kernel parameter is different to the recommended value, complete the following steps:
a. Using any text editor, create or edit the `/etc/sysctl.conf` file and add or edit lines similar to the following:

```
kernel.shmall = 2097152
kernel.shmmax = 2147483648
kernel.shmmni = 4096
kernel.sem = 250 32000 100 128
fs.file-max = 65536
net.ipv4.ip_local_port_range = 1024 65000
net.core.rmem_default = 262144
net.core.rmem_max = 262144
net.core.wmem_default = 262144
net.core.wmem_max = 262144
```

By specifying the values in the `/etc/sysctl.conf` file, they persist when you restart the system.

b. Enter the following command to change the current values of the kernel parameters:

```
# /sbin/sysctl -p
```

Review the output from this command to verify that the values are correct. If the values are incorrect, edit the `/etc/sysctl.conf` file, then enter this command again.

c. On SuSE systems only, enter the following command to cause the system to read the `/etc/sysctl.conf` file when it reboots:

```
# /sbin/chkconfig boot.sysctl on
```

3. Repeat this procedure on all other cluster nodes.

**Set Shell Limits for the oracle User**

To improve the performance of the software on Linux systems, you must increase the following shell limits for the `oracle` user:

<table>
<thead>
<tr>
<th>Shell Limit</th>
<th>Item in limits.conf</th>
<th>Hard Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of open file descriptors</td>
<td>nofile</td>
<td>65536</td>
</tr>
<tr>
<td>Maximum number of processes available to a single user</td>
<td>nproc</td>
<td>16384</td>
</tr>
</tbody>
</table>

To increase the shell limits:

1. Add the following lines to `/etc/security/limits.conf` file:

```
oracle   soft   nproc  2047
oracle   hard   nproc  16384
oracle   soft   nofile 1024
oracle   hard   nofile 65536
```
2. Add or edit the following line in the /etc/pam.d/login file, if it does not already exist:

   session required /lib/security/pam_limits.so

3. Depending on the oracle user's default shell, make the following changes to the default shell start-up file:
   - For the Bourne, Bash, or Korn shell, add the following lines to the /etc/profile file (or the /etc/profile.local file on SuSE systems):
     
     ```bash
     if [ $USER = "oracle" ]; then
       if [ $SHELL = "/bin/ksh" ]; then
         ulimit -p 16384
         ulimit -n 65536
       else
         ulimit -u 16384 -n 65536
       fi
     fi
     ```
   - For the C shell (csh or tcsh), add the following lines to the /etc/csh.login file (or the /etc/csh.login.local file on SuSE systems):
     
     ```bash
     if ( $USER == "oracle" ) then
       limit maxproc 16384
       limit descriptors 65536
     endif
     ```

4. Repeat this procedure on all other cluster nodes.

## Identify Required Software Directories

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

- Oracle base directory
- Oracle Inventory directory
- CRS 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. It is analogous to the C:\Oracle directory used for Oracle software installations on Windows systems. On Linux systems, the 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 UNIX 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 UNIX users install Oracle software on the same system, 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 a new Oracle base directory if necessary.

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

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, the Installer prompts you to specify the path to this directory. If you are installing the software on a local file system, Oracle recommends that you choose the following path:

oracle_base/oraInventory

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

Note: All Oracle software installations rely on this directory. Make sure that you back it up regularly. Do not delete this directory unless you have completely removed all Oracle software from the system.

CRS Home Directory
The CRS home directory is the directory where you choose to install the software for Oracle Cluster Ready Services. You must install CRS in a separate home directory. When you run the 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 CRS home directory:

/u01/crs/oracle/product/10.1.0/crs

If the Oracle base directory is on a cluster file system or an NFS file system on a NAS device, you must specify a path for the Oracle Inventory directory on a local file.
system. The Oracle base directory must be on a local file system to enable all of the
nodes to have separate inventories.

The 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.

---

**Note:** Because you must change the permissions of all of the parent
directories of the CRS home directory after installing the software to
grant write access only to the root user, the CRS 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. When you
run the 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 home directory:

```
oracle_base/product/10.1.0/db_1
```

The 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.

---

**Identify or Create an Oracle Base Directory**

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

- Identifying an Existing Oracle Base Directory
- Creating a New Oracle Base Directory

---

**Note:** You can choose to create a new 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:

- Identify an existing Oracle Inventory directory

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

  ```bash
  # more /etc/oraInst.loc
  ```

  If the `oraInst.loc` file exists, 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.

- Identify existing Oracle home directories

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

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

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

```
*:~/u03/app/oracle/product/10.1.0/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, 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 cluster nodes or it must be an NFS file system on a certified NAS device.

If you are not using an NFS file system, create identical Oracle base directories on the other nodes.

- It must have sufficient free disk space on all cluster nodes, as follows:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Free Disk Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Oracle base directory will contain only software files.</td>
<td>Up to 3 GB</td>
</tr>
<tr>
<td>The Oracle base directory will contain both software and database files (not recommended for production databases).</td>
<td>Up to 4 GB</td>
</tr>
</tbody>
</table>

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

```
# df -k oracle_base_path
```

To continue:
- If an Oracle base directory exists and you want to use it, refer to the "Create the CRS Home Directory" section on page 2-23.

  When you are configuring the oracle user’s environment later in this chapter, set the ORACLE_BASE environment variable to specify the directory you chose.

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

### Creating a New Oracle Base Directory

Before you create a new Oracle base directory, you must identify an appropriate file system with sufficient free disk space, as follows:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Free Disk Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Oracle base directory will contain only software files.</td>
<td>Up to 3 GB</td>
</tr>
<tr>
<td>The Oracle base directory will contain both software and database files (not recommended for production databases).</td>
<td>Up to 4 GB</td>
</tr>
</tbody>
</table>

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 file system can be a local file system or an NFS file system on a certified NAS device. Do not create the Oracle base directory on an OCFS 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 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
   ```

   If the mount point you identified is `/u01` and `oracle` is the user name of the Oracle software owner, 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 cluster nodes.

3. When you are configuring the oracle user’s environment later in this chapter, set the ORACLE_BASE environment variable to specify this directory.
Create the CRS Home Directory

You must create a CRS home directory before installing Oracle CRS. You can create the CRS home directory on the same file system as the Oracle base directory, or you can choose a different file system for this directory. If you choose the same file system as the Oracle base directory, you must not use a subdirectory of the Oracle base directory as the CRS home directory.

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 MB of free disk space.
   If you are using the same file system for the Oracle base directory, this 1 MB of disk space is additional to the free disk space requirement that you identified previously.

   **Note:** The file system can be a local file system or an NFS file system on a certified NAS device. Do not create the CRS home directory on an OCFS file system.

   The path to the CRS 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 CRS 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/10.1.0/crs
   # chown -R oracle:oinstall /mount_point/crs/oracle_sw_owner
   # chmod -R 775 /mount_point/crs/oracle_sw_owner
   ```

   If the mount point you identified is `/u01` and `oracle` is the user name of the Oracle software owner, the recommended CRS home directory path is as follows:

   `/u01/crs/oracle/product/10.1.0/crs`

2. If necessary, repeat the commands listed in the previous step to create the same directory on the other cluster nodes.

3. When you are installing Oracle CRS, set the `ORACLE_HOME` environment variable to specify this directory.

   **Note:** During the installation, before you run the `root.sh` script, you must change the permissions on the parent directories of the CRS home directory to permit only the `root` user to write to those directories.

Choose a Storage Option for Oracle CRS, Database, and Recovery Files

The following table shows the storage options supported for storing Oracle Cluster Ready Services (CRS) files, Oracle database files, and Oracle database recovery files. Oracle database files include datafiles, control files, redo log files, the server parameter...
Create Directories for Oracle CRS, Database, or Recovery Files

If you decide to place the Oracle CRS, database, or recovery files on a file system, use the following guidelines when deciding where to place them.
Guidelines for Placing Oracle CRS Files on a File System
The Installer does not suggest a default location for the Oracle Cluster Registry (OCR) or the Oracle CRS voting disk. If you choose to create these files on a file system, use the following guidelines when deciding where to place them:

- You must choose a shared file system on shared disks, for example:
  - A cluster file system such as OCFS
  - An NFS file system on a certified NAS device

**Note:** If you are using a shared file system on a NAS device to store a shared Oracle home directory for CRS or RAC, you must use the same NAS device for Oracle CRS file storage.

- It must have at least 100 MB of free disk space for the OCR and 20 MB of free disk space for the CRS voting disk.
- For improved reliability, you should choose a file system on a highly available storage device, for example, a RAID device that implements mirroring.
- If you are placing the Oracle Cluster Ready Services software on a shared file system, you can use the same file system for these files.
- 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, 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.

Guidelines for Placing Oracle Database Files on a File System
If you choose to place the Oracle database files on a file system, use the following guidelines when deciding where to place them:

- You must choose a shared file system on shared disks, for example:
  - A cluster file system such as OCFS
  - An NFS file system on a certified NAS device

**Note:** If you are using a shared file system on a NAS device to store a shared Oracle home directory for CRS or RAC, you must use the same NAS device for Oracle database file storage.

- 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.

---

- You must choose a shared file system on shared disks, for example:
  - A cluster file system such as OCFS
  - An NFS file system on a certified NAS device

- 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.

- 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.

### Creating Required Directories

Note: You must complete this procedure only if you want to place the Oracle CRS, database, or recovery files on a separate file system to the Oracle base directory.

To create directories for the Oracle CRS, database, or recovery files on separate file systems to 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 mount point that you use for the file system must be identical on each node. Make sure that the file systems are configured to mount automatically when a node reboots.

2. Use the `df -h` command to determine the free disk space on each mounted file system.

3. From the display, identify the file systems that you want to use:

<table>
<thead>
<tr>
<th>File Type</th>
<th>File System Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRS files</td>
<td>Choose a file system with at least 120 MB of free disk space</td>
</tr>
<tr>
<td>Database files</td>
<td>Choose either:</td>
</tr>
<tr>
<td></td>
<td>- A single file system with at least 1.2 GB of free disk space</td>
</tr>
<tr>
<td></td>
<td>- Two or more file systems with at least 1.2 GB of free disk</td>
</tr>
<tr>
<td></td>
<td>space in total</td>
</tr>
<tr>
<td>Recovery files</td>
<td>Choose a file system with at least 2 GB of free disk space.</td>
</tr>
</tbody>
</table>

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

4. Note the names of the mount point directories for the file systems that you identified.

5. Enter commands similar to the following to create the recommended subdirectories in each of the mount point directories and set the appropriate owner, group, and permissions on them:

   - CRS file directory:
     
     ```
     # mkdir /mount_point/oracrs
     # chown oracle:oinstall /mount_point/oracrs
     ```
Configure Disks for Automatic Storage Management

This section describes how to configure disks for use with ASM. 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 ASM
- Using an Existing ASM Disk Group
- Configuring Disks for ASM

**Note:** Although this section refers to disks, you can also use zero-padded files on a certified NAS storage device in an ASM disk group. Refer to the Oracle Database Installation Guide for Linux x86-64 for information about creating and configuring NAS-based files for use in an ASM disk group.

**Identifying Storage Requirements for ASM**

To identify the storage requirements for using ASM, 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 ASM 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 ASM for the other.

For RAC installations, if you choose to enable automated backups and you do not have a shared file system available, you must choose ASM for recovery file storage.

6. If you also want to use ASM or raw devices for storage, see one of the following sections:

- Configure Disks for Automatic Storage Management on page 2-28
- Configure Raw Partitions on page 2-38

Otherwise, refer to the "Verify that the Required Software is Running" section on page 2-43.
If you enable automated backups during the installation, you can choose ASM as the storage mechanism for recovery files by specifying an ASM 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 DBCA in interactive mode, by choosing the Advanced database configuration option for example, you can decide whether you want to use the same ASM disk group for database files and recovery files, or you can choose to use different disk groups for each file type.

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

- If you select an installation method that runs DBCA in non-interactive mode, you must use the same ASM disk group for database files and recovery files.

2. Choose the ASM redundancy level that you want to use for the ASM disk group.

   The redundancy level that you choose for the ASM disk group determines how ASM mirrors files in the disk group and determines the number of disks and amount of 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 ASM 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, ASM 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 use normal redundancy disk groups.

   - High redundancy
     
     In a high redundancy disk group, ASM 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 must consider the higher cost of additional storage devices before deciding to use this redundancy level.

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 the installation:
Configure Disks for Automatic Storage Management

2-30
Oracle Database Installation Guide

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

$$15 + (2 \times \text{number\_of\_disks}) + (126 \times \text{number\_of\_ASM\_instances})$$

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:

$$15 + (2 \times 3) + (126 \times 4) = 525$$

If an ASM instance is already running on the system, 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 ASM disk group devices.

<table>
<thead>
<tr>
<th>Redundancy Level</th>
<th>Minimum Number of Disks</th>
<th>Database Files</th>
<th>Recovery Files</th>
<th>Both File Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>1</td>
<td>1.15 GB</td>
<td>2.3 GB</td>
<td>3.45 GB</td>
</tr>
<tr>
<td>Normal</td>
<td>2</td>
<td>2.3 GB</td>
<td>4.6 GB</td>
<td>6.9 GB</td>
</tr>
<tr>
<td>High</td>
<td>3</td>
<td>3.45 GB</td>
<td>6.9 GB</td>
<td>10.35 GB</td>
</tr>
</tbody>
</table>

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

$$15 + (2 \times \text{number\_of\_disks}) + (126 \times \text{number\_of\_ASM\_instances})$$

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:

$$15 + (2 \times 3) + (126 \times 4) = 525$$

If an ASM instance is already running on the system, 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 ASM disk group devices.

Note: You need to complete this step only if you intend to use an installation method that runs DBCA 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, 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, 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, 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, install or identify appropriate disk devices to add to a new disk group. Use the following guidelines when identifying appropriate disk devices:

- All of the devices in an ASM 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. ASM expects each disk group device to be on a separate physical disk.

Although you can specify a logical volume as a device in an ASM disk group, Oracle does not recommend their use. Logical volume managers can hide the physical disk architecture, preventing ASM from optimizing I/O across the physical devices.

For information about completing this task, refer to the "Configuring Disks for ASM" section on page 2-32.

Using an Existing ASM Disk Group

If you want to store either database or recovery files in an existing ASM disk group, you have the following choices, depending on the installation method that you select:

- If you select an installation method that runs DBCA in interactive mode, by choosing the Advanced database configuration option for example, you can decide whether you want to create a new disk group or use an existing one.

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

- If you select an installation method that runs DBCA in non-interactive mode, you must choose an existing disk group for the new database; you cannot create a new disk group. However, you can add disk devices to an existing disk group if it has insufficient free space for your requirements.

---

**Note:** The ASM instance that manages the existing disk group can be running in a different Oracle home directory.

To determine whether an existing ASM disk group exists, or to determine whether 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 whether an ASM instance is configured on the system:

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

   If an ASM instance is configured on the system, the `oratab` file should contain a line similar to the following:

   ```
   +ASM:oracle_home_path:N
   ```

   In this example, `+ASM` is the system identifier (SID) of the ASM instance and `oracle_home_path` is the Oracle home directory where it is installed. By convention, the SID for an ASM instance begins with a plus sign.

2. Set the `ORACLE_SID` and `ORACLE_HOME` environment variables to specify the appropriate values for the ASM instance that you want to use.

3. Connect to the ASM instance as the SYS user with SYSDBA privilege and start the instance if necessary:

   ```bash
   # $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, Oracle recommends that you use devices that have the same size and performance characteristics as the existing devices in that disk group.

---

**Configuring Disks for ASM**

Oracle provides an ASM library driver that you can use to improve the I/O performance of databases that use ASM for storage management. If you intend to use ASM for database storage, Oracle recommends that you install the ASM library driver and associated utilities and use them to configure the devices that you want to include in an ASM disk group. If you do not use the ASM library driver, you must bind each disk device that you want to use to a raw device. The following sections describe how to configure disks using each method:

- Configuring Disks for ASM Using the ASM Library Driver
- Configuring Disks for ASM Using Raw Devices

   **Note:** If you choose to configure disks using the ASM library driver, you must use Database Configuration Assistant (DBCA) in interactive mode to create the database. You can run DBCA in interactive mode by choosing the Custom installation type or the Advanced database configuration option. You must also change the default disk discovery string to `ORCL:*`.

---

**Configuring Disks for ASM Using the ASM Library Driver**

To use the ASM library driver to configure ASM devices, complete the following tasks.

**Install and Configure the ASM Library Driver Software**

To install and configure the ASM library driver software, follow these steps:

1. Enter the following command to determine the kernel version and architecture of the system:

   ```
   # uname -rm
   ```

2. If necessary, download the required ASM library driver packages from the OTN Web site:

   ```
   ```

   You must install the following three packages, where `version` is the version of the ASM library driver, `arch` is the system architecture, and `kernel` is the version of the kernel that you are using:
Configure Disks for Automatic Storage Management

Pre-Installation Tasks for Installing RAC on Linux-Based Systems

3. Switch user to the root user:

   $ su -

4. Enter a command similar to the following to install the packages:

   # rpm -Uvh oracleasm-support-\textit{version}.arch.rpm \\
   oracleasm-kernel-\textit{version}.arch.rpm \\
   oracleasmlib-\textit{version}.arch.rpm

   For example, if you are using the Red Hat Enterprise Linux AS 2.1 enterprise kernel on an x86 system, enter a command similar to the following:

   # rpm -Uvh oracleasm-support-1.0.0-1.i386.rpm \\
   oracleasm-2.4.9-e-enterprise-1.0.0-1.i686.rpm \\
   oracleasmlib-1.0.0-1.i386.rpm

5. Enter a command similar to the following to determine the UID of the Oracle software owner user that you are using for this installation (typically \texttt{oracle}) and the GID of the OSDBA group (typically \texttt{dba}):

   # id oracle

6. Enter the following command to run the \texttt{oracleasm} initialization script with the \texttt{configure} option:

   # /etc/init.d/oracleasm configure

7. Enter the following information in response to the prompts that the script displays:

<table>
<thead>
<tr>
<th>Prompt</th>
<th>Suggested Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default UID to own the driver</td>
<td>Specify the UID of</td>
</tr>
<tr>
<td>interface:</td>
<td>the Oracle software</td>
</tr>
<tr>
<td></td>
<td>owner user (oracle).</td>
</tr>
<tr>
<td>Default GID to own the driver</td>
<td>Specify the GID of</td>
</tr>
<tr>
<td>interface:</td>
<td>the OSDBA group</td>
</tr>
<tr>
<td></td>
<td>(dba).</td>
</tr>
<tr>
<td>Start Oracle ASM Library</td>
<td>Enter \texttt{y} to</td>
</tr>
<tr>
<td>driver on boot (y/n):</td>
<td>start the Oracle</td>
</tr>
<tr>
<td></td>
<td>ASM library driver</td>
</tr>
<tr>
<td></td>
<td>when the system</td>
</tr>
<tr>
<td></td>
<td>starts.</td>
</tr>
</tbody>
</table>

   The script completes the following tasks:
   - Creates the /etc/sysconfig/oracleasm configuration file
   - Creates the /dev/oracleasm mount point
   - Loads the oracleasm kernel module
   - Mounts the ASM library driver file system

   \textbf{Note}: The ASM library driver file system is not a regular file system. It is used only by the ASM library to communicate with the ASM driver.

8. Repeat this procedure on all cluster nodes where you want to install RAC.
Configure the Disk Devices to Use the ASM Library Driver

To configure the disk devices that you want to use in an ASM disk group, follow these steps:

1. If necessary, install the shared disks that you intend to use for the disk group and restart the system.

2. To identify the device name for the disks that you want to use, enter the following command:

   ```
   # /sbin/fdisk -l
   ```

   Depending on the type of disk, the device name can vary:

<table>
<thead>
<tr>
<th>Disk Type</th>
<th>Device Name Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDE disk</td>
<td>/dev/hdxn</td>
<td>In this example, (x) is a letter that identifies the IDE disk and (n) is the partition number. For example, /dev/hda is the first disk on the first IDE bus.</td>
</tr>
<tr>
<td>SCSI disk</td>
<td>/dev/sdxn</td>
<td>In this example, (x) is a letter that identifies the SCSI disk and (n) is the partition number. For example, /dev/sda is the first disk on the first SCSI bus.</td>
</tr>
<tr>
<td>RAID disk</td>
<td>/dev/rd/cxdypz</td>
<td>Depending on the RAID controller, RAID devices can have different device names. In the examples shown, (x) is a number that identifies the controller, (y) is a number that identifies the disk, and (z) is a number that identifies the partition. For example, /dev/ida/c0d1 is the second logical drive on the first controller.</td>
</tr>
</tbody>
</table>

   To include devices in a disk group, you can specify either whole-drive device names or partition device names.

   **Note:** On Linux systems, Oracle recommends that you create a single whole-disk partition on each disk that you want to use.

3. Using either `fdisk` or `parted`, create a single whole-disk partition on the disk device that you want to use.

4. Enter a command similar to the following to mark a disk as an ASM disk:

   ```
   # /etc/init.d/oracleasm createdisk disk1 /dev/sdb1
   ```

   In this example, `disk1` is a name that you want to assign to the disk.

   **Note:** If you are using a multi-pathing disk driver with ASM, make sure that you specify the correct logical device name for the disk.

5. To make the disk available on the other cluster nodes, enter the following command as `root` on each node:

   ```
   # /etc/init.d/oracleasm scandisks
   ```
This command identifies shared disks attached to the node that are marked as ASM disks.

---

**Note:** To create a database during the installation using the ASM library driver, you must choose an installation method that runs DBCA in interactive mode, for example by choosing the Custom installation type or the Advanced database configuration option. You must also change the default disk discovery string to `ORCL:*`.

---

**Administer the ASM Library Driver and Disks**

To administer the ASM library driver and disks, use the `oracleasm` initialization script with different options, as follows:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| configure | Use the `configure` option to reconfigure the ASM library driver, if necessary:  
  # /etc/init.d/oracleasm configure |
| enable    | Use the `disable` and `enable` options to change the behavior of the ASM library driver when the system boots. The `enable` option causes the ASM library driver to load when the system boots:  
  # /etc/init.d/oracleasm enable |
| disable   | Use the `disable` option to change the behavior of the ASM library driver when the system boots. The `disable` option causes the ASM library driver to unload when the system boots:  
  # /etc/init.d/oracleasm disable |
| start     | Use the `start`, `stop`, and `restart` options to load or unload the ASM library driver without rebooting the system:  
  # /etc/init.d/oracleasm restart |
| stop      | Use the `stop` option to stop the ASM library driver:  
  # /etc/init.d/oracleasm stop |
| restart   | Use the `restart` option to restart the ASM library driver:  
  # /etc/init.d/oracleasm restart |
| createdisk| Use the `createdisk` option to mark a disk device for use with the ASM library driver and give it a name:  
  # /etc/init.d/oracleasm createdisk diskname devicename |
| deletedisk| Use the `deletedisk` option to unmark a named disk device:  
  # /etc/init.d/oracleasm deletedisk diskname |
| caution   | Do not use this command to unmark disks that are being used by an ASM disk group. You must drop the disk from the ASM disk group before you unmark it. |
| querydisk | Use the `querydisk` option to determine whether a disk device or disk name is being used by the ASM library driver:  
  # /etc/init.d/oracleasm querydisk {diskname | devicename} |
| listdisks | Use the `listdisks` option to list the disk names of marked ASM library driver disks:  
  # /etc/init.d/oracleasm listdisks |
| scandisks | Use the `scandisks` option to enable cluster nodes to identify which shared disks have been marked as ASM library driver disks on another node:  
  # /etc/init.d/oracleasm scandisks |
Configuring Disks for ASM Using Raw Devices

**Note:** For improved performance and easier administration, Oracle recommends that you use the ASM library driver rather than raw devices to configure ASM disks.

To configure disks for ASM using raw devices, follow these steps:

1. If necessary, install the shared disks that you intend to use for the disk group and reboot the system.

2. To identify the device names for the disks that you want to use, enter the following command:
   
   ```
   # /sbin/fdisk -l
   ```
   
   Depending on the type of disk, the device name can vary:

<table>
<thead>
<tr>
<th>Disk Type</th>
<th>Device Name Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDE disk</td>
<td>/dev/hdxn</td>
<td>In this example, (x) is a letter that identifies the IDE disk and (n) is the partition number. For example, /dev/hda is the first disk on the first IDE bus.</td>
</tr>
<tr>
<td>SCSI disk</td>
<td>/dev/sdxn</td>
<td>In this example, (x) is a letter that identifies the SCSI disk and (n) is the partition number. For example, /dev/sda is the first disk on the first SCSI bus.</td>
</tr>
<tr>
<td>RAID disk</td>
<td>/dev/rd/cxdypz</td>
<td>Depending on the RAID controller, RAID devices can have different device names. In the examples shown, (x) is a number that identifies the controller, (y) is a number that identifies the disk, and (z) is a number that identifies the partition. For example, /dev/rda/c0d1 is the second logical drive on the first controller.</td>
</tr>
<tr>
<td></td>
<td>/dev/ida/cxdypz</td>
<td></td>
</tr>
</tbody>
</table>

To include devices in a disk group, you can specify either whole-drive device names or partition device names.

**Note:** On Linux systems, Oracle recommends that you create a single whole-disk partition on each disk that you want to use.

3. Using either `fdisk` or `parted`, create a single whole-disk partition on the disk devices that you want to use.

4. On Red Hat systems, complete the following steps on each node to bind the disk devices to raw devices:

   **Note:** If the nodes are configured differently, the disk device names might be different on some nodes. In the following procedure, make sure that you specify the correct disk device names on each node.

   a. To determine what raw devices are already bound to other devices, enter the following command on every node:
Configure Disks for Automatic Storage Management

# /usr/bin/raw -qa

Raw devices have device names in the form /dev/raw/rawn, where n is a number that identifies the raw device.

For each device that you want to include in the disk group, identify a raw device name that is unused on all nodes.

b. Open the /etc/sysconfig/rawdevices file in any text editor and add a line similar to the following for each device that you want to include in a disk group:

/dev/raw/raw1 /dev/sdb1

Specify an unused raw device for each disk device.

c. For each raw device that you specified in the rawdevices file, enter commands similar to the following on the device file:

# chown oracle:dba /dev/raw/raw
# chmod 660 /dev/raw/raw

d. To bind the disk devices to the raw devices, enter the following command:

# /sbin/service rawdevices restart

The system automatically binds the devices listed in the rawdevices file when it restarts.

5. On SuSE systems, complete the following steps on each node to bind the disk devices to raw devices:

Note: If the nodes are configured differently, the disk device names might be different on some nodes. In the following procedure, make sure that you specify the correct disk device names on each node.

a. To determine what raw devices are already bound to other devices, enter the following command on every node:

# /sbin/raw -qa

Raw devices have device names in the form /dev/raw/rawn, where n is a number that identifies the raw device.

For each device that you want to include in the disk group, identify a raw device name that is unused on all nodes.

b. Open the /etc/raw file in any text editor and add a line similar to the following for each device that you want to include in a disk group:

raw1:sdb1

Note: If you are using a multi-pathing disk driver with ASM, make sure that you specify the correct logical device name for the disk.
Configure Raw Partitions

Note: If you are using a multi-pathing disk driver with ASM, make sure that you specify the correct logical device name for the disk.

Specify an unused raw device for each disk device.

c. For each raw device that you specified in the /etc/raw file, enter commands similar to the following to set the owner, group, and permissions on the device file:

   # chown oracle:dba /dev/raw/rawn
   # chmod 660 /dev/raw/rawn

d. To bind the disk devices to the raw devices, enter the following command:

   # /etc/init.d/raw start

e. To ensure that the raw devices are bound when the system restarts, enter the following command:

   # /sbin/chkconfig raw on

6. If you also want to use raw devices for storage, see the "Configure Raw Partitions" section on page 2-38. Otherwise, see the "Verify that the Required Software is Running" section on page 2-43.

Configure Raw Partitions

Refer to the following section for information about configuring raw devices.

Note: If you are using ASM for database file storage, you need only create raw devices for the Oracle CRS files. However, if a cluster file system is available on your platform, Oracle recommends that you use that file system to store the Oracle CRS files instead of using raw devices for them.

Configuring Raw Partitions

The following subsections describe how to configure raw partitions on Linux.

Review Important Information

The procedures contained in this section describe how to create raw partitions for Oracle CRS and database file storage. Although Red Hat Enterprise Linux 3 and SuSE Linux Enterprise Server 8 provide a Logical Volume Manager (LVM), this LVM is not cluster aware. For this reason, Oracle does not support the use of logical volumes with RAC for either CRS or database files.

Create Raw Partitions

To create the required raw partitions, follow these steps:

1. If necessary, install the shared disks that you intend to use and restart the system.
2. To identify the device name for the disks that you want to use, enter the following command:

```bash
# /sbin/fdisk -l
```

Depending on the type of disk, the device name can vary:

<table>
<thead>
<tr>
<th>Disk Type</th>
<th>Device Name Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDE disk</td>
<td>/dev/hdxn</td>
<td>In this example, x is a letter that identifies the IDE disk and n is the partition number. For example, /dev/hda is the first disk on the first IDE bus.</td>
</tr>
<tr>
<td>SCSI disk</td>
<td>/dev/sdxn</td>
<td>In this example, x is a letter that identifies the SCSI disk and n is the partition number. For example, /dev/sda is the first disk on the first SCSI bus.</td>
</tr>
<tr>
<td>RAID disk</td>
<td>/dev/rd/cxdypz</td>
<td>Depending on the RAID controller, RAID devices can have different device names. In the examples shown, x is a number that identifies the controller, y is a number that identifies the disk, and z is a number that identifies the partition. For example, /dev/ida/c0d1 is the second logical drive on the first controller.</td>
</tr>
</tbody>
</table>

You can create the required raw partitions either on new devices that you added or on previously partitioned devices that have unpartitioned free space. To identify devices that have unpartitioned free space, examine the start and end cylinder numbers of the existing partitions and determine whether the device contains unused cylinders.

3. To create raw partitions on a device, enter a command similar to the following:

```bash
# /sbin/fdisk devicename
```

Use the following guidelines when creating partitions:

- Use the `p` command to list the partition table of the device.
- Use the `n` command to create a new partition.
- After you have created the required partitions on this device, use the `w` command to write the modified partition table to the device.
- Refer to the `fdisk` man page for more information about creating partitions.

*Table 2–1* lists the number and size of the raw disk devices that you must configure for database files. *Table 2–2* lists the number and size of the raw disk devices that you must configure for CRS files.
Configure Raw Partitions

After you have created the required partitions, you must bind the partitions to raw devices on every node. However, you must first determine what raw devices are already bound to other devices. The procedure that you must follow to complete this task varies, depending on the Linux distribution that you are using:

<table>
<thead>
<tr>
<th>Number</th>
<th>Partition Size (MB)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>300 + (Number of instances * 250)</td>
<td>SYSAUX tablespace</td>
</tr>
<tr>
<td>Number of instances</td>
<td>500</td>
<td>UNDOTBSn tablespace (One tablespace for each instance)</td>
</tr>
<tr>
<td>1</td>
<td>250</td>
<td>TEMP tablespace</td>
</tr>
<tr>
<td>1</td>
<td>160</td>
<td>EXAMPLE tablespace</td>
</tr>
<tr>
<td>1</td>
<td>120</td>
<td>USERS tablespace</td>
</tr>
<tr>
<td>2 * number of instances</td>
<td>120</td>
<td>Two online redo log files for each instance</td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>First and second control files</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Server parameter file (SPFILE)</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Password file</td>
</tr>
</tbody>
</table>

**Note:** If you prefer to use manual, instead of automatic, undo management, create a single RBS tablespace raw device at least 500 MB in size instead of the UNDOTBSn raw devices.

<table>
<thead>
<tr>
<th>Number</th>
<th>Partition Size (MB)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>Oracle Cluster Registry</td>
</tr>
</tbody>
</table>

**Note:** You need to create this raw partition only once on the cluster. If you create more than one database on the cluster, they all share the same Oracle Cluster Registry (OCR).

If you are upgrading from Oracle9i Release 2, you can continue to use the raw device that you used for the SRVM configuration repository instead of creating this new raw device.

<table>
<thead>
<tr>
<th>Number</th>
<th>Partition Size (MB)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>Oracle CRS voting disk</td>
</tr>
</tbody>
</table>

**Note:** You need to create this raw partition only once on the cluster. If you create more than one database on the cluster, they all share the same Oracle CRS voting disk.

### Bind the Partitions to Raw Devices

After you have created the required partitions, you must bind the partitions to raw devices on every node. However, you must first determine what raw devices are already bound to other devices. The procedure that you must follow to complete this task varies, depending on the Linux distribution that you are using:

**Note:** If the nodes are configured differently, the disk device names might be different on some nodes. In the following procedure, make sure that you specify the correct disk device names on each node.

---

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- **Red Hat:**

  1. To determine what raw devices are already bound to other devices, enter the following command on every node:

     ```
     # /usr/bin/raw -qa
     ```

     Raw devices have device names in the form `/dev/raw/rawn`, where `n` is a number that identifies the raw device.

     For each device that you want to use, identify a raw device name that is unused on all nodes.

  2. Open the `/etc/sysconfig/rawdevices` file in any text editor and add a line similar to the following for each partition that you created:

     ```
     /dev/raw/raw1 /dev/sdb1
     ```

     Specify an unused raw device for each partition.

  3. For the raw device that you created for the Oracle Cluster Registry, enter commands similar to the following to set the owner, group, and permissions on the device file:

     ```
     # chown root:oinstall /dev/raw/rawn
     # chmod 640 /dev/raw/rawn
     ```

  4. For each other raw device that you specified in the `rawdevices` file, enter commands similar to the following to set the owner, group, and permissions on the device file:

     ```
     # chown oracle:dba /dev/raw/rawn
     # chmod 660 /dev/raw/rawn
     ```

  5. To bind the partitions to the raw devices, enter the following command:

     ```
     # /sbin/service rawdevices restart
     ```

     The system automatically binds the devices listed in the `rawdevices` file when it restarts.

  6. Repeat steps 2 to 5 on the other cluster nodes.

- **SuSE:**

  1. To determine what raw devices are already bound to other devices, enter the following command on every node:

     ```
     # /usr/sbin/raw -qa
     ```

     Raw devices have device names in the form `/dev/raw/rawn`, where `n` is a number that identifies the raw device.

     For each device that you want to use, identify a raw device name that is unused on all nodes.

  2. Open the `/etc/raw` file in any text editor and add a line similar to the following to associate each partition with an unused raw device:

     ```
     raw1:sdb1
     ```

  3. For the raw device that you created for the Oracle Cluster Registry, enter commands similar to the following to set the owner, group, and permissions on the device file:
Configure Raw Partitions

# chown root:oinstall /dev/raw/rawn
# chmod 640 /dev/raw/rawn

4. For each other raw device that you specified in the /etc/raw file, enter commands similar to the following to set the owner, group, and permissions on the device file:

# chown oracle:dba /dev/raw/rawn
# chmod 660 /dev/raw/rawn

5. To bind the partitions to the raw devices, enter the following command:

# /etc/init.d/raw start

6. To ensure that the raw devices are bound when the system restarts, enter the following command:

# /sbin/chkconfig raw on

7. Repeat steps 2 to 6 on the other cluster nodes.

Create the DBCA 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 CRS files in the DBCA raw device mapping file.
---

To allow Database Configuration Assistant (DBCA) 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/raw/raw1

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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 RAC database, the file must specify one automatic undo tablespace datafile (`undotbsn`) and two redo log files (`redo_1`, `redo_2`) for each instance.

- Specify at least two control files (`control1`, `control2`).

- To use manual instead of automatic undo management, specify a single RBS tablespace datafile (`rbs`) instead of the automatic undo management tablespace datafiles.

5. Save the file and note the file name that you specified.

6. When you are configuring the oracle user’s environment later in this chapter, set the `DBCA_RAW_CONFIG` environment variable to specify the full path to this file.
To verify that the `hangcheck-timer` module is running on every node:

1. Enter the following command on each node to determine which kernel modules are loaded:
   
   ```bash
   # /sbin/lsmod
   ```

2. If the `hangcheck-timer` module is not listed for any node, enter a command similar to the following to start the module on that node:
   
   ```bash
   # /sbin/insmod hangcheck-timer hangcheck_tick=30 hangcheck_margin=180
   ```

3. To ensure that the module is loaded every time the system restarts, verify that the local system startup file contains the command shown in the previous step, or add it if necessary:

   - **Red Hat:**
     
     On Red Hat Enterprise Linux systems, add the command to the `/etc/rc.d/rc.local` file.
   
   - **SuSE:**
     
     On SuSE systems, add the command to the `/etc/init.d/boot.local` file.

### Check the Configuration of OCFS

If you intend to use Oracle Cluster File System for database files, verify that it is configured correctly, as follows:

1. Enter the following command to verify that OCFS is configured to start at runlevels 2, 3, and 5:
   
   ```bash
   # /usr/sbin/chkconfig --list ocfs
   ```

2. Verify that the OCFS file systems you want to use are mounted and are specified in the `/etc/fstab` file.

### Stop Existing Oracle Processes

**Caution:** If you are installing additional Oracle Database 10g products in an existing Oracle home, stop all processes running in the Oracle home. You must complete this task to enable the Installer to relink certain executables and libraries.

If you choose to create a database during the installation, most installation types configure and start a default Oracle Net listener using TCP/IP port 1521 and the IPC key value `EXTPROC`. However, if an existing Oracle Net listener process is using the same port or key value, the 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 the Installer.
To determine whether an existing 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 a listener process is running and to identify its name and the Oracle home directory in which it is installed:
   
   ```
   $ ps -ef | grep tnslsnr
   ```

   This command displays information about the Oracle Net listeners running on the system:
   
   ```
   ... oracle_home1/bin/tnslsnr 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, refer to the "Configure the Oracle User’s Environment" section on page 2-46 to continue.

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`, 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 cluster nodes.
Configure the Oracle User's Environment

You run the Installer from the oracle account. However, before you start the 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 and ORACLE_BASE environment variables.

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

1. Start a new terminal session, for example, an X terminal (xterm).
2. Enter the following command to ensure that X Window applications can display on this system:
   
   ```
   $ xhost +
   ```
3. If you are not already logged in to the system where you want to install the software, log in to that system as the oracle user.
4. If you are not logged in as the oracle user, 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:
   
   - Bash shell on Red Hat Enterprise Linux:
     
     ```
     $ vi .bash_profile
     ```
   - Bourne shell (sh), Bash shell (bash), or Korn shell (ksh):
     
     ```
     $ vi .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 variables are set in the file, remove the appropriate lines from the file.
9. Save the file and exit from the editor.
10. To run the shell startup script, enter one of the following commands:

    - Bash shell on Red Hat Enterprise Linux:
      
      ```
      $ . ./bash_profile
      ```
    - Bourne, Bash, or Korn shell:
      
      ```
      $ . ./profile
      ```
    - C shell:
      
      ```
      % source ./.login
      ```
11. If you are not installing the software on the local system, enter a command similar to the following to direct X applications to display on the local system:
   - Bourne, Bash, or Korn shell:
     ```
     $ DISPLAY=localhost:0.0 ; export DISPLAY
     ```
   - C shell:
     ```
     % setenv DISPLAY localhost:0.0
     ```

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

12. If you determined that the `/tmp` directory has less than 400 MB of free disk space, 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:
   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 a+wr /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
        ```

13. Enter commands similar to the following to set the `ORACLE_BASE` environment variable:
   - Bourne, Bash, or Korn shell:
     ```
     $ ORACLE_BASE=/u01/app/oracle
     $ export ORACLE_BASE
     ```
   - C shell:
     ```
     % setenv ORACLE_BASE /u01/app/oracle
     ```

   In these examples, `/u01/app/oracle` is the Oracle base directory that you created or identified earlier.

14. If you are using raw devices for database file storage, 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/raw.conf
$ export DBCA_RAW_CONFIG

- C shell:
  % setenv DBCA_RAW_CONFIG=${ORACLE_BASE}/oradata/dbname/raw.conf

**15.** Enter the following command to ensure that the **ORACLE_HOME** and **TNS_ADMIN**
environment variables are not set:

- Bourne, Bash, or Korn shell:
  $ unset ORACLE_HOME
  $ unset TNS_ADMIN

- C shell:
  % unsetenv ORACLE_HOME
  % unsetenv TNS_ADMIN

---

**Note:** If the **ORACLE_HOME** environment variable is set, the
Installer uses the value that it specifies as the default path for the
Oracle home directory. However, if you set the **ORACLE_BASE**
environment variable, Oracle recommends that you unset the
**ORACLE_HOME** environment variable and choose the default path
suggested by the Installer.

---

**16.** 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 that the
environment variables you set in this section have the correct values.
Part III

Installing CRS and Oracle Database 10g with RAC, Creating RAC Databases, and Performing Post-Installation Tasks

Part III describes the two-phase installation process of how to install Cluster Ready Services (CRS) and the Oracle Database 10g with Real Application Clusters (RAC). It also explains how to create RAC databases, and it describes the post-installation tasks. The chapters in Part III are:

- Chapter 3, "Installing Cluster Ready Services on Linux Systems"
- Chapter 4, "Installing Oracle Database 10g with Real Application Clusters"
- Chapter 5, "Creating RAC Databases with the Database Configuration Assistant"
- Chapter 6, "Real Application Clusters Post-Installation Procedures"
This chapter describes the procedures for installing Cluster Ready Services (CRS) on UNIX, phase one of the Oracle Database 10g Real Application Clusters installation on Linux systems. The topics in this chapter are:

- Installation Setup Procedures
- Installing Cluster Ready Services with the OUI

### Installation Setup Procedures

Perform the following procedures to complete phase one of the installation of the Oracle Database 10g with RAC.

1. Verify user equivalence by executing the `ssh` command on the local node with the `date` command argument using the following syntax:
   ```
   ssh 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 `ssh` is in the `/usr/local/bin` directory, then use `ssh` to configure user equivalence.

   You cannot use `ssh` to verify user equivalence if `ssh` is in another location in your `PATH`. In this case, use `rsh` to confirm user equivalence.

2. In addition to the host machine’s public internet protocol (IP) address, obtain two more IP addresses for each node that is going to be part of your installation. During the installation, enter the IP addresses into DNS. One of the IP addresses must be a public IP address for the node’s virtual IP address (VIP). Oracle uses VIPs for client-to-database connections. Therefore, the VIP address must be publicly accessible. The other address must be a private IP address for inter-node, or instance-to-instance Cache Fusion traffic. Using public interfaces for Cache Fusion can cause performance problems.

### Installing Cluster Ready Services with the OUI

This section describes the procedures for using the Oracle Universal Installer (OUI) to install CRS. Note that the CRS home that you identify in this phase of the installation is only for CRS software; this home cannot be the same home as the home that you will use in phase two to install the Oracle Database 10g software with RAC.
If a GSD from Oracle9i, Release 9.2 or earlier, is running, then stop it before installing Oracle Database 10g CRS by executing the following command from the GSD's Oracle home:

```
$ORACLE_HOME/bin/gsdctl stop
```

If you are installing CRS on a node that already has a single-instance Oracle Database 10g installation, then perform the following operations:

- If there are any ASM instances running on the node, stop these existing ASM instances. After CRS is installed, restart the ASM instances again. This ensures that they are associated with the new cluster software.
- Log on as the root user and stop all Oracle services by executing the command:

```
Oracle home/bin/localconfig delete
```

where `Oracle home` is the home that is running CSS.

2. Log in as the oracle user and set the `ORACLE_BASE` environment variable to specify the Oracle base directory that you created previously, for example `/u01/app/oracle`.

3. Set the `ORACLE_HOME` environment variable to specify the CRS home directory that you created previously, for example `/u01/crs/oracle/product/10.1.0/crs_1`.

4. Run the `runInstaller` command from the top-level directory of the Oracle Cluster Ready Services Release 1 CD-ROM or the `crs` directory on the DVD-ROM. These are separate CD-ROMs and DVD-ROMs that contain the Cluster Ready Services software. When the OUI displays the Welcome page, click Next.

5. Depending on whether your environment has an Oracle inventory, the following scenarios apply:

   - If you are performing this installation in an environment where the OUI inventory is already set up, then the OUI displays the Specify File Locations page. If the Specify File Locations page appears, proceed to Step 7.
   - If you are performing this installation in an environment in which you have never installed Oracle database software, in other words the environment does not have an OUI inventory, then the OUI displays the Specify Inventory Directory and Credentials page. Enter the inventory location and the UNIX group name information into the Specify Inventory Directory and Credentials page, click Next, and the OUI displays a dialog.

6. The OUI dialog indicates that you should run the `oraInventory location/orainstRoot.sh` script. Run the `orainstRoot.sh` script as root user, click Continue, and the OUI displays the Specify File Locations page.

7. The Specify File Locations Page contains predetermined information for the source of the installation files and the target destination information. Enter the CRS home name and its location in the target destination, click Next, and the OUI displays the Language Selection page.

---

**Note:** For Linux, you cannot install the Oracle Database 10g Cluster Ready Services software on the Oracle Database 10g Linux cluster file system.
8. In the Language Selection page select the languages that you want CRS to use, click Next, and the OUI displays the Cluster Configuration page.

9. The Cluster Configuration page contains pre-defined node information if the OUI detects that your system has vendor clusterware. Otherwise, the OUI displays the Cluster Configuration page without pre-defined node information.

If you install the clusterware in this installation session without using vendor clusterware, then enter a public node name and a private node name for each node. 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, the cluster name that you use must be globally unique throughout the enterprise and the allowable character set for the cluster name is the same as that of host names, that is, underscores (_), hyphens (-), and single-byte alphanumeric characters (a to z, A to Z, and 0 to 9). Oracle recommends that you use the vendor cluster name if one exists. Make sure that you also enter a private node name or private IP address for each node. This is an address that is only accessible by the other nodes in this cluster. Oracle uses the private IP addresses for Cache Fusion processing. Click Next after you have entered the cluster configuration information and the OUI performs validation checks such as node availability and remote Oracle home permissions verifications. These verifications may require some time to complete. When the OUI completes the verifications, the OUI displays the Specify Network Interface Usage page.

10. In the Specify Network Interface Usage page the OUI displays a list of cluster-wide interfaces. Use the drop-down menus on this page to classify each interface as Public, Private, or Do Not Use. The default setting for each interface is Do Not Use. You must classify at least one interconnect as Public and one as Private.

11. When you click Next on the Specify Network Interface Usage page, the OUI will look for the `ocr.loc` file. The OUI will look in the `/etc` directory. If the `ocr.loc` file exists, and if the `ocr.loc` file has a valid entry for the Oracle Cluster Registry (OCR) location, then the Voting Disk Location page appears and you should proceed to Step 12.

Otherwise, the Oracle Cluster Registry Location Information page appears. Enter a complete path for the raw device or shared file system file for the Oracle Cluster Registry, click Next, and the Voting Disk Information page appears.

12. On the Voting Disk Information page, enter a complete path and file name for the file in which you want to store the voting disk and click Next. This must be a shared raw device or a shared file system file.

**Note:** The CRS home that you identify in this step must be different from the Oracle home that you will use in phase two of the installation.

**Note:** The IP addresses that you use for all of the nodes in the current installation process must be from the same subnet.
After you complete the Voting Disk Information page and click Next, if the Oracle inventories on the remote nodes are not set up, then the OUI displays a dialog asking you to run the `orainstRoot.sh` script on all of the nodes. After the `orainstRoot.sh` script processing completes, the OUI displays a Summary page.

The OUI displays the list of components that will be installed on the Summary page. Review the list of components and click install.

During the installation, unless you are using a clustered file system for the CRS home, the OUI first copies software to the local node and then copies the software to the remote nodes. Then the OUI displays a dialog indicating that you must run the `root.sh` script on all the nodes that are part of this installation.

Before running the `root.sh` script, log in as `root` and change permissions on the parent directories of the CRS home directory to permit only the `root` user to write to those directories. For example, if the CRS home directory is `/u01/crs/oracle/product/10.1.0/crs_1`, then enter commands similar to the following:

```
# chmod go-w /u01/crs/oracle/product/10.1.0
# chmod go-w /u01/crs/oracle/product
# chmod go-w /u01/crs/oracle/
# chmod go-w /u01/crs/
# chmod go-w /u01
```

You must perform this step on all of the nodes that are part of this installation session if you are not installing the CRS software on a cluster file system.

In the same terminal window, run the `root.sh` script as the `root` user. Execute the `root.sh` script on one node at a time. Only start another session of `root.sh` on another node after the previous `root.sh` execution completes; do not execute `root.sh` on more than one node at a time.

After you have run the `root.sh` script on all of the nodes that are part of this installation and when the final `root.sh` script has completed, return to the OUI and click OK on the dialog. The OUI runs the Oracle Notification Server Configuration Assistant and Oracle Private Interconnect Configuration Assistant. These assistants run without your intervention.

---

Notes:

- The storage size for the OCR should be at least 100MB and the storage size for the voting disk should be at least 20MB. In addition, Oracle recommends that you use a RAID array for storing the OCR and the voting disk to ensure the continuous availability of the partitions.

- The OCR disk must be owned by `root`, be in the `dba` group, and have permissions set to 640; the voting disk must be owned by `oracle`, be in the `dba` group, and have permissions set to 644.

See Also: The pre-installation chapters in Part II for information about the minimum raw device sizes.

---

Note: You must perform this step on all of the nodes that are part of this installation session if you are not installing the CRS software on a cluster file system.
17. When the OUI displays the End of Installation page, click Exit to exit the Installer.

18. Unset the ORACLE_HOME environment variable.

19. Verify your CRS installation by executing the following olsnodes command from the CRS Home/bin directory:

   olsnodes

   The output from this command should be a listing of the nodes on which CRS was installed, as shown in the following example:

   $ cd /opt/oracle/app/product/10.1.0/crs_1/bin
   $ ./olsnodes -n

   racserver1      1
   racserver2      2

   At this point, you have completed phase one, the installation of Cluster Ready Services, and are ready to install the Oracle Database 10g with RAC as described in Chapter 4, “Installing Oracle Database 10g with Real Application Clusters”.

   Oracle assumes that when you install Oracle Database 10g Cluster Ready Services software, that you will also install the Oracle Database 10g with RAC software. If there will be a significant delay before you perform phase two of the RAC installation to install Oracle Database 10g with RAC software, then run CRS_Home/bin/gsdctl start to start the GSD manually to service the 9.2 SRVCTL tool and assistants. Then before installing the Oracle Database 10g with RAC software, run the command CRS_Home/bin/gsdctl stop to stop the GSD.

Cluster Ready Services Background Processes

   The following processes must be running in your environment after the CRS installation in order for Cluster Ready Services to function:
   - evmd -- Event manager daemon that starts the racgevt process to manage callouts.
   - ocsd -- Manages cluster node membership and runs as oracle user; failure of this process results in cluster 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.
This chapter describes phase two of the installation procedures for installing the Oracle Database 10g with Real Application Clusters (RAC). This chapter also describes some of the Oracle Universal Installer (OUI) features. The procedures in this chapter apply to UNIX-based systems. This chapter contains the following topics:

- Selecting a Database Configuration Type
- Installation Setup Procedures
- Installation of Oracle Database 10g with RAC Using the Oracle Universal Installer
- De-Installing Real Application Clusters Software

Selecting a Database Configuration Type

This section describes OUI features that you should understand before beginning phase two of the RAC installation process. When you run the OUI and select the Oracle Database 10g, 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 the fourth type, or the Advanced configuration, then you can use the Database Configuration Assistant (DBCA) to create the database as described in Chapter 5. Oracle recommends that you use the DBCA to create your database.

You can also select the Advanced configuration, select a preconfigured template, customize the template, and use the DBCA to create a database using the template. These templates correspond to the General Purpose, Transaction Processing, and Data Warehouse configuration types. You can also use the DBCA with the Advanced template to create a database.

Oracle recommends that you use one of the preconfigured database options or use the Advanced option and the DBCA to create your database. However, if you want to configure your environment and create your database manually, then select the "Do not create a starter database" configuration option and refer to the manual database creation procedures posted at http://www.oracle.com/technology/.

Configuration Type Descriptions

The configuration type that you select, as described in Table 4–1, determines how you proceed.
Selecting a Database Configuration Type

If you select one of the first three configuration types on the OUI Select Database Configuration page, then complete the procedure in this chapter under the heading "Installation Setup Procedures" on page 4-3. These three configuration types use preconfigured templates. After you complete these procedures, the Oracle Network Configuration Assistant (NETCA) and the DBCA run without further input and the OUI displays a progress indicator during the installation.

If you choose raw devices on the Specify Database File Storage Option page, then the DBCA verifies that you configured the raw devices for each tablespace.

If you select the Advanced configuration, then you must enter specific information as described in the next section.

Using the Advanced Configuration Type

When you select the Advanced configuration type, the OUI runs the DBCA which displays four preconfigured database template choices:

- General Purpose
- Transaction Processing
- Data Warehouse
- Advanced

The first three templates create a database that is optimized for that environment. You also can customize these templates. The Advanced type, however, creates a database without using preconfigured options.

The following section provides more detail about OUI and DBCA processing when creating a RAC database.

Behavior of the OUI, the DBCA, and Other Assistants During Installation

After installation, the OUI starts the NETCA. After the NETCA completes its processing, the OUI runs the DBCA to create your database using the optimal flexible architecture (OFA). This means that the DBCA creates your database files, including

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Table 4–1  Oracle Universal Installer Database Configuration Types

<table>
<thead>
<tr>
<th>Configuration Type</th>
<th>Description</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Purpose, Transaction Processing</td>
<td>installs a preconfigured starter database, licensable Oracle options</td>
<td>Minimal input required. You can create your database more quickly than with Advanced type.</td>
</tr>
<tr>
<td>and Data Warehouse</td>
<td>(including the Oracle Database 10g with RAC), networking services, Oracle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Database 10g utilities, and online documentation. At the end of the installation, the DBCA creates and configures your RAC database.</td>
<td></td>
</tr>
<tr>
<td>Advanced</td>
<td>Enables you to customize your database options and storage components.</td>
<td>Enables you to create arbitrary tablespaces and datafiles and customize all aspects of your database.</td>
</tr>
<tr>
<td>Do not create a starter database</td>
<td>Installs only the software. Does not configure the listeners or network infrastructure and does not create a database.</td>
<td></td>
</tr>
</tbody>
</table>

---

General Purpose, Transaction Processing, and Data Warehouse Configuration Types

If you select one of the first three configuration types on the OUI Select Database Configuration page, then complete the procedure in this chapter under the heading "Installation Setup Procedures" on page 4-3. These three configuration types use preconfigured templates. After you complete these procedures, the Oracle Network Configuration Assistant (NETCA) and the DBCA run without further input and the OUI displays a progress indicator during the installation.

The DBCA processing for these 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 the DBCA verifies that you configured the raw devices for each tablespace.

If you select the Advanced configuration, then you must enter specific information as described in the next section.

Using the Advanced Configuration Type

When you select the Advanced configuration type, the OUI runs the DBCA which displays four preconfigured database template choices:

- General Purpose
- Transaction Processing
- Data Warehouse
- Advanced

The first three templates create a database that is optimized for that environment. You also can customize these templates. The Advanced type, however, creates a database without using preconfigured options.

The following section provides more detail about OUI and DBCA processing when creating a RAC database.

Behavior of the OUI, the DBCA, and Other Assistants During Installation

After installation, the OUI starts the NETCA. After the NETCA completes its processing, the OUI runs the DBCA to create your database using the optimal flexible architecture (OFA). This means that the DBCA creates your database files, including

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4-2  Oracle Real Application Clusters Installation and Configuration Guide
the default server parameter file (spfile), using standard file naming and file placement practices. The primary phases of DBCA processing are:

- 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 the DBCA in standalone mode to create a database.

**See Also:** The *Oracle Net Services Administrator’s Guide* if you experience problems, for example, with the listener configuration, and for further information about LDAP support

The remainder of this chapter explains how to use the OUI to install the Oracle Database 10g with RAC.

**Installation Setup Procedures**

Complete one of the following installation setup procedure:

- Installation Setup Procedures for Linux x86-64-based Systems

**Installation Setup Procedures for Linux x86-64-based Systems**

If the user who installed Cluster Ready Services (CRS) is different from the user who installs RAC, then all of the user-level pre-install steps must be completed.

1. Verify user equivalence by running the \texttt{ssh} command on the local node with the date command argument using the following syntax:

   \begin{verbatim}
   ssh node_name date
   ssh node_name xclock
   \end{verbatim}

   The output from these commands should be the timestamp of the remote node identified by the value that you use for \texttt{node_name}. In additionally, the system should display the remote node's xclock. When you run these commands, you should not see any other errors, warnings, or additional output. If \texttt{ssh} is in the \texttt{/usr/local/bin} directory, then use \texttt{ssh} to configure user equivalence.

   The OUI cannot use \texttt{ssh} to verify user equivalence if \texttt{ssh} is in another location in your \texttt{PATH}. In this case, use \texttt{rsh} to confirm user equivalence.

   **Note:** When you test user equivalence by executing the \texttt{ssh} or \texttt{rsh} commands, the system should not respond with questions nor should you see additional output, for example, besides the output of the date command and the xclock. You should also not have any echo messages in your \texttt{.login} or \texttt{.cshrc} files.

2. Perform a network connectivity test to ensure that all nodes on which you want to perform this installation can communicate with each other. Ensure that the public and private network interfaces have the same interface names on each node of your cluster.
3. Set directory and file creation permissions using the `umask` command so that you can write as `oracle` user to all of the Oracle homes in the RAC database environment in which you are performing this installation.

4. Create directories for the Oracle home and Oracle datafiles according to OFA standards.

---

**Note:** The Oracle home that you create for installing Oracle Database 10g with the RAC software cannot be the same Oracle home that you used during the CRS installation.

---

You can use your Oracle9i database language and territory definition files with the Oracle Database 10g release 1 (10.1.0.3) that you are about to install. To enable this functionality, you must run the OUI from a command line, described in Step1 in "Installation of Oracle Database 10g with RAC Using the Oracle Universal Installer" on page 4-4, and use following statement to set the `b_cr9idata` variable to `true`:

```
runInstaller oracle.rsf.nlsrtl_rsf:b_cr9idata=true
```
4. The Selected Nodes page is an informational page that displays the selected nodes that are associated with a cluster home. Click Next on this page and the OUI displays the Select Installation Type page described in Step 6.

**Note:** Even if you are using a clustered file system, then the Selected Nodes page should display all the nodes you intend to use for your RAC databases.

When you click Next on the Selected Nodes page, the OUI verifies that the Oracle home directory is writable on the remote nodes and that the remote nodes are operating. The OUI also re-validates user equivalence.

If the OUI detects a network or user equivalence problem on any node that you have included in this installation, then the OUI displays a warning on the Selected Nodes page. This warning appears next to the node and indicates that you should correct a problem on the affected node before proceeding. To resolve problems, examine the OUI actions recorded in the following file:

```
OraInventory\logs\installActionsdate_time.log
```

5. On the Specify Hardware Cluster Installation Mode page, select an installation mode. The Cluster Installation mode is selected by default when the OUI detects that you are performing this installation on a cluster. In addition, the local node is always selected for the installation. Select additional nodes that are to be part of this installation session and click Next.

**See Also:** If you select Local Installation, then refer to the *Oracle Database Installation Guide, 10g Release 1 (10.1.0.3) for Linux x86-64* to perform a single-node, non-RAC installation on a UNIX cluster, or to the appropriate quick start guide.

When you click Next on the Specify Hardware Cluster Installation page, the OUI verifies that the Oracle home directory is writable on the remote nodes and that the remote nodes are operating. The OUI also re-validates user equivalence.

If the OUI detects a network or user equivalence problem on any node that you have included in this installation, then the OUI displays a warning on the Specify Hardware Cluster Installation Selection page. This warning appears next to the node and indicates that you should correct a problem on the affected node before proceeding. To resolve problems, examine the OUI actions recorded in the installation log file. The installation log file is:

```
OraInventory/logs/installActionsdate_time.log
```

You can either make corrections and click Next, or you can deselect nodes that have errors and click Next. When you click Next, the OUI displays the Select Installation Type page.
6. On the Select Installation Type page you can select Enterprise Edition, Standard Edition, or Custom Install type. If you select Enterprise Edition or Standard Edition, then your installation will include the components related to the chosen edition. If you select the Custom install, then select the individual components that you want to install from the list of available components. Note that if you have purchased a Standard Edition license and you perform a Custom installation, then only install the products covered by the Standard Edition license.

After you make your selection and click Next on the Select Installation Type page, the OUI displays one of the following pages, depending on your configuration and selections:

- Product-specific Prerequisite Checks page: This page is displayed during installations on Linux systems and is described in Step 7.

7. The Product-specific Prerequisite Checks page verifies the operating system kernel parameters or attributes and calculates the \texttt{ORACLE_BASE} location. Click Next and the next page that the OUI displays depends on your configuration and selection options as follows:

- Available Products Components page: This page is displayed if the OUI detects a previous release of the database and is described in Step 8.

- Upgrading an Existing Database page: This page is displayed if you selected a Custom install and is described in Step 9.

- Select Database Configuration page: This page is displayed if you did not select a Custom install and there is no database to upgrade. This page is described in Step 10.

8. On the Upgrading an Existing Database page, you can choose to upgrade one or more existing databases or continue with the installation without performing any upgrades. If you wish to upgrade an existing database, then select the check box labelled "Upgrade an Existing Database" and then select the databases to upgrade from the list provided. If you prefer not to upgrade any of the listed databases, then leave the "Upgrade an Existing Database" check box unchecked.

If you selected "Upgrade an Existing Database", then the OUI continues with the Summary page, described in Step 18, when you click Next. If you did not select "Upgrade an Existing Database", then the OUI continues with the Select Database Configuration page, described in Step 10, when you click Next.

9. On the Available Products Components page, select the components you wish to install and click Next. This opens the Component Locations page in some cases, such as when insufficient disk space is available. Choose the location for your install and click Next. The OUI will display the Privileged Operating System Groups page described in Step 17.

10. The Select Database Configuration page, provides options for you to create a preconfigured database as part of the installation process or to install the software without creating a database. If you want to create a database as part of your installation, then select General Purpose, Transaction Processing, Data Warehouse, or Advanced. If you only want to install the software, then select "Do not create a starter database". Click Help for more information about these choices.
If you choose to create a General Purpose, Transaction Processing, or a Data Warehouse database, then when you click Next, the OUI displays the Specify Database Configuration Options page, described in Step 11. If you choose the Advanced option or select “Do not create a starter database”, then when you click Next, the OUI displays the Privileged Operating System Groups page, described in Step 17.

11. On the Specify Database Configuration Options page, enter a global database name. A global database name is a name that includes the database name and database domain, such as `db.us.acme.com`. The name that you enter on this page must be unique among all the global database names used in your environment. Accept or change the common prefix for the Oracle `sid` for each instance. Each instance has a `sid` that comprises the common prefix that you enter in this step and an instance ID that is automatically generated. Note that a SID prefix cannot exceed 5 characters. Also select a database character set and, on Linux systems only, select any database examples to install from the Sample Schemas.

When you click Next on the Specify Database Configuration Options page, the OUI displays the Select Database Management Option page.

12. On the Select Database Management Option page, if you are installing on a UNIX-based system and 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 email option and enter the outgoing SMTP server name and email address.

If you perform an installation that does not include 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 the OUI, the 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 the OUI utility and `Enterprise Manager Advanced Configuration Guide` for details about installing Database Control with the DBCA and the EMCA utilities.

When you click Next on the Select Database Management Option page, the OUI displays the Specify Database File Storage Option page.

13. Select a data storage option on the Specify Database File Storage Option page.

If you select Automatic Storage Management (ASM): Then the OUI displays an ASM Management Options page showing the disk partition locations from which you must select. These partitions appear in the default location as follows:

- On Linux systems, the default partitions dependent on the operating system, as follows:

Note: If you are installing on a Linux system which uses an ASM library driver, then you must select either the Advanced option or a software only install. Additionally, you must specify `ORCL:*` as the disk discovery path when asked for this information in the DBCA.
If you select **File System**: Then enter the full path of the location for the datafiles destination on your shared or cluster file system and click Next.

If you select **raw devices**: Then enter a location for the raw device mapping file and click Next. If the `DBCA_RAW_CONFIG` environment variable is set, then the location already is set with the value for this variable.

When you click Next on the Specify Database File Storage Option page, the OUI displays the Specify Backup and Recovery Options page.

14. If you enable backup on the Specify Backup and Recovery Options page, then you can choose File System or ASM. You will also enter the user name and password. When you click Next on the Specify Backup and Recovery Options page, the next page the OUI displays depends on your configuration and selection options:

- If you have selected ASM as a storage option, then the next page is either the Select ASM Disk Group page, if there is an existing ASM instance and disk group available, or the Configure Automatic Storage Management page, described in Step 15, if you need to define your ASM environment.
- If you have not selected ASM as a storage option, then the next page is the Specify Database Schema Passwords page, described in Step 16.

15. The Configure Automatic Storage Management page lists the available disk partition locations. Select the disks that you prepared for your ASM disk groups. To continue to the Specify Database Schema Passwords page, click Next.

16. On the Specify Database Schema Passwords page, you can choose different passwords for SYS, SYSTEM, DBSNMP, and SYSDMF, or you can choose one password for all of the privileged accounts. When you click Next on the Specify Database Schema Passwords page, the next page that the OUI displays depends on your configuration and selection options as follows:

- If the user is not a member of the **dba** group, then the next page is the Privileged Operating System Groups page, described in Step 17.
- If the user is a member of the **dba** group, then the next page is the Summary page, described in Step 18.

17. On Privileged Operating System Groups page, you enter the group name for the **sysdba** and **sysoper** users. When you click Next on the Privileged Operating System Groups page, the OUI displays the Create Database page, which you can ignore if you are upgrading. Finally, the OUI proceeds to the Summary page.

18. The Summary page displays the software components that the OUI will install and the space available in the Oracle home with a list of the nodes that are part of the installation session. Verify the details about the installation that appear on the Summary page and click Install or click Back to revise your installation.

During the installation, unless you are placing your Oracle home on a clustered file system, the OUI copies software to the local node and then copies the software to the remote nodes. The OUI then prompts you to run the `root.sh` script on all the selected nodes to start the VIPCA and display the VIPCA Welcome page.

Before you run `root.sh`, make sure that your display environment variables are properly set.
19. Review the information on the VIPCA Welcome page, click Next, and the VIPCA displays the Public Network Interfaces page.

20. On the Public Network Interfaces page determine the network interface cards (NICs) to which you want to assign your public VIP addresses, click Next, and the VIPCA displays the IP Address page.

21. On the IP Address page enter an unused (unassigned) public virtual IP address for each node displayed on this page and click Next. After you click Next, the VIPCA displays a Summary page. Review the information on this page and click Finish. A progress dialog appears while the VIPCA configures the virtual IP addresses with the network interfaces that you selected. The VIPCA then creates and starts the VIPs, GSD, and Oracle Notification Service (ONS) node applications. When the configuration completes, click OK to see the VIPCA session results. Review the information on the Configuration Results page, and click Exit to exit the VIPCA.

22. On Linux systems, run the root.sh procedure, one node at a time, on each of the nodes that is part of this installation. The VIPCA will not run again on the remote node because the node applications for the remote node are already configured.

23. Click OK on the OUI dialog to continue the installation. This enables the remaining Oracle configuration assistants to run in the order shown in the following list so that the assistants can perform post-installation processing:
   - NETCA
   - DBCA

   At the end of the database creation, DBCA configures Database Control and starts the services. Database Control is immediately available to administer and monitor your newly installed Oracle Database 10g with Real Application Clusters environment.

You have completed the second and final phase of the installation. Proceed to Chapter 6, "Real Application Clusters Post-Installation Procedures" to perform the post-installation tasks.

---

Notes:

- If you need to change the VIP on a RAC node, then you should use the command
  
  `srvctl modify nodeapps -A new_address`

  where `new_address` is defined as explained in Appendix B of the Oracle Real Application Clusters Administrator's Guide.

- Use the DBCA and the OUI to de-install RAC.

---

De-Installing Real Application Clusters Software

Perform the following procedures to de-install Oracle Database 10g RAC and CRS software. You must de-install the Oracle database software first before de-installing the Cluster Ready Services (CRS) software. These steps to complete these de-installation tasks are described in the following sections:

- De-Installing Oracle Database 10g RAC Software
- De-Installing Cluster Ready Services
De-Installing Real Application Clusters Software

**Note:** These sections describe a complete de-installation of the RAC, ASM, and CRS software where RAC and ASM share the Oracle home and no other Oracle home exists.

If you have multiple Oracle homes on the cluster, then check for any dependencies that might affect your other databases. Such dependencies can include listeners, ASM instances, and so on that run in the Oracle home to be deleted. To identify dependencies, on UNIX-based platforms, review the `oratab` file to identify common Oracle homes.

**See Also:** *Oracle Real Application Clusters Administrator’s 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

This section describes the procedure to de-install the Oracle Database 10g RAC software. Before you perform these steps, consider making a backup of any databases that run from the Oracle home you are about to delete. You should then stop any instances and processes on all nodes that depend on the software being de-installed.

1. Delete all of the databases that are dependent on the Oracle home that you are deleting by using the DBCA "Delete a database" option.

2. If ASM runs from the same Oracle home that you are de-installing, then ensure that there are no other database dependencies on this ASM instance and 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 on all of the nodes that are affected by the de-installation of this Oracle home to identify the database instances that are using ASM:

   ```sql
   SQL> select INSTANCE_NAME from GV$ASM_CLIENT;
   ```

   **Note:** This command only lists the 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.

   b. For each instance listed in the output of the statement that you ran in Step a, stop the respective databases.

   c. Oracle recommends that you backup the database files for all of the databases that are currently using this ASM instance.

   d. Using your connection to the ASM instance, run the following command to identify the disk groups that are managed by the ASM instance:

   ```sql
   SQL> select * from V$ASM_DISKGROUP;
   ```
e. For each diskgroup listed in the output of the statement that you ran in Step d, run the following command to drop the disk group:

```
SQL> drop diskgroup diskgroup_name including contents;
```

where `diskgroup_name` is the name of the diskgroup.

f. Shutdown ASM on all of the nodes on which this Oracle home exists. Do this by running the command `srvctl stop asm -n node_name` for all nodes on which this Oracle home exists.

g. To remove the ASM configuration, run the following command for all nodes on which this Oracle home exists:

```
srvctl remove asm -n node_name
```

where `node_name` is the name of a node from which you want to remove the ASM instance.

h. To remove the ASM configuration, run the following command on all nodes on which this Oracle home exists:

```
srvctl remove asm -n node_name
```

where `node_name` is the name of a node from which you want to remove the ASM instance.

i. If you are de-installing from a Linux-based 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
```

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 the `oratab` entries that begin with the characters `+ASM` for each ASM instance on which you performed the previous step, step j.
3. If the listener runs from this Oracle home, then use the NETCA to remove the listener and its configuration.

4. If the CRS node applications for VIP, ONS, and GSD were created in this Oracle home, then you can remove them and re-create them in another Oracle Database 10g Oracle home, or you can modify the Oracle home for these applications so that they use an alternate Oracle Database 10g Oracle home. Both of these alternative procedures are described in the following two points.

Perform one of the following procedures:

a. Stop and remove the CRS node applications on each node that is associated with the Oracle home that you are deleting. Do this by running the command `srvctl stop nodeapps -n node_name` for all of the nodes that are affected by the deletion of the Oracle home. Then remove the CRS node applications by running one of the following commands:

   ```bash
   $ORACLE_HOME/install/rootdeletenode.sh
   ```

   Respond to the prompts to confirm your operations for each node. If other Oracle Database 10g RAC Oracle homes exist, then re-create the node applications in that Oracle home by running the command `srvctl create nodeapps`.

b. Alternatively, you can modify the CRS node application Oracle home by running the following command:

   ```bash
   srvctl modify nodeapps -o oracle_home
   ```

5. After you complete the previous steps in this procedure, run the OUI and on the Welcome page, click Deinstall Products to display the list of installed products on which you can select the Oracle home to de-install.

See Also: Oracle Real Application Clusters Administrator’s Guide for more information about using RAC scalability features of adding and deleting nodes and instances from RAC databases and for details of the SRVCTL command syntax.

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 the OUI and want to perform another RAC installation, then you must start a new OUI session.

De-Installing Cluster Ready Services

De-install each Oracle Database 10g RAC home by running the procedure in the previous section, “De-Installing Oracle Database 10g RAC Software”. Then complete the de-installation by removing the CRS software using one of the following procedure:

1. Run the command `CRSHome/install/rootdelete.sh` to disable the CRS 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 CRS 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 CRS.

2. Run the script `CRS Home/install/rootdeinstall.sh` on a local node to remove the OCR.

3. Run the OUI and in the Welcome page, click Deinstall Products to display the list of installed products on which you can select the CRS home to de-install.

---

**Note:** A node is a local node if you plan to run Steps 2 and 3 on that node.
Creating RAC Databases with the Database Configuration Assistant

This chapter describes how to use the Database Configuration Assistant (DBCA) in standalone mode to create and delete Real Application Clusters (RAC) databases. The topics in this chapter include:

- Using the Database Configuration Assistant in Real Application Clusters
- Benefits of Using the Database Configuration Assistant
- Real Application Clusters High Availability Services
- Creating the Database after Installation Using the Database Configuration Assistant
- Creating a Real Application Clusters Database with the DBCA
- Deleting a Real Application Clusters Database with the DBCA

See Also: Oracle Real Application Clusters Administrator’s Guide for procedures on using the DBCA to add and delete instances

Using the Database Configuration Assistant in Real Application Clusters

The primary functions of the DBCA processing include:

- Create the database and its instances
- Set up network configuration for database, instances and database services
- Configure Enterprise Manager Grid Control
- Start up database, its instances, services, and any other node applications

See Also:

- "Creating the Database after Installation Using the Database Configuration Assistant" on page 5-2 for more information about using the DBCA in standalone mode
- The Oracle 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)-compliant directory support
Benefits of Using the Database Configuration Assistant

Oracle recommends that you use the DBCA to create your RAC database because the DBCA’s preconfigured databases optimize your environment for features such as ASM, the server parameter file, and automatic undo management. The DBCA also provides pages to create new ASM disk groups if they are needed and configures recovery and backup disk space if you are using ASM or cluster file system storage.

With the DBCA, you may create site-specific tablespaces as part of database creation. If you have datafile requirements that differ from those offered by the DBCA templates, then create your database with the DBCA and modify the datafiles later. You can also execute user-specified scripts as part of your database creation process.

The 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.

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

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. Make a selection in this row for your failover and reconnection policy preference as described in the following list:

- None: Do not use TAF
- Basic: Establish connections at failover time
- Pre-connect: Establish one connection to a preferred instance and another connection to a backup instance that you have selected to be available

Creating the Database after Installation Using the Database Configuration Assistant

To create a database with the DBCA in standalone mode without ASM or a cluster file system, you must have configured each raw device as described in Appendix C. In addition, you must have run the Oracle Net Configuration Assistant to configure your Oracle Net listener.ora file.

If you select DBCA templates that use preconfigured datafiles and if you do not use ASM or a cluster file system, then during database creation the DBCA first verifies that you created the raw devices for each tablespace. If you have not configured the raw
Creating a Real Application Clusters Database with the DBCA

Creating RAC Databases with the Database Configuration Assistant

To start the DBCA, connect to one of your nodes with Oracle RAC installed and then:
- Enter the `DBCA` command from the `$ORACLE_HOME/bin` directory

### Creating a Real Application Clusters Database with the DBCA

The first page that the DBCA displays is the Welcome page for RAC. The DBCA displays this RAC-specific Welcome page only if the Oracle home from which it is invoked was cluster installed.

**See Also:** The DBCA online help for more information

If the DBCA does not display the Welcome page for RAC, then the DBCA was unable to detect whether the Oracle home is cluster installed. In this case, check that the OUI inventory is correctly located in `/var/opt/oracle/oraInst.loc` and that `oraInventory` is not corrupted. Also, perform clusterware diagnostics by executing the `olsnodes` command from the `bin` directory in CRS home. Otherwise, to create a RAC database:

1. Select Real Application Clusters database, click Next, and the DBCA displays the Operations page. The DBCA enables the Configure Database Options, Delete a database, Instance Management, and Services Management options only if there is at least one RAC database configured on your cluster that runs from the Oracle home.

2. Select Create a database and click Next, and the DBCA displays the Node Selection page.

3. The DBCA highlights the local node by default. Select the other nodes that you want to configure as members of your cluster database, click Next, and the DBCA displays the Database Templates page. If nodes that are part of your cluster installation do not appear on the Node Selection page, then perform inventory diagnostics and the clusterware diagnostics by executing the `olsnodes` command.

4. The templates on the Database Templates page are Custom Database, Transaction Processing, Data Warehouse, and General Purpose. The Custom Database template does not include datafiles or options specially configured for a particular type of application. Use one of the other templates, which include datafiles, if you want to create database with specifically configured options. Select the template from which you wish to create your cluster database, click Next, and the DBCA displays the Database Identification page.

5. Enter the global database name and the Oracle system identifier (SID) prefix for your cluster database, click Next, and the DBCA displays the Management Options page.

**Note:** The global database name can be up to 30 characters in length and must begin with an alphabetical character. The SID prefix must begin with an alphabetical character and contain no more than 5 characters. The DBCA uses the SID prefix to generate a unique value for the `ORACLE_SID` for each instance.
6. On the Management Options page, you can choose to manage your database with Enterprise Manager. On Linux systems only, you can also choose either the Grid Control or Database Control option if you select Enterprise Manager database management. If you select Enterprise Manager with the Grid Control option and DBCA discovers agents running on the local node, then you can select the preferred agent from a list.

If you select the Database Control option on a Linux server, then you can set up e-mail notification and enable daily backups. 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 takes backup.

After you make your selections and enter any required information, click Next, and the DBCA displays the Database Credentials page.

7. Enter the passwords for your database on the Database Credentials page. You can enter the same or different passwords for the users SYS and SYSTEM, plus DBSNMP and SYSMAN if you selected Enterprise Manager on the Management Options page. Select the Use the Same Password for All Accounts option to assign the same password to the listed users. Or provide a different password for each of these users by selecting the Use different Passwords option. Enter the password information, click Next, and DBCA displays the Storage Options page.

8. Use the Storage Options page to select a storage type for database creation. The Cluster File System option is the default. Select a storage option and click Next to proceed to the next page. If you selected Cluster File System, then the next page that appears is the Database File Locations page, described in Step 9. If you select Raw Devices, the next page that appears is the Recovery Configuration page, described in Step 10. If you select Automatic Storage Management (ASM), then provide additional information as follows:

   a. If there is not an ASM instance on any of the cluster nodes, then the DBCA displays the Create ASM Instance page for you, described in Step c. Otherwise the DBCA displays the ASM Disk Groups page, described in Step d.

   b. If an ASM instance exists on the local node, then the DBCA displays a dialog asking you to enter the password for the SYS user for ASM.

   c. To initiate the creation of the required ASM instance, supply the password for the SYS user of the ASM instance. If your Oracle home is installed on cluster file system, then the ASM instance uses an SPFILE, otherwise, you can select either an IFILE or an SPFILE on shared storage for the instances. After you enter the required information, click Next to create the ASM instance. Once the instance is created, DBCA proceeds to the ASM Disk Groups page described in Step d.

   d. From the ASM Disk Groups page, you can create a new disk group, add disks to an existing disk group, or select a disk group for your database storage.

      If you have just created a new ASM instance, then there will be no disk groups from which to select, so you must create a new one by clicking Create New to open the Create Disk Group page, described in Step e.

      Similarly, if one or more disk groups are displayed but you want to add a new one, then click Create New and follow the procedure described in Step e to complete the Create Disk Group page.

      If you want to use an existing disk group but wish to add more disks to it, click Add Disks and follow the instructions in Step f.
Once you are satisfied with the ASM disk groups available to you, select the one you wish to use for your database files and click Next to proceed to the Database File Locations page, described in step 9.

**Note:** 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

e. Enter the disk group name and then click the redundancy level for the group if you do not wish to use the default value (Normal). Create your disk group by selecting from the list of candidate disks. Continue by following the process described in Step g.

f. If there is a disk group that you want to use but you want to add more disks to it, then select the group and click Add Disks. Add to the disk group by selecting from the list of candidate disks. Continue by following the process described in Step g.

g. If you do not see the disks you wish to add, 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 checking the select box. If you select a disk with a Member status, you must also check the Force column to confirm that you want the DBCA to remove the disk from its current ASM disk group. When you have selected the desired disks, click OK to add them to your disk group and return to the ASM Disk Groups Page. To proceed, see the instructions described earlier in Step d.

h. If the DBCA displays the following message:

   The file oracle_home/bin/oracle does not exist on nodes node_list.
   Make sure that file exists on these nodes before proceeding.

   then 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 Real Application Clusters Administrator’s Guide*. However, do not perform Step 5 in that section. The OUI extends the ASM Oracle home to the selected nodes and performs any configuration required for running an ASM instance on these nodes.

i. If the DBCA displays the message Please run the DBCA from one of the nodes that has an existing ASM instance node_list., then you are attempting to create a RAC database using ASM storage and the ASM instance does not exist on the node from which you ran the DBCA. However, ASM instances do exist on the remote nodes that appear in the message node list. In this case, the DBCA cannot clone the existing ASM instance from the remote node to the local node. To correct this, start the DBCA from one of the nodes shown in the node list to create your RAC database using ASM storage. This copies the ASM instance of the local node and modifies its parameters and attributes to create ASM instances on the nodes in your cluster that do not have ASM instances.
j. If the DBCA displays the message `ORACLE_BASE` for ASM home `asm_home` does not match the value for database home `db_home`. Please set `ORACLE_BASE` to `asm_home` and restart DBCA., then this means that you selected a node to be part of your RAC database that does not have an ASM instance. In addition, the ASM instance on the local node is running from an Oracle home that is different from the Oracle home for the database to be created. Both the ASM home and the database home must be under a common `ORACLE_BASE`. If you created the original ASM instance without setting `ORACLE_BASE`, then set the `ORACLE_BASE` to the `asm_home` and restart the DBCA to proceed.

9. The Database File Locations page enables you to select the file storage for your database files: locations provided in a template, a common location for all database files (the files will not be Oracle-managed files), or Oracle-managed files in a common location. If you do not select the template option, you can enter an existing ASM disk group name or directory path name in the space provided, or click Browse to open a selection list.

If you wish to multiplex the database redo log files and control files, click Multiplex Redo Logs and Control Files and provide the location for each copy you want. Click OK when you have defined the multiplex locations to return to the Database File Locations page.

You may also define your own variables for the file locations if you plan to use the Database Storage page, explained in Step 14, to define individual file locations.

10. On the Recovery Configuration page, you can select redo log archiving by selecting Enable Archiving. If you are using ASM or CFS 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 CFS, then the flash recovery area defaults to `$ORACLE_BASE/flash_recovery_area`.

You may also define your own variables for the file locations if you plan to use the Database Storage page, explained in Step 14, to define individual file locations.

When you have completed your entries, click Next, and the Database Content page is displayed.

11. On the Database Content page, if you chose the Custom Database option, you can select or deselect the database components and their corresponding tablespace assignment. For a seed database, you can select whether to include the sample schemas in your database and to run custom scripts as part of the database creation processing. After completing your selections, click Next, and the Databases Services page is displayed.

12. To create services on the Database Services page, expand the Services tree. Oracle displays the global database name in the top left-hand corner of the page. Select the global database name and click Add to add services to the database. Enter a service name in the Add a Service dialog and click OK to add the service and return to the Database Services page.

The service name appears under the global database name. Select the service name and the DBCA displays the service preferences for the service on the right-hand side of the DBCA Database Services page. Change the instance preference (Not Used, Preferred, or Available) and TAF policies for the service as needed.

Repeat this procedure for each service and when you are done configuring services for your database, click Next. The DBCA displays the Initialization Parameters page.
13. By default, the Initialization Parameters page shows only the basic parameters and only enables you to change the parameter file definition if you are using raw storage. Each tab on the Initialization Parameters page provides different sets of information that you can add or modify as follows:

a. Memory Tab: Click Typical for default values based on the database type you selected or Custom to set your own values for the memory parameters. You can also see values for the advanced parameters by clicking All Initialization Parameters.

Carefully review the parameter settings displayed in this dialog because the DBCA configures these settings in your server parameter file. Instance-specific parameter settings for your RAC database appear at the bottom of this dialog. The sid prefixes for these entries appear in the left column.

To review the instance-specific parameter settings, scroll downward using the scroll bar on the right side of the dialog. Use the check box in the Override Default column to indicate whether the DBCA should place the parameter setting in your server parameter file. The DBCA only places a parameter entry into the server parameter file if the entry displays a check mark in the Override Default column of the All Initialization Parameters dialog.

---

**Notes:**

- You cannot modify the sid in the Instance column.
- You can alter self-tuning parameters with this dialog. However, setting these parameters to inappropriate values may disable the Oracle self-tuning features.
- You cannot specify instance-specific values for global parameters with the DBCA.
- You should set the value of the CLUSTER_DB_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.
- If your global database name is longer than eight characters, then the database name value (in the db_name parameter) is truncated to the first eight characters and the DB_UNIQUE_NAME parameter value is set to the global name.

b. Sizing Tab: Use this page to select the database standard block size and process count.

c. Character Sets Tab: Use this page to set the database character set value.

d. Connection Mode Tab: You can use this tab to select either dedicated or shared database connections to your database.

e. Parameter File Tab: This tab will only appear if you are using raw storage. Use this tab to enter a raw device name for the location of the server parameter file.

When you have completed all your work on the Initialization Parameters page, click Next, and the Database Storage page is displayed.

14. If you selected a preconfigured database template, such as the General Purpose template, then the DBCA displays the control files, datafiles, and redo logs on the Database Storage page. Select the folder and the file name underneath the folder to
edit the file name. However, if you selected the Custom Database template, the template without datafiles, then the DBCA displays the control files, tablespaces, datafiles, and redo logs. To change the tablespace properties, such as the datafile or the tablespace size, click the tablespaces icon to expand the object tree on the left-hand side of the page and click the tablespace. The tablespace property dialog appears on the right-hand side. Make your changes and click OK.

When entering file names in the Database Storage page for raw storage, note the following

- If you have not set the DBCA_RAW_CONFIG environment variable, then the DBCA displays default datafile names. You must override these names to provide raw device names on this page for each control file, datafile, and redo log group file.

After you complete your entries on the Database Storage page, click Next, and the DBCA displays the Creation Options page.

15. On the Creation Options page, select one of the following database options and click Finish.

- Create Database: Creates the database
- Save as a Database Template: Creates a template that records the database structure, including user-supplied inputs, initialization parameters, and so on. You can later use this template to create a database.
- Generate Database Creation Scripts: Generates database creation scripts. The DBCA only displays this option if you selected the Custom Database template.

After you click Finish, the DBCA displays a Summary dialog.

16. Review the Summary dialog information and click OK to create the database.

After you complete Step 16 the DBCA:

- Creates an operative RAC database and its instances
- Creates the RAC data dictionary views
- Configures the network for the cluster database
- Starts the listeners and database instances and then starts the high availability services

**Deleting a Real Application Clusters Database with the DBCA**

This section explains how to delete a RAC database with the DBCA. This process deletes a database and removes a database’s initialization parameter files, instances, OFA structure, and Oracle network configuration. However, this process does not remove datafiles if you placed the files on raw devices or on raw partitions.

To delete a database with the DBCA:

1. Start the 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, the DBCA displays the Operations page.
3. Select Delete a database, click Next, and the 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.

   **See Also:** "Database Password and Role Management in Real Application Clusters" on page B-19

5. Select the database to delete and click Finish.

   After you click Finish, the DBCA displays a dialog to confirm the database and instances that the 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, the DBCA continues the operation and deletes all of the associated instances for this database. The 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
   - Deleted the OFA directory structure from the cluster
   - Deleted the datafiles if the datafiles were not on raw devices
This chapter describes how to complete the post-installation tasks after you have installed the Oracle Database 10g with Real Application Clusters (RAC) software. It contains the following sections:

- Required Post-Installation Tasks
- Recommended Post-Installation Tasks

**Note:** This chapter only describes basic configurations. Refer to the *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 Patches
- Configure Oracle Products
- Oracle Real Application Clusters 10g Installed on an OCFS
- Running Oracle9i RAC with Oracle RAC 10g

### 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 by using the `dd.exe` utility.

Also make a backup of the voting disk contents after you complete any node additions or node deletions and after running any deinstallation procedures.

### Download and Install Patches

Refer to the OracleMetaLink Web site for required patches for your installation. To download required patches:

1. Use a Web browser to view the OracleMetaLink Web site:
   
   ![http://metalink.oracle.com](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.
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 and 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 patches 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 patches 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 on the documentation CD-ROM or on the OTN Web site.

**Oracle Real Application Clusters 10g Installed on an OCFS**

If you installed RAC on an OCFS, then perform the following steps on each node of the cluster after installation:

1. Stop the Oracle 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 instance.
Recommended Post-Installation Tasks

Running Oracle9i RAC with Oracle RAC 10g

If you are running Oracle9i RAC on the same cluster nodes as Oracle Real Application Clusters 10g, complete the following steps:

Note: These steps are required only if you installed Oracle Real Application Clusters 10g on the same cluster nodes as Oracle9i RAC. If you upgraded from Oracle9i RAC to Oracle Real Application Clusters 10g, do not complete these steps.

1. Create the following directory:
   $ mkdir -p /etc/ORCLcluster/oracm/lib

2. Change directory to this directory:
   $ cd /etc/ORCLcluster/oracm/lib

3. Copy the /oracle9i_home/lib/libcmdll.so file to the current directory:
   $ cp /oracle9i_home/lib/libcmdll.so .

4. On any cluster node, enter commands similar to the following to restart the node applications on all cluster nodes:
   $ORACLE_HOME/bin/svrctl stop nodeapps -n nodename
   $ORACLE_HOME/bin/svrctl start nodeapps -n nodename

In this example, $ORACLE_HOME is the Oracle Real Application Clusters 10g Oracle home and nodename is the name of the node. Repeat the commands for each node in the cluster.

Recommended Post-Installation Tasks

This section explains the tasks that Oracle recommends you perform after completing an installation. It contains the following tasks:

- Verifying Enterprise Manager Operations
- Recommended Post-Installation Tasks for UNIX

Verifying Enterprise Manager Operations

On all systems, you should run the following command to verify the Enterprise Manager configuration in your newly installed 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. Execute the following command:

```
srvctl config database -d db
```

The output should be similar to:

```
db1-server db1 /private/system/db
db2-server db2 /private/system/db
```
You should continue with the following section:
"Recommended Post-Installation Tasks for UNIX"

When you have completed these tasks, you should proceed with the initial configuration tasks described in Part IV.

Recommended Post-Installation Tasks for UNIX

Oracle recommends that you complete the following tasks after installing Oracle RAC on a UNIX-based system:

- Back Up the root.sh Script
- Set Up Users Accounts

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 System.

When you complete these procedures, you are ready to perform the initial configuration tasks described in Part IV.
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. The chapters in Part IV are:

- Chapter 7, "Configuring the Server Parameter File in Real Application Clusters Environments"
- Chapter 8, "Understanding the Real Application Clusters Installed Configuration"
This chapter describes server parameter file (spfile) placement and configuration in Real Application Clusters (RAC) environments. The topics in this chapter are:

- Parameter Files and 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: The Oracle Real Application Clusters Administrator’s Guide for more information about parameters and the Oracle Real Application Clusters Deployment and Performance Guide for a discussion of parallel execution-related parameters in RAC data warehouse environments

Parameter Files and Real Application Clusters

Oracle 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 administer parameters using spfile. If you use client-side parameter files, then Oracle does not preserve parameter changes made for self-tuning after shutdown.

See Also: The 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; the server parameter file is a binary file that you should not edit.
If you are upgrading from a previous Oracle 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 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 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 one of the following alternate file locations:

SPFILE='$ORACLE_HOME/dbs/spfile.ora'

If you use ASM, then the SPFILE value will be:

SPFILE='+disk_group_name/dbunique_name/spfiledbname.ora'

where *dbunique_name* is the unique database name and *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 the DBCA to create your database and to use the server parameter file, on the Initialization Parameters page select Create server parameter file (spfile) under the File Locations tab which is visible only if you are using raw storage. Then enter either a shared file system filename or the raw device path name in the Server Parameters Filename field.

**Note:** When you use the 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 searches for your parameter file in a particular order depending on your platform. Oracle examines directories in the following order:
Migrating to the Server Parameter File in Real Application Clusters Environments

Migrating 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 a cluster file system, place the server parameter file on a file system. Otherwise, place the server parameter file on a shared raw device that is at least 5MB in size.

Procedures for Migrating to the Server Parameter File

Migrate to the server parameter 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 as "parameter=value" without sid prefixes.

2. Copy all instance-specific parameter definitions from initsid.ora files using the following syntax where sid is the 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'

   If you use raw storage, then use the following syntax to create the server parameter file on a raw device:

   CREATE SPFILE='/dev/vx/rdsk/oracle_dg/dbspfile'
   FROM PFILE='?/dbs/initdbname.ora'

   These statements read your combined initdbname.ora file that you created by merging your IFILES. Then it transfers the settings for the parameters from the merged file into your server parameter file.

4. Oracle recommends that you use the server parameter file by executing the STARTUP command as in this example:
STARTUP PFILE=${ORACLE_HOME}/dbs/init\sid.ora

Where the file \sid.ora contains the entry:
SPFILE='/dev/vx/rdsx/oracle_db/dbspfile'

If you use this STARTUP command syntax, then Oracle uses the server parameter file entry specified in \sid.ora.

Server Parameter File Errors in Real Application Clusters

Oracle 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 displays errors for parameter changes that you attempt when you incorrectly use the ALTER SYSTEM SET statement. Oracle does this when an error occurs while reading from or writing to the server parameter file.

See Also: The Oracle Real Application Clusters Administrator’s Guide for more information about backing up the SPFILE
This chapter describes the Real Application Clusters (RAC) installed configuration. The topics in this chapter include:

- Understanding the Configured Environment in Real Application Clusters
- The Oracle Cluster Registry in Real Application Clusters
- UNIX oratab Configurations for Real Application Clusters
- Database Components Created Using the 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)
- Profile (sqlnet.ora File)

**Understanding the Configured Environment in Real Application Clusters**

The Oracle Net Configuration Assistant (NetCA) and the Database Configuration Assistant (DBCA) configure your environment to meet the requirements for database creation and Enterprise Manager discovery of Real Application Cluster databases.

---

**Note:** Configuration files are created on each node in your cluster database.

---

**The Oracle Cluster Registry in Real Application Clusters**

The Database Configuration Assistant uses the 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. If you do not use a cluster file system, then you must make this file a shared raw device. The Oracle Universal Installer (OUI) automatically initializes the OCR during the CRS installation.
UNIX oratab Configurations for 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 as well whether the database should be automatically started upon restart. The database entry has the following syntax:

db_unique_name:$ORACLE_HOME:N

where 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. A sample entry for a database named db is:

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 the DBCA, or it refers to the entry you made for the DATABASE keyword of the CREATE DATABASE statement.

Database Components Created Using the Database Configuration Assistant

This section describes the database components that the DBCA creates which include:

- Tablespace and Datafiles
- Control Files
- Redo Log Files

Tablespaces and Datafiles

An Oracle database for both single-instance and cluster database environments is divided into smaller logical areas of space known as tablespaces. Each tablespace corresponds to one or more datafiles stored on a disk. Table 8–1 shows the tablespace names used by a RAC database and the types of data they contain:

<table>
<thead>
<tr>
<th>Tablespace Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSTEM</td>
<td>Consists of the data dictionary, including definitions of tables, views, and stored procedures needed by the database. Oracle automatically maintains information in this tablespace.</td>
</tr>
<tr>
<td>SYSAUX</td>
<td>An auxiliary system tablespace that contains the DRSYS (contains data for OracleText), CMLITE (contains the OLAP schemas), XDB (for XML features), ODM (for Oracle Data Mining), TOOLS (contains Enterprise Manager tables), INDEX, EXAMPLE, and OEM-REPO tablespaces.</td>
</tr>
<tr>
<td>USERS</td>
<td>Consists of application data. As you create and enter data into tables, Oracle fills this space with your data.</td>
</tr>
</tbody>
</table>
You cannot alter these tablespace names when using the preconfigured database configuration options from the 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 datafiles. The datafile names created by the preconfigured database configuration options vary by operating system and storage type such as ASM, OFS, raw devices, and so on. Linux systems, for example, prompt you to set the file names.

**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. If you chose cluster file system, then these files are shared file system files. If you do not have a cluster file system, then these files are raw devices. 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. You must enter the raw device names unless you are using a cluster file system.

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 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 Real Application Clusters Administrator’s 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.
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 the PMON process of an instance 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 changes the setting for `REMOTE_LISTENER` dynamically when you reconfigure your cluster database, for example, when you add or delete instances.

By default, the DBCA configures your environment with dedicated servers. However, if you select the Shared server option on the DBCA, then Oracle configures the shared server. In this case, Oracle 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 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 under the following headings:

See Also: Chapter 7, “Configuring the Server Parameter File in Real Application Clusters Environments” for more information about the creation and use of parameter files.
Local Listeners

If you configured 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 the 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 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, the Oracle Net Configuration Assistant creates and starts a default listener called LISTENER_NODENAME. The listener is configured with a default protocol listening addresses for the database and external procedures. The advanced installation process prompts you to create at least one listener with the Oracle Net Configuration Assistant. The listener is configured to respond to connection requests that are directed at 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 1 (10.1.0.3) 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, the Oracle Net Configuration Assistant
starts the listener. A sample listener.ora file with an entry for an instance named node1 is:

```
listener_node1=
  (description=
    (address=(protocol=ipc)(key=extproc))
    (address=(protocol=tcp)(host=node1-vip)(port=1521))
    (address=(protocol=tcp)(host=node1-ip)(port=1521)))
```

```
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 PMON discovery routine executes. By default, PMON discovery occurs every 60 seconds.

To override the 60-second delay, use the SQL ALTER SYSTEM REGISTER statement. This statement forces PMON to register the service immediately.

Oracle recommends that you create a script to execute this statement immediately after starting the listener. If you execute 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 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 the 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 the database service entries

See Also: Oracle 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

---

8-6 Oracle Real Application Clusters Installation and Configuration Guide
Net Service Names (tnsnames.ora File)

- 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 tnsnames.ora is singular because you can only specify one service name.

---

The DBCA creates net service names for connections as shown in Table 8–2:

<table>
<thead>
<tr>
<th>Net Service Name Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database connections</td>
<td>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. A listener address is configured for each node that runs an instance of the database. The LOAD_BALANCE option causes Oracle to choose the address randomly. If the chosen address fails, then the FAILOVER 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. In the following example, db.us.oracle.com is used by the client to connect to the target database, db.us.oracle.com.</td>
</tr>
<tr>
<td></td>
<td>db.us.acme.com=</td>
</tr>
<tr>
<td></td>
<td>{description=</td>
</tr>
<tr>
<td></td>
<td>{load_balance=on}</td>
</tr>
<tr>
<td></td>
<td>{address=(protocol=tcp)(host=node1-vip)(port=1521)}</td>
</tr>
<tr>
<td></td>
<td>{address=(protocol=tcp)(host=node2-vip)(port=1521)}</td>
</tr>
<tr>
<td></td>
<td>{connect_data=</td>
</tr>
<tr>
<td></td>
<td>{service_name=db.us.acme.com}})</td>
</tr>
<tr>
<td></td>
<td>Note: FAILOVER=ON is set by default for a list of addresses. Thus, you do not need to explicitly specify the FAILOVER=ON parameter. When you set DB_UNIQUE_NAME by entering a global database name that is longer than eight characters, excluding DB_DOMAIN, then a net service entry similar to the following is created:</td>
</tr>
<tr>
<td></td>
<td>mydatabase.us.acme.com=</td>
</tr>
<tr>
<td></td>
<td>{description=</td>
</tr>
<tr>
<td></td>
<td>{address=(protocol=tcp)(host=node1-vip)(port=1521)}</td>
</tr>
<tr>
<td></td>
<td>{address=(protocol=tcp)(host=node2-vip)(port=1521)}</td>
</tr>
<tr>
<td></td>
<td>{load_balance=on}</td>
</tr>
<tr>
<td></td>
<td>{connect_data=</td>
</tr>
<tr>
<td></td>
<td>{server = dedicated}</td>
</tr>
<tr>
<td></td>
<td>{service_name = mydatabase.us.acme.com}</td>
</tr>
<tr>
<td></td>
<td>}</td>
</tr>
<tr>
<td>Instance connections</td>
<td>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. In the following example, db1.us.acme.com, is used by Oracle Enterprise Manager to connect to an instance named db1 on db1-server:</td>
</tr>
<tr>
<td></td>
<td>db1.us.acme.com=</td>
</tr>
<tr>
<td></td>
<td>{description=</td>
</tr>
<tr>
<td></td>
<td>{address=(protocol=tcp)(host=node1-vip)(port=1521)}</td>
</tr>
<tr>
<td></td>
<td>{connect_data=</td>
</tr>
<tr>
<td></td>
<td>{service_name=db.us.acme.com}</td>
</tr>
<tr>
<td></td>
<td>{instance_name=db1}}</td>
</tr>
</tbody>
</table>
Remote listeners

As discussed in "Configuring Service Registration-Related Parameters in Real Application Clusters" on page 8-4, the REMOTE_LISTENER parameter identifies the global list of listeners and it is dynamic. Oracle changes the setting for REMOTE_LISTENER when you reconfigure your cluster database.

Whether using shared servers or dedicated servers, the list of remote listeners is supplied using the REMOTE_LISTENERS parameter, for example:

REMOTE_LISTENERS=listeners_db_unique_name

This enables the instance to register with remote listeners on the other nodes; listeners_db_unique_name is resolved through a naming method such as a tnsnames.ora file.

In the following example, listeners_db.us.acme.com is resolved to a list of listeners available on the nodes on which the cluster database has instances:

listeners_db.us.acme.com=
|address_list=|
| (address=(protocol=tcp)(host=node1-vip)(port=1521))|
| (address=(protocol=tcp)(host=node2-vip)(port=1521))|

The instance uses this list to determine the addresses of the remote listeners with which to register its information.

Nondefault listeners

As discussed in "Local Listeners" on page 8-5 and "Multiple Listeners" on page 8-5, the LOCAL_LISTENER parameter is set in the init.sid.ora file if a nondefault listener is configured, for example:

sid.local_listener=listener_sid

Where listener_sid is resolved to a listener address through a naming method such as a tnsnames.ora file.

In the following sample, listener_db1.us.acme.com is resolved to the nondefault listener address:

listener_db1.us.acme.com=
| (address=(protocol=tcp)(host=node1-vip)(port=1522))|

|Table 8–2 (Cont.)  Connections for Net Service Names

<table>
<thead>
<tr>
<th>Net Service Name Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| Remote listeners      | As discussed in "Configuring Service Registration-Related Parameters in Real Application Clusters" on page 8-4, the REMOTE_LISTENER parameter identifies the global list of listeners and it is dynamic. Oracle changes the setting for REMOTE_LISTENER when you reconfigure your cluster database. Whether using shared servers or dedicated servers, the list of remote listeners is supplied using the REMOTE_LISTENERS parameter, for example: REMOTE_LISTENERS=listeners_db_unique_name This enables the instance to register with remote listeners on the other nodes; listeners_db_unique_name is resolved through a naming method such as a tnsnames.ora file. In the following example, listeners_db.us.acme.com is resolved to a list of listeners available on the nodes on which the cluster database has instances: listeners_db.us.acme.com=
|address_list=|
| (address=(protocol=tcp)(host=node1-vip)(port=1521))|
| (address=(protocol=tcp)(host=node2-vip)(port=1521))|

The instance uses this list to determine the addresses of the remote listeners with which to register its information. |
| Nondefault listeners | As discussed in "Local Listeners" on page 8-5 and "Multiple Listeners" on page 8-5, the LOCAL_LISTENER parameter is set in the init.sid.ora file if a nondefault listener is configured, for example: sid.local_listener=listener_sid Where listener_sid is resolved to a listener address through a naming method such as a tnsnames.ora file. In the following sample, listener_db1.us.acme.com is resolved to the nondefault listener address: listener_db1.us.acme.com=
| (address=(protocol=tcp)(host=node1-vip)(port=1522))|
When you configure high availability services using the DBCA Services page, then the 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.

```
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)
            )
        )
    )
```
Table 8–2 (Cont.) Connections for Net Service Names

<table>
<thead>
<tr>
<th>Net Service Name Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services Entries (continued)</td>
<td>When a service has a TAF policy of PRECONNECT, then a service_name_preconnect net service entry is also created as in the following example:</td>
</tr>
<tr>
<td>db_svc3_preconnect.us.acme.com =</td>
<td></td>
</tr>
<tr>
<td>(description =</td>
<td></td>
</tr>
<tr>
<td>(address = (protocol = tcp)(host = node1-vip)(port = 1521))</td>
<td></td>
</tr>
<tr>
<td>(address = (protocol = tcp)(host = node2-vip)(port = 1521))</td>
<td></td>
</tr>
<tr>
<td>(load_balance = yes)</td>
<td></td>
</tr>
<tr>
<td>(connect_data =</td>
<td></td>
</tr>
<tr>
<td>(server = dedicated)</td>
<td></td>
</tr>
<tr>
<td>(service_name = db_svc3_preconnect.us.acme.com)</td>
<td></td>
</tr>
<tr>
<td>(failover_mode =</td>
<td></td>
</tr>
<tr>
<td>(backup = db_svc3.us.acme.com)</td>
<td></td>
</tr>
<tr>
<td>(type = select)</td>
<td></td>
</tr>
<tr>
<td>(method = basic)</td>
<td></td>
</tr>
<tr>
<td>(retries = 180)</td>
<td></td>
</tr>
<tr>
<td>(delay = 5)</td>
<td></td>
</tr>
<tr>
<td>)</td>
<td></td>
</tr>
<tr>
<td>)</td>
<td></td>
</tr>
<tr>
<td>listeners_db.us.acme.com=</td>
<td></td>
</tr>
<tr>
<td>(address_list=</td>
<td></td>
</tr>
<tr>
<td>Services Entries (continued)</td>
<td>An entry for connections to external procedures. This enables an Oracle Database 10g database to connect to external procedures.</td>
</tr>
<tr>
<td>extproc_connection_data.us.acme.com=</td>
<td></td>
</tr>
<tr>
<td>(description=</td>
<td></td>
</tr>
<tr>
<td>(address_list=</td>
<td></td>
</tr>
<tr>
<td>(address=(protocol=ipc)(key=extproc0))</td>
<td></td>
</tr>
<tr>
<td>(connect_data=</td>
<td></td>
</tr>
<tr>
<td>(sid=plsextproc))</td>
<td></td>
</tr>
</tbody>
</table>

Example 8–1 Example tnsnames.ora File

The following 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 Net Services Administrator’s Guide* for further information about the tnsnames.ora file

---

**Profile (sqlnet.ora File)**

The sqlnet.ora file is automatically configured with:

- The computer’s domain

  This domain is automatically appended to any unqualified net service name. For example, if the default domain is set to `us.acme.com`, then Oracle resolves `db` in the connect string `CONNECT scott/tiger@db` as: `db.us.acme.com`.

- A naming method the server uses to resolve a name to a connect descriptor

  The order of naming methods is as follows: directory naming (for Custom Install or Advanced database configuration options only), tnsnames.ora file, Oracle Names server, and host naming.

The following is a sample sqlnet.ora file created during a preconfigured database configuration install:

```sql
names.default_domain=us.acme.com
names.directory_path=(tnsnames, onames,hostname)
```

**See Also:** The *Oracle Net Services Administrator’s Guide* for further information about the sqlnet.ora file
Part V provides Real Application Clusters (RAC) installation and configuration reference information. The contents of Part V are:

- Appendix A, "Troubleshooting the Real Application Clusters Installation Process"
- Appendix B, "Using Scripts to Create Real Application Clusters Databases"
- Appendix C, "Configuring Raw Devices for Real Application Clusters"
- Appendix D, "Converting to Real Application Clusters from Single-Instance Oracle Databases"
- Appendix E, "Directory Structure for Oracle Database 10g Real Application Clusters Environments"
Troubleshooting the Real Application Clusters Installation Process

This appendix provides troubleshooting information for installing Oracle Database 10g Real Application Clusters (RAC). The topic in this appendix is:

- Troubleshooting the Real Application Clusters Installation

See Also: The Oracle Database 10g Real Application Clusters documentation set included on your Oracle Database 10g Server Documentation CD:

- Oracle Real Application Clusters Administrator’s Guide
- Oracle Real Application Clusters Deployment and Performance Guide

Troubleshooting the Real Application Clusters Installation

This section contains these topics:

- Real Application Clusters Installation Error Messages
- Performing Cluster Diagnostics During Real Application Clusters Installations

Real Application Clusters Installation Error Messages

Real Application Clusters Management Tools Error Messages are in Oracle Real Application Clusters Administrator’s Guide.

Performing Cluster Diagnostics During Real Application Clusters Installations

If the Oracle Universal Installer (OUI) does not display the Node Selection page, then perform clusterware diagnostics by executing the `olsnodes -v` command from the binary directory in your CRS home (`CRS home/bin`) and analyzing its output. Refer to your clusterware documentation if the detailed output indicates that your clusterware is not running.
This chapter describes the steps required to create an Oracle Real Application Clusters (RAC) database from scripts. The topic in this appendix is:

- Creating a Database Using Scripts

---

Note: The scripts generated by DBCA are for reference purposes only. Oracle strongly recommends that you use DBCA to create a database.

---

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, execute the following steps:

1. Invoke the Database Configuration Assistant (DBCA) and select your preferred options to build the RAC database. However, you must select the Custom Database template on the Database Templates page for the 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.

2. Navigate to the directory, which you noted in Step 1, where the 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, Oracle recommends that you rerun the DBCA to create scripts with the desired configuration rather than editing the scripts yourself.

   See Also: "Creating RAC Databases with the Database Configuration Assistant" for details on executing a DBCA session.

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 Net Services to support your new database and instances as described in Chapter 8, "Understanding the 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 SVRCTL to configure and start database and instance applications as described in the *Oracle Real Application Clusters Administrator’s Guide*. 
This appendix provides additional information about configuring raw devices to deploy Real Application Clusters (RAC). You must configure raw devices if you do not use ASM or a cluster file system. The topic in this appendix is:

- Raw Devices Required by the DBCA for Non-CFS Environments

## Raw Devices Required by the DBCA for Non-CFS Environments

If you want to use the DBCA to create a database on raw storage, then configure the raw devices described in this section. These devices are in addition to the OCR and voting disk required to install Cluster Ready Services (CRS). Create these devices before running the OUI to install the Oracle Database 10g software. The DBCA cannot create a RAC database unless you have properly configured the following devices:

- Four raw devices for four tablespace datafiles
- 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 datafiles. In addition, each instance’s online redo log files must be readable by all other instances for recovery.

## Planning Your Raw Device Creation Strategy

Before installing the Oracle Database 10g software with RAC, 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, select a limited set of standard partition sizes for your entire database. Partition sizes of 50MB, 100MB, 500MB, and 1GB are suitable for most databases. Also create a few very small and a few very large spare partitions that are, for example, 1MB and perhaps 5GB 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:** Ensuring that there are spare partitions enables you to perform emergency file relocations or additions if a tablespace datafile becomes full.
Converting to Real Application Clusters from Single-Instance Oracle Databases

This chapter describes the procedures for converting from Oracle Database 10g single-instance databases to Real Application Clusters (RAC) databases. The topics in this appendix are:

- Deciding to Convert
- Prerequisites for Conversion
- Single-Instance to Cluster-Enabled Conversion Administrative Issues
- Converting from Single-Instance to Real Application Clusters
- Post-Conversion Steps

If you are upgrading from Oracle Parallel Server to RAC or from an earlier version of RAC, then use the 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 version of Oracle 10g and running on the same platform.

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

Deciding to Convert

Do not convert to RAC if:

- You are not using a supported configuration of a cluster file system or shared disks
- Your application was specifically designed to not use 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.

Prerequisites for Conversion

Your system must meet the following hardware and software requirements to convert to RAC:

- A supported hardware and operating system software configuration
An additional license for Oracle Database 10g Enterprise Edition with RAC.

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 from Single-Instance to Real Application Clusters

To convert from single-instance Oracle databases to RAC, Oracle strongly recommends that you use the Database Configuration Assistant (DBCA). This is because the 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 the Oracle Net Services, Cluster Ready Services (CRS) resources, and the configuration for RAC database management for use by Oracle Enterprise Manager or the SRVCTL utility. This section describes the following scenarios:

- Single Instance on a Non-Cluster Machine to Oracle Database 10g with RAC
- Single Instance on a Cluster to Oracle Database 10g RAC

Single Instance on a Non-Cluster Machine to Oracle Database 10g with RAC

To convert from a single-instance Oracle database that is on a non-cluster machine to RAC, perform the procedures described under the following headings in the order shown:

- Back up the Original Single-Instance Database
- Perform the Pre-Installation Steps
- Set up the Cluster
- Copy the Preconfigured Database Image
- Install Oracle Database 10g Software with Real Application Clusters

Back up the Original Single-Instance Database

Use the DBCA to create a preconfigured image of your single-instance database by invoking the DBCA from the \bin directory under ORACLE_HOME and choosing Welcome > Manage Templates > Create a database template [select From an existing database (structure as well as data)] > Database Name [select the database name] > Template Name [enter template name, use database name as the default, and description and template datafile location] > Finish.

The DBCA will generate two files, a database structure file (template_name.dbc) and database preconfigured image file (template_name.dfb). These files are generated by default in the ORACLE_HOME/assistants/dbca/templates.
Perform the Pre-Installation Steps

Perform the pre-installation steps as documented in Part II of this book. For example, on Linux systems, this includes creating the `oracle` user account and the `dba` group on all nodes, setting up `oracle` user equivalence, setting the `DBCA_RAW_CONFIG` environment variable, and so on. Then set up shared storage by referring to the "Configure Disk Storage for Oracle Database and Recovery Files" sections in the pre-installation chapters 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 vendor’s documentation. Once you have configured all of the nodes in your cluster, either with or without vendor clusterware, install CRS by referring to the procedures in Chapter 3, "Installing Cluster Ready Services on Linux Systems".

Copy the Preconfigured Database Image

This includes copying the database structure `*.dbc` file and the database preconfigured image `*.dfb` file that the 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 the DBCA.

Install Oracle Database 10g Software with Real Application Clusters

1. Run the Oracle Universal Installer (OUI) to perform an Oracle installation with the Oracle 10g Database 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 software, the OUI runs the post installation configuration tools such as the Network Configuration Assistant (NetCA), the 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 setup the `DBCA_RAW_CONFIG` environment variable. You must also replace default database files with raw devices on the Storage page.

See Also: Chapter 5 for more details about the DBCA

6. After creating the RAC database, the DBCA displays the Password Management page on which you must change the passwords for database privileged users who have `SYSDBA` and `SYSOPER` roles. Once the DBCA exits, the conversion process is complete.
There are three scenarios in which a single-instance database can exist on a cluster machine:

■ Scenario 1: The Oracle home from which the single-instance database is running is cluster installed.
■ Scenario 2: The Oracle home from which the single-instance database is running is cluster installed but the RAC feature is disabled.
■ Scenario 3: The Oracle home from which the single-instance database is running is not cluster installed.

Use the following procedures to convert your single-instance database on a cluster machine 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 the DBCA to create a preconfigured image of your single-instance database as described under the heading "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 under the heading "Perform the Pre-Installation Steps" on page D-3. Ensure that all of these nodes can access the shared storage. Also extend the CRS home to the new nodes using the procedures for "Extending Clusterware and Oracle Software to New Nodes" as described in the Oracle Real Application Clusters Administrator's 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 the Oracle Real Application Clusters Administrator's Guide.

4. From one of the newly added nodes, configure the listeners on the additional nodes using the NetCA. Choose the same port number and protocol that you used on the existing node. If the 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 under the heading "Back up the Original Single-Instance Database" on page D-2, then use the DBCA to complete the conversion to a RAC database.

2. Start the 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, on the Initialization Parameters page 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 datafiles to create the cluster database. Click Finish and create the database.

After creating the RAC database, the DBCA displays the Password Management page on which you must change the passwords for database privileged users who have SYSDBA and SYSOPER roles. Once the DBCA exits, the conversion process is complete.

**Manual Conversion Procedure**

Because you did not use the 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 OFA directory structure on all of the nodes that you have added.

   **See Also:** "UNIX 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 datafiles, 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 executing 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:

   ```sql
   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, adjust the size of the SGA to avoid swapping and paging when you convert to RAC. This is because RAC requires about 350 bytes for each buffer to accommodate the Global Cache Service (GCS). For example, if you have 10,000 buffers, RAC requires about 350*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 datafile 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 shutdown 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. Make sure that you replace the
Converting from Single-Instance to Real Application Clusters

ORACLE_SID name in each password file appropriately for each additional instance.

11. Add REMOTE_LISTENER=LISTENERS_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 REMOTE_LISTENER in the tnsnames.ora file and copy it to all nodes.

13. Create the SPFILE from the PFILE using the procedures under the heading 'Procedures for Migrating to the Server Parameter File' on page 7-3. 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 on Windows-based systems that contains the following entry:

   spfile='spfile_path_name'

   where 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 execute the following SQL statement to see the statuses 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

On Linux systems, this installation is possible 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", "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. On the cluster node where the single-instance database is running, execute step 1 of "Single Instance on a Cluster Running from a Cluster Enabled Oracle Home" on page D-4.

2. Change the directory to the lib subdirectory in the rdbms directory under the Oracle home.

3. Relink the oracle binary by executing the following commands:

   make -f ins_rdbms.mk rac_on
   make -f ins_rdbms.mk ioracle


Single Instance on a Cluster Running from non-Cluster Installed Oracle Home

This installation is only possible if you selected the local installation option on the OUI Specify Hardware Cluster Installation page during an Oracle Database 10g installation.

To convert this database to a RAC database, perform the procedures described under the following headings:
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". In this step, make sure that you select a new Oracle home other than the one from which the single-instance database was running.

**Post-Conversion Steps**

After completing the conversion, note the following points as described in the RAC documentation:

- Follow the recommendations for using load balancing and TAF as described in the *Oracle Real Application Clusters Administrator’s Guide*
- Use locally managed tablespaces instead of dictionary managed tablespaces to reduce contention and manage sequences in RAC as described in the *Oracle Real Application Clusters Deployment and Performance 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 the *Oracle Real Application Clusters Administrator’s Guide*

The buffer cache and shared pool capacity requirements in RAC are slightly greater than those in single-instance Oracle databases. Therefore, you may wish to increase the size of the buffer cache by about 10% and the size of the shared pool by about 15%.
This appendix describes the directory structures for Real Application Clusters (RAC) software environments. The topics in this appendix are:

- Understanding the Real Application Clusters Directory Structure
- UNIX 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. The ORACLE_HOME and admin directories are also located under ORACLE_BASE.

UNIX Directory Structures for Real Application Clusters

Table E–1 shows the hierarchical directory tree of a sample OFA-compliant database for RAC on Linux systems:

<table>
<thead>
<tr>
<th>Root</th>
<th>Second-Level</th>
<th>Third-Level</th>
<th>Fourth-Level</th>
<th>Fifth-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ORACLE_BASE</td>
<td></td>
<td></td>
<td></td>
<td>/u01/app/oracle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The default ORACLE_BASE directory.</td>
</tr>
<tr>
<td>ORACLE_HOME</td>
<td></td>
<td></td>
<td></td>
<td>/product/10.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The default name of the Oracle home.</td>
</tr>
<tr>
<td>/admin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/db_unique_name</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Database unique name, the same as dbname when database name is eight or fewer characters in length.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>/bdump</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/cdump</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/hdump</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/pfile</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>/udump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRS Home</td>
<td></td>
<td></td>
<td></td>
<td>/crs/10.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The default name of the CRS home.</td>
</tr>
</tbody>
</table>
### Table E–1 (Cont.) Directory Structure for A Sample OFA-Compliant UNIX Environment

<table>
<thead>
<tr>
<th>Root</th>
<th>Second-Level</th>
<th>Third-Level</th>
<th>Fourth-Level</th>
<th>Fifth-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/bin</td>
<td></td>
<td></td>
<td>Subtree for Oracle binaries.</td>
</tr>
<tr>
<td></td>
<td>/network</td>
<td></td>
<td></td>
<td>Subtree for Oracle Net.</td>
</tr>
</tbody>
</table>

**See Also:** *Oracle Database 10g Administrator’s Reference Release 1 (10.0) for UNIX Systems* for further information about the $ORACLE_HOME and /admin directories.
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