Oracle® Grid Infrastructure
Installation Guide
12c Release 1 (12.1) for Microsoft Windows x64 (64-Bit)
E17618-06

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Preface

*Oracle Grid Infrastructure Installation Guide for Microsoft Windows x64 (64-Bit)* explains how to configure a server in preparation for installing and configuring an Oracle Grid Infrastructure installation (Oracle Clusterware and Oracle Automatic Storage Management). It also explains how to configure a server and storage in preparation for an Oracle Real Application Clusters (Oracle RAC) installation.

**Intended Audience**

*Oracle Grid Infrastructure Installation Guide for Microsoft Windows x64 (64-Bit)* provides configuration information for network and system administrators, and database installation information for database administrators (DBAs) who install and configure Oracle Clusterware and Oracle Automatic Storage Management in an Oracle Grid Infrastructure for a cluster installation.

For customers with specialized system roles who intend to install Oracle RAC, this book is intended to be used by system administrators, network administrators, or storage administrators to configure a system in preparation for an Oracle Grid Infrastructure for a cluster installation, and complete all configuration tasks that require Administrator user privileges. When the Oracle Grid Infrastructure installation and configuration is successfully completed, a system administrator should only provide configuration information and grant access to the database administrator to run scripts that require Administrator user privileges during an Oracle RAC installation.

This guide assumes that you are familiar with Oracle Database concepts. For additional information, refer to books in the Related Documents list.

**Documentation Accessibility**

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

**Access to Oracle Support**

Oracle customers have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info or visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.
Java Access Bridge and Accessibility

Java Access Bridge enables assistive technologies to read Java applications running on the Windows platform. Assistive technologies can read Java-based interfaces, such as Oracle Universal Installer and Oracle Enterprise Manager Database Express.

See Also: Oracle Database Installation Guide for Microsoft Windows for more information about installing Java Access Bridge

Related Documents

For more information, refer to the following Oracle resources.

Oracle Clusterware and Oracle Real Application Clusters Documentation

This installation guide reviews steps required to complete an Oracle Clusterware and Oracle Automatic Storage Management installation, and to perform preinstallation steps for Oracle RAC.

Installing Oracle RAC or Oracle RAC One Node is a multi-step process. Perform the following steps by reviewing the appropriate documentation:

<table>
<thead>
<tr>
<th>Installation Task</th>
<th>Documentation to Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preinstallation setup for Oracle Grid Infrastructure and Oracle RAC</td>
<td>Oracle Grid Infrastructure Installation Guide for Microsoft Windows x64 (64-Bit) (this guide)</td>
</tr>
<tr>
<td>Install Oracle Grid Infrastructure and configure Oracle Clusterware and Oracle ASM</td>
<td>Oracle Grid Infrastructure Installation Guide for Microsoft Windows x64 (64-Bit) (this guide)</td>
</tr>
<tr>
<td>Install Oracle Database software and configure Oracle RAC</td>
<td>Oracle Real Application Clusters Installation Guide for Microsoft Windows x64 (64-Bit)</td>
</tr>
</tbody>
</table>

You can install the Oracle Database software for standalone databases or Oracle RAC databases on servers that run Oracle Grid Infrastructure. You cannot install Oracle Restart on servers that run Oracle Grid Infrastructure. To install an Oracle Restart deployment of Oracle Grid Infrastructure, see Oracle Database Installation Guide.

Installation Guides

- Oracle Database Installation Guide for Microsoft Windows x64 (64-Bit)
- Oracle Real Application Clusters Installation Guide for Microsoft Windows x64 (64-Bit)

Operating System-Specific Administrative Guides

- Oracle Database Platform Guide for Microsoft Windows

Oracle Clusterware and Oracle Automatic Storage Management Administrative Guides

- Oracle Clusterware Administration and Deployment Guide
- Oracle Automatic Storage Management Administrator’s Guide

Oracle Real Application Clusters Administrative Guides

- Oracle Real Application Clusters Administration and Deployment Guide
- Oracle Database 2 Day + Real Application Clusters Guide
To download free release notes, installation documentation, white papers, or other collateral, visit Oracle Technology Network (OTN). You must register online before using OTN; registration is free and can be done at the following website:

http://www.oracle.com/technetwork/community/join/overview/

If you have a username and password for OTN, then you can go directly to the documentation section of the OTN website at the following website:

http://www.oracle.com/technetwork/indexes/documentation/

Most Oracle error message documentation is only available in HTML format. If you only have access to the Oracle Documentation, then browse the error messages by range. When you find the correct range of error messages, use your browser’s Find feature to locate a specific message. When connected to the Internet, you can search for a specific error message using the error message search feature of the Oracle online documentation.

**Conventions**

The following text conventions are used in this document:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>boldface</strong></td>
<td>Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.</td>
</tr>
<tr>
<td><strong>italic</strong></td>
<td>Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.</td>
</tr>
<tr>
<td><strong>monospace</strong></td>
<td>Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.</td>
</tr>
</tbody>
</table>
This preface lists changes in Oracle Grid Infrastructure Installation Guide.

Changes in Oracle Clusterware 12c Release 1 (12.1)

The following are changes in Oracle Grid Infrastructure Installation Guide for Oracle Clusterware 12c Release 1 (12.1):

**New Features**

- Oracle ASM File Access Control Enhancements on Windows
  
  You can now use access control to separate roles in Windows environments. With Oracle database services running with the privileges of an Oracle home user rather than Local System, the Oracle ASM access control feature is enabled to support role separation on Windows. In previous releases, this feature was disabled on Windows because all Oracle services run as Local System.

  You can change the identity of an Oracle ASM user from one operating system user to another operating system user without having to drop and re-create the user, which requires dropping all the files a user owns, which improves the manageability of Oracle ASM users and the files they own.

  You can modify Windows file access controls while files are open using ASMCMD file access control commands, such as chgrp, chmod, and chown.


- Cluster Health Monitor Enhancements
  
  Cluster Health Monitor (CHM) has been enhanced to provide a highly available server monitor service that provides improved detection of operating system and cluster resource-related degradation and failures.

  See Oracle Clusterware Administration and Deployment Guide.

- Oracle Cluster Registry Backup in ASM Disk Group Support
  
  The Oracle Cluster Registry (OCR) backup mechanism enables storing the OCR backup in an Oracle ASM disk group. Storing the OCR backup in an Oracle ASM disk group simplifies OCR management by permitting access to the OCR backup from any node in the cluster should an OCR recovery become necessary.

- Oracle Grid Infrastructure Rolling Migration for One-Off Patches
Oracle Grid Infrastructure one-off patch rolling migration and upgrade for Oracle Automatic Storage Management (Oracle ASM) and Oracle Clusterware enables you to independently upgrade or patch clustered Oracle Grid Infrastructure nodes with one-off patches, without affecting database availability. This feature provides greater uptime and patching flexibility. This release also introduces a new Cluster state, “Rolling Patch.” Operations allowed in a patch quiesce state are similar to the existing “Rolling Upgrade” cluster state.

See Oracle Automatic Storage Management Administrator’s Guide and Section D.2, “About Oracle ASM and Oracle Grid Infrastructure Installation and Upgrade.”

Oracle Home User Support for Oracle Database and Oracle Grid Infrastructure

Starting with Oracle Database 12c Release 1 (12.1), Oracle Database supports the use of an Oracle Home User, which can be specified at installation time. The Oracle Home User can be a Built-in Account or a Windows Domain User Account. If you specify a Windows User Account, then the user should be a standard (non-Administrator) account to ensure that the Oracle Home User has a limited set of privileges. Using an Oracle Home User ensures that Oracle Database services have only those privileges required to run Oracle products.

See Oracle Database Platform Guide for Microsoft Windows and Section 5.2, "Configuring User Accounts."

Oracle RAC Hang Detection and Node Eviction Protection

Slowdowns in the cluster, mainly affecting the Oracle Database instances, are detected and classified as a hung process or instance and removed accordingly to prevent unnecessary node evictions as a consequence. While the occasional eviction of a node in an Oracle RAC cluster is mostly transparent to the application, this feature minimizes its occurrence. Also, the Global Conflict Resolution (GCR) process has been enhanced to provide better detection and avoidance of issues causing node evictions.

Policy-Based Cluster Management and Administration

Oracle Grid Infrastructure allows running multiple applications in one cluster. Using a policy-based approach, the workload introduced by these applications can be allocated across the cluster using a policy. In addition, a policy set enables different policies to be applied to the cluster over time as required. Policy sets can be defined using a web-based interface or a command-line interface.

Hosting various workloads in the same cluster helps to consolidate the workloads into a shared infrastructure that provides high availability and scalability. Using a centralized policy-based approach allows for dynamic resource reallocation and prioritization as the demand changes.

See Oracle Clusterware Administration and Deployment Guide.

Shared Grid Naming Service (GNS) Across Multiple Clusters

In previous releases, the Grid Naming Service (GNS) was dedicated to one Oracle Grid Infrastructure-based cluster, providing name resolution only for its own cluster member nodes. With this release, one Oracle GNS can now manage just the cluster member nodes in its own cluster, or GNS can provide naming resolution for all nodes across all clusters in the data center that are delegated to Oracle GNS for resolution.

Using only one Oracle GNS for all nodes that are part of an Oracle Grid Infrastructure cluster in the data center not only streamlines the naming convention, but also enables a data center cloud, minimizing day-to-day administration efforts.
Support for Separation of Database Administration Duties

Oracle Database 12c Release 1 (12.1) provides support for separation of administrative duties for Oracle Database by introducing task-specific and least-privileged administrative privileges that do not require the SYSDBA system privilege. These new system privileges are: SYSBACKUP for backup and recovery, SYSKG for Oracle Data Guard, and SYSKM for encryption key management.

See "Managing Administrative Privileges" in Oracle Database Security Guide and Section 5.1.8.4, "Extended Oracle Database Groups for Job Role Separation."

Updates to Oracle ASM File Access Control Commands and Open Files Support

This feature enables the modification of Windows file access controls while files are open. This feature supports updates to ASMCMD file access control commands, such as chgrp, chmod, and chown.

See Oracle Automatic Storage Management Administrator's Guide.

Deprecated Features

The following features are deprecated in this release, and may be desupported in a future release:

- Standalone Deinstallation Tool
  The deinstallation tool is now integrated with the installation media.

- The -cleanupOBase flag of the deinstallation tool
  The -cleanupOBase flag is deprecated in this release. There is no replacement for this flag.

- Oracle Restart
  Oracle Restart is a feature provided as part of Oracle Grid Infrastructure. Oracle Restart monitors and can restart Oracle Database instances, Oracle Net Listeners, and Oracle ASM instances. Oracle Restart is currently restricted to manage single instance Oracle Databases and Oracle ASM instances only, and is subject to desupport in future releases. Oracle continues to provide Oracle ASM as part of the Oracle Grid Infrastructure installation for Standalone and Cluster deployments.

Desupported Features

The following features are no longer supported by Oracle. See Oracle Database Upgrade Guide for a complete list of desupported features in this release.

- Direct use of raw devices with Oracle Clusterware and Oracle Database
- Oracle Cluster File System (OCFS) for Windows is Desupported
- Oracle Objects for OLE
- Oracle Enterprise Manager Database Control

Other Changes

- Windows Server 2003 and Windows Server 2003 R2 are not supported with this release
- Document Structure Changes
This book is redesigned to provide an installation checklist to assist with preparing for installation, and chapters that subdivide preinstallation tasks into category topics.
Oracle Grid Infrastructure Installation Checklist

Use this checklist to coordinate tasks to help ensure that all system and storage preparation and configuration tasks are completed before starting Oracle Grid Infrastructure for a cluster installation.

1.1 Installation Differences Between Windows and Linux or UNIX

If you are experienced with installing Oracle components in Linux or UNIX environments, then note that many manual setup tasks required on Linux or UNIX are not required on Windows. The key differences between Linux or UNIX and Windows installations are:

- **Startup and shutdown services**
  With Windows, you log in to a user account with Administrator privileges to install the Oracle Database software. You can also specify an Oracle Home User (based on a standard non-administrative Windows user account) during installation. On Linux and UNIX systems, you must create and use a software owner user account, and this user must belong to the Oracle Inventory group.

- **Environment variables**
  On Windows systems, Oracle Universal Installer (OUI) sets environment variables such as PATH, ORACLE_BASE, ORACLE_HOME, and ORACLE_SID in the registry. On Linux and UNIX systems, you must manually set these environment variables.

  If you have multiple Oracle databases in an Oracle home, then only the SID of the last Oracle database is set in the registry. See Oracle Universal Installer and OPatch User’s Guide for Windows and UNIX for more information about managing Oracle homes.

- **Operating System Groups**
  On Windows systems, OUI creates the ORA_DBA, ORA_OPER, ORA_SID_DBA, ORA_SID_OPER, ORA_HOMENAME_DBA, and ORA_HOMENAME_OPER groups, which are used for operating system authentication for Oracle instances. On Linux and UNIX systems, you must create the operating system groups manually. Windows does not use an Oracle Inventory group.

- **Account for running Oracle Universal Installer (OUI)***
  With Windows, you log in to a user account with Administrator privileges to install the Oracle Database software. You can also specify an Oracle Home User (based on a standard non-administrative Windows User Account) during installation. On Linux and UNIX systems, you must create and use a software owner user account, and this user must belong to the Oracle Inventory group.
1.2 System Hardware, Software and Configuration Checklists

The following tables provide lists of basic system requirements to check. This list is not comprehensive for all deployment options. For more specific details about these checks, and other configuration information, see Chapter 3 through Chapter 7.

- Oracle Grid Infrastructure Installation Server Hardware Checklist
- Oracle Grid Infrastructure and Oracle RAC Environment Checklist
- Oracle Grid Infrastructure Network Checklist
- Oracle Grid Infrastructure and Oracle RAC Upgrades Checklist
- Oracle Grid Infrastructure Storage Configuration Tasks
- Oracle Grid Infrastructure Starting the Installation Tasks

1.2.1 Oracle Grid Infrastructure Installation Server Hardware Checklist

Review the following hardware checklist for all installations:

<table>
<thead>
<tr>
<th>Check</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server hardware: server make, model, core architecture, and host bus adaptors (HBA) are supported to run with Oracle RAC.</td>
<td></td>
</tr>
<tr>
<td>Network Switches</td>
<td></td>
</tr>
<tr>
<td>Public network switch, at least 1 GbE, connected to a public gateway</td>
<td></td>
</tr>
<tr>
<td>Private network switch, at least 1 GbE, dedicated for use only with other cluster member nodes</td>
<td></td>
</tr>
<tr>
<td>Random Access Memory (RAM): At least 2.5 GB. Oracle recommends that you have 4 GB or more.</td>
<td></td>
</tr>
<tr>
<td>Temp space allocation: At least 1 GB allocated to %TEMP%.</td>
<td></td>
</tr>
<tr>
<td>Operating System</td>
<td></td>
</tr>
<tr>
<td>Supported in the list of supported releases listed in Section 3.5, &quot;Identifying Software Requirements&quot;.</td>
<td></td>
</tr>
<tr>
<td>Same operating system version running on each cluster member node</td>
<td></td>
</tr>
<tr>
<td>Storage hardware: Either Storage Area Network (SAN) or Network-Attached Storage (NAS).</td>
<td></td>
</tr>
<tr>
<td>Local Storage Space for Oracle Software</td>
<td></td>
</tr>
<tr>
<td>At least 8 GB of space for the Oracle Grid Infrastructure for a cluster home (Grid home). Oracle recommends that you allocate 100 GB to allow additional space for patches.</td>
<td></td>
</tr>
<tr>
<td>At least 3.5 GB of space for the Oracle base of the Oracle Installation user for the Oracle Grid Infrastructure software (Grid user). The Oracle base includes Oracle Clusterware and Oracle ASM log files.</td>
<td></td>
</tr>
<tr>
<td>At least 5.8 GB of space the Oracle Database software on x86_64 platforms.</td>
<td></td>
</tr>
<tr>
<td>Intelligent Platform Management Interface (IPMI) Configuration</td>
<td>completed, with IPMI administrator account information available to the Oracle Installation user</td>
</tr>
<tr>
<td>If you intend to use IPMI, then ensure baseboard management controller (BMC) interfaces are configured, and have an administration account username and password to provide when prompted during installation.</td>
<td></td>
</tr>
<tr>
<td>For nonstandard installations, if you must change the configuration on one or more nodes after installation (for example, if you have different administrator user names and passwords for BMC interfaces on cluster nodes), then decide to reconfigure the BMC interface, or modify IPMI administrator account information after installation.</td>
<td></td>
</tr>
<tr>
<td>IPMI is not supported for use with domains.</td>
<td></td>
</tr>
</tbody>
</table>

1.2.2 Oracle Grid Infrastructure and Oracle RAC Environment Checklist

Review the following environment checklist for all installations:
1.2.3 Oracle Grid Infrastructure Network Checklist

Review this network checklist for all installations to ensure that you have the required hardware, names, and addresses for the cluster. During installation, you designate interfaces for use as public, private, or Oracle ASM interfaces. You can also designate interfaces that are in use for other purposes, and not available for Oracle Grid Infrastructure use.

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Network Hardware:</strong></td>
</tr>
<tr>
<td>■ Public network switch (redundant switches recommended) connected to a public gateway and to the public interface ports for each cluster member node.</td>
</tr>
<tr>
<td>■ Ethernet interface card (redundant network cards recommended, bonded as one Ethernet port name).</td>
</tr>
<tr>
<td>■ The switches and network interface cards must be at least 1 GbE.</td>
</tr>
<tr>
<td>■ The network protocol is TCP/IP.</td>
</tr>
<tr>
<td><strong>Private Network Hardware for the Interconnect</strong></td>
</tr>
<tr>
<td>■ Private dedicated network switch (redundant switches recommended, bonded as one Ethernet port name), connected to the private interface ports for each cluster member node.</td>
</tr>
<tr>
<td>■ The switches and network interface adapters must be at least 1 GbE.</td>
</tr>
</tbody>
</table>

---

**Table 1–2 Environment Configuration for Oracle Grid Infrastructure and Oracle RAC**

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Create Users.</strong> Review Section 5.1, &quot;Creating Groups and Users for Oracle Grid Infrastructure and Oracle RAC&quot; for information about the users you need to create for your specific requirements. Oracle Installation users have different requirements from Oracle Home users. User names must use only ASCII characters.</td>
</tr>
<tr>
<td><strong>Create mount point paths for the software executable files.</strong> Oracle recommends that you follow the guidelines for an Optimal Flexible Architecture configuration, as described in the appendix &quot;Optimal Flexible Architecture,&quot; in Oracle Database Installation Guide for your platform.</td>
</tr>
<tr>
<td><strong>Ensure that the Grid home (the Oracle home path you select for Oracle Grid Infrastructure) uses only ASCII characters</strong> This restriction includes Oracle Installation user names, which are used as a default for some home paths, as well as other directory names you may select for paths.</td>
</tr>
<tr>
<td><strong>Unset Oracle software environment variables.</strong> If you have set ORA_CRS_HOME as an environment variable, then unset it before starting an installation or upgrade. Do not use ORA_CRS_HOME as a user environment variable. If you have had an existing installation on your system, and you are using the same user account to install this installation, then unset the following environment variables: ORA_CRS_HOME; ORACLE_HOME; ORA_NLS10; TNS_ADMIN</td>
</tr>
</tbody>
</table>

---

**Table 1–3 Network Configuration Tasks for Oracle Grid Infrastructure and Oracle RAC**

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Network Hardware:</strong></td>
</tr>
<tr>
<td>■ Public network switch (redundant switches recommended) connected to a public gateway and to the public interface ports for each cluster member node.</td>
</tr>
<tr>
<td>■ Ethernet interface card (redundant network cards recommended, bonded as one Ethernet port name).</td>
</tr>
<tr>
<td>■ The switches and network interface cards must be at least 1 GbE.</td>
</tr>
<tr>
<td>■ The network protocol is TCP/IP.</td>
</tr>
<tr>
<td><strong>Private Network Hardware for the Interconnect</strong></td>
</tr>
<tr>
<td>■ Private dedicated network switch (redundant switches recommended, bonded as one Ethernet port name), connected to the private interface ports for each cluster member node.</td>
</tr>
<tr>
<td>■ The switches and network interface adapters must be at least 1 GbE.</td>
</tr>
</tbody>
</table>
### Oracle Grid Infrastructure and Oracle RAC Upgrades Checklist

Review this upgrade checklist if you have an existing Oracle Grid Infrastructure or Oracle RAC installation. A cluster is being upgraded until all cluster member nodes run Oracle Grid Infrastructure 12c Release 1 (12.1), and the new clusterware becomes the active release.

**Note:** On the Windows platform, to upgrade Oracle Clusterware from releases 10.2.0.5 and 11.1.0.7 to release 12.1, you must perform an interim upgrade to 11.2.0.3 for Oracle Clusterware. After upgrading Oracle Clusterware to release 11.2.0.3, you must move the Oracle Cluster Registry (OCR) and voting disk (VDSK) to Oracle ASM. You must also move any files stored on OCFS on Windows or RAW devices to a supported storage mechanism. You can then upgrade Oracle Clusterware release 11.2.0.3 to 12c Release 1 (12.1).

If you intend to install Oracle RAC, then you must first complete the upgrade to Oracle Grid Infrastructure 12c Release 1 (12.1) on all cluster nodes before you install the Oracle Database 12c Release 1 (12.1) release of Oracle RAC.

---

#### Table 1–3 (Cont.) Network Configuration Tasks for Oracle Grid Infrastructure and Oracle RAC

<table>
<thead>
<tr>
<th>Check</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Flex ASM Network Hardware</td>
<td>Oracle Flex ASM can use either the same private networks as Oracle Clusterware, or use its own dedicated private networks. Each network can be classified PUBLIC or PRIVATE+ASM or PRIVATE or ASM. ASM networks use the TCP protocol.</td>
</tr>
<tr>
<td>Cluster Names and Addresses:</td>
<td>Determine and configure the following names and addresses for the cluster:</td>
</tr>
<tr>
<td>■ Cluster name:</td>
<td>The name for the cluster, which is entered during installation. The cluster name must be globally unique throughout your host domain. The cluster name must be at least one character long and no more than 15 characters long. The cluster name should use the same set of characters that is used for host names, in accordance with RFC 1123: Hyphens (-), and single-byte alphanumeric characters (a to z, A to Z, and 0 to 9).</td>
</tr>
<tr>
<td>■ Grid Naming Service Virtual IP Address (GNS VIP):</td>
<td>If you plan to use GNS, then configure a GNS name and fixed address on the DNS for GNS VIP, and cluster addresses. GNS domain delegation is mandatory with dynamic public networks (DHCP, autoconfiguration).</td>
</tr>
<tr>
<td>■ Single Client Access Name (SCAN) and addresses when using GNS:</td>
<td>Do not configure SCAN names and addresses in your DNS. GNS manages the SCANs.</td>
</tr>
<tr>
<td>■ Manual configuration of SCAN and addresses:</td>
<td>If you are not using GNS, then configure a SCAN name to resolve to three addresses on the domain name service (DNS).</td>
</tr>
<tr>
<td>Standard Node Public, Private and Virtual IP names and Addresses:</td>
<td>If you are configuring a Standard cluster with Grid Naming Service (GNS), then OUI displays the public and virtual host name addresses labeled as &quot;AUTO&quot; because they are configured automatically. To use this option, you must have configured a subdomain on your DNS that is delegated to GNS for resolution, and you must have a fixed GNS VIP address where the delegated service requests can be routed. If you are not using GNS, and you are configuring a Standard cluster, then configure the following for each node:</td>
</tr>
<tr>
<td>■ Public node name and address, configured on the DNS and in the hosts (for example, node1.example.com, address 192.0.2.10). The public node name should be the primary host name of each node, which is the name displayed by the hostname command.</td>
<td></td>
</tr>
<tr>
<td>■ Private node address, configured on the private interface for each node. The installer identifies addresses in the private range as private IP addresses by default. For example: 10.0.0.10</td>
<td></td>
</tr>
<tr>
<td>■ Public node virtual IP name and address (for example, node1-vip.example.com, address 192.0.2.11) If you are not using GNS, then determine a virtual host name for each node. A virtual host name is a public node name that enables the rerouting of client requests sent to the node if the node is down. Oracle Database uses VIPs for client-to-database connections, so the VIP address must be publicly accessible. Oracle recommends that you provide a name in the format hostname-vip. For example: myclstr2-vip.</td>
<td></td>
</tr>
</tbody>
</table>
**Note:** All Oracle Grid Infrastructure upgrades (upgrades of existing Oracle Clusterware and Oracle ASM installations) are out-of-place upgrades.

<table>
<thead>
<tr>
<th>Table 1–4</th>
<th><strong>Installation Upgrades Checklist for Oracle Grid Infrastructure</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check</strong></td>
<td><strong>Task</strong></td>
</tr>
<tr>
<td>Review <em>Oracle Database Upgrade Guide</em></td>
<td>Install the latest available patchset release</td>
</tr>
</tbody>
</table>
| Confirm that the Oracle Automatic Storage Management (Oracle ASM) instances use standard Oracle ASM instance names.  
The default ASM SID for a single-instance database is `+ASM`, and the default SID for ASM on Oracle Real Application Clusters nodes is `+ASMnode#`, where `node#` is the node number. With Oracle Grid Infrastructure 11.2.0.1 and later, nondefault Oracle ASM instance names are not supported.  
If you have nondefault Oracle ASM instance names, then before you upgrade your cluster, use your existing release `srvctl` to remove individual Oracle ASM instances with nondefault names, and add Oracle ASM instances with default names. | |
| Check Network Addresses for Standard Oracle Grid Infrastructure deployments to ensure the following IP addresses conditions for the public and private networks are met:  
- The private and public IP addresses are in unrelated, separate subnets. The private subnet should be in a dedicated private subnet.  
- The public and virtual IP addresses, including SCAN addresses, are in the same subnet (the range of addresses permitted by the subnet mask for the subnet network).  
- Neither private nor public IP addresses use a link local subnet (169.254.*.*). | Confirm that you are using a supported operating system, patch release, and all required operating system packages for the new Oracle Grid Infrastructure installation. |
| Run the `ocrcheck` command to confirm Oracle Cluster Registry (OCR) file integrity. If this check fails, then repair the OCRs before proceeding. | Review *Oracle 12c Upgrade Companion* (My Oracle Support Note 1462240.1) for the most current information regarding other upgrade issues:  
[https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=1462240.1](https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=1462240.1) |
| Run the Oracle Database Pre-Upgrade utility SQL script that is located in the path `%ORACLE_HOME%/rdbms/admin` after you complete the Oracle Grid Infrastructure installation to prepare your databases for upgrades.  
For more information, review My Oracle Support note 884522.1:  
[https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=884522.1](https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=884522.1) | |

### 1.2.5 Oracle Grid Infrastructure Storage Configuration Tasks

Review the following storage configuration task checklist for all installations:

<table>
<thead>
<tr>
<th>Table 1–5</th>
<th><strong>Oracle Grid Infrastructure Storage Configuration Checks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check</strong></td>
<td><strong>Task</strong></td>
</tr>
</tbody>
</table>
| During installation, you are asked to provide paths for the following Oracle Clusterware files. These files must be shared across all nodes of the cluster on Oracle ASM because the files created during installation must be available to all cluster member nodes.  
- **Voting files** are files that Oracle Clusterware uses to verify cluster node membership and status.  
- **Oracle Cluster Registry** (OCR) files contain cluster and database configuration information for Oracle Clusterware. |  

*Oracle Grid Infrastructure Installation Checklist*  1-5
1.2.6 Oracle Grid Infrastructure Starting the Installation Tasks

Table 1–6 Oracle Grid Infrastructure Checks to Perform Before Starting the Installer

<table>
<thead>
<tr>
<th>Check</th>
<th>Task</th>
</tr>
</thead>
</table>
| Check running Oracle processes, and shut down if necessary: | ■ On a node with a standalone database not using Oracle ASM: You do not need to shut down the database while you install Oracle Grid Infrastructure.  
■ On an Oracle RAC Database node: This installation requires an upgrade of Oracle Clusterware, as Oracle Clusterware is required to run Oracle RAC. As part of the upgrade, you must shut down the database one node at a time as the rolling upgrade proceeds from node to node. |
| Ensure scheduled tasks do not run during installation | If the installer is running when daily scheduled tasks start, then you may encounter unexplained installation problems if your scheduled task is performing cleanup, and temporary files are deleted before the installation is finished. Oracle recommends that you complete installation before daily scheduled tasks are run, or disable daily scheduled tasks that perform file and directory cleanup until after the installation completes. |
| Decide to install other languages | During installation, you are asked if you want the user interface text translated into languages other than the default, which is English. If the language set for the operating system is not supported by the installer, then by default the installer runs in the English language.  
Refer to Oracle Database Globalization Support Guide for detailed information about character sets and language configuration. |
| Obtain proxy realm authentication information if you have a proxy realm on your network | During installation, the installer attempts to download Oracle software updates. If you have a proxy realm configured, then you must provide the proxy realm information and user authentication information to access the Internet through the proxy service. If you do not have a proxy realm, then leave the proxy authentication fields blank. |
| Decide to use the Software Updates option. | The installer can install system requirements updates (hardware, operating system parameters, and kernel packages) for supported operating systems, and other significant updates that can help ensure your installation proceeds smoothly. Oracle recommends that you enable software updates during installation.  
If you choose to enable software updates, then during installation you must provide a valid My Oracle Support user name and password, so that the installer can download the latest updates. Alternatively, you can provide a path to the location of software updates packages that you have previously downloaded.  
If you plan to run the installation in a secured data center, then you can download updates before starting the installation by starting the installer in download update mode on a system that has Internet access. To start the installer so that it download updates, enter the following command:  
C:\> setup.exe -downloadUpdates  
Provide the My Oracle Support user name and password, and provide proxy settings if needed. After you download updates, transfer the update file to a directory on the server where you plan to run the installation. |
| For Advanced installations, decide to install the Oracle Grid Infrastructure Management Repository to monitor and analyze cluster performance. | If you choose not to configure Oracle Grid Infrastructure Management Repository, then you disable permanently the Cluster Health Monitor, QoS Management, Memory Guard, and Rapid Homes Provisioning features. If you decide later that you want to enable these features, then you must reinstall Oracle Grid Infrastructure.  
Oracle recommends that you install Oracle Grid Infrastructure Management Repository. |
You must complete certain operating system tasks on your servers before you install Oracle Grid Infrastructure for a Cluster and Oracle Real Application Clusters. The values provided in this chapter are for installation minimums only. Oracle recommends that you configure production systems in accordance with planned system loads.

This chapter contains the following topics:

- Checking Server Hardware and Memory Configuration
- General Server Requirements
- Server Minimum Hardware and Memory Requirements
- Server Minimum Storage Requirements

### 2.1 Checking Server Hardware and Memory Configuration

Perform the following tasks to gather your current system information.

- Checking the Available RAM on Windows Systems
- Checking the Currently Configured Virtual Memory on Windows Systems
- Checking the Operating System Version
- Checking the System Processor Type and Speed
- Checking the Available Disk Space for Oracle Home Directories
- Checking the Available TEMP Disk Space

#### 2.1.1 Checking the Available RAM on Windows Systems

The minimum required RAM is 4 gigabyte (GB) for Oracle Grid Infrastructure for a Cluster installations, including installations where you plan to install Oracle RAC.

To determine the physical RAM size, for a computer, you can use either of the following methods:

1. Open **System** in the control panel and Select the **General** tab.
2. Alternatively, start the Windows Task Manager, then select the **Performance** tab to view the available memory for your system.
2.1.2 Checking the Currently Configured Virtual Memory on Windows Systems

Virtual memory (also known as a paging file) stores information that cannot fit in RAM, the main memory for the computer. All processes share the paging files, and a lack of space in the paging files can prevent processes from allocating memory.

Oracle recommends that you set the paging file size to match the amount of RAM available on the server, up to a maximum of 16 GB. If possible, split the paging file into multiple files on multiple physical devices. This configuration encourages parallel access to virtual memory, and improves the software performance.

To determine the size of the configured virtual memory (also known as paging file size) perform the following steps:

1. From the Control panel, select System.
2. In the System Properties window, select the Advanced tab.
3. Under Performance, click Performance Options, or Settings.
4. In the Performance Options window, click the Advanced tab.
   
The virtual memory configuration is displayed at the bottom of the window.

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

2.1.3 Checking the Operating System Version

To determine whether your computer is running a 64-bit (x64) Windows operating system, perform the following steps:

1. Right-click My Computer and select Properties.
2. On the General tab, under the heading of System, view the displayed text.
   
   You will see text similar to "64-bit Operating System" if you have the x64 version of the operating system installed.

2.1.4 Checking the System Processor Type and Speed

To view your processor type (32-bit or 64-bit) and its speed, perform the following steps:

1. From the Start menu, select Run. In the Run window, type in msinfo32.exe.
2. In the System Summary display, locate the System Type entry. If the value for System Type is x64-based PC, then you have a 64-bit system. If the value for System Type is x86-based PC, then you have a 32-bit system.
3. Locate the Processor entry. If necessary, scroll to the right until you can see the end of the Processor value. The last part of this string shows the processor speed. For example, if you see ~2612 megahertz (MHz), then that means the processor speed is 2.61 GHz.

2.1.5 Checking the Available Disk Space for Oracle Home Directories

The Grid home includes Oracle Clusterware and Oracle ASM software and configuration files. Additional disk space on a cluster file system is required for the Oracle Grid Infrastructure Management Repository, Oracle Cluster Registry (OCR) and voting files used by Oracle Clusterware. If the temp space and the Grid home are on the same file system, then add together their respective requirements for the total minimum space required for that file system.
If you are installing Oracle RAC, then you must configure additional disk space for:

- The Oracle RAC software and log files
- The shared data files and, optionally, the shared Fast Recovery Area in an Oracle ASM disk group

To determine the amount of available free disk space, there are two methods you can use:

1. Using the Computer properties window:
   a. Open the Start menu, then click Computer.
   b. View the free disk space for each drive.
   c. Right-click the drive on which you plan to install the Oracle software and select Properties to view additional information about the disk space for that drive.

2. Using the Disk Management Microsoft Management Console (MMC) plug-in:
   a. From the Start menu, select Run...
   b. In the Run window, type in Diskmgmt.msc to open the Disk Management graphical user interface (GUI).
      The Disk Management GUI displays the available space on the available file systems.

If you use standard redundancy for Oracle Clusterware files, which is 3 Oracle Cluster Registry (OCR) files and 3 voting files, then you should have at least 2 GB of disk space available on three separate physical disks reserved for storing the Oracle Clusterware files in Oracle ASM.

**Note:** You cannot install OCR or voting files (Oracle Clusterware files) on raw partitions. You can install Oracle Clusterware files only on Oracle ASM. Raw devices can be used as Oracle ASM disks.

To ensure high availability of OCR or voting files on Oracle ASM, you need to have at least 2 GB of disk space for Oracle Clusterware files in three separate failure groups, with at least three physical disks. Each disk must have at least 1 GB of capacity to ensure that there is sufficient space to create Oracle Clusterware files.

**See Also:**

- Chapter 6, "Configuring Storage for Oracle Grid Infrastructure and Oracle RAC"
- Oracle Automatic Storage Management Administrator’s Guide

### 2.1.6 Checking the Available TEMP Disk Space

The amount of disk space available in the TEMP directory is equivalent to the total amount of free disk space, minus what will be needed for the Oracle software to be installed.

**Note:** The temporary directory must reside in the same directory path on each node in the cluster.
You must have 1 GB of disk space available in the \texttt{TEMP} directory. If you do not have sufficient space, then first delete all unnecessary files. If the temp disk space is still less than the required amount, then increase the partition size of the disk or set the \texttt{TEMP} environment variable to point to a different hard drive. Ensure the environment variables \texttt{TEMP} and \texttt{TMP} both point to the location of the TEMP directory, for example:

\begin{verbatim}
TEMP=C:\WINDOWS\TEMP
TMP=C:\WINDOWS\TEMP
\end{verbatim}

To modify the setting for the \texttt{TEMP} environment variable:
1. Log in as or switch to the user that will be performing the installation.
   See Section 5.1.1, "About the Oracle Installation User."
2. From the Control Panel, select \textbf{System}.
3. Select \textbf{Advanced System Settings}.
4. In the System Properties windows, select the \textbf{Advanced} tab, then click \textbf{Environment Variables}.
5. Modify the value of the \texttt{TEMP} environment variable in the user variables list.

2.2 General Server Requirements

- Select servers with the same instruction set architecture as cluster members.
- Ensure servers run the same operating system binary.
- Oracle Grid Infrastructure installations and Oracle Real Application Clusters (Oracle RAC) support servers with different hardware in the same cluster. Your cluster can have nodes with CPUs of different speeds or sizes, but Oracle recommends that you use nodes with the same hardware configuration.

Oracle recommends that if you configure clusters using different configuration, that you categorize cluster nodes into homogenous pools as part of your server categorization management policy.

\textbf{See Also:} \textit{Oracle Clusterware Administration and Deployment Guide} for more information about server state and configuration attributes, and about using server pools to manage resources and workloads.

2.3 Server Minimum Hardware and Memory Requirements

Each system must meet the following minimum hardware and memory requirements:

\begin{table}[h]
\centering
\caption{Minimum Hardware and Memory Requirements for Oracle Grid Infrastructure Installation}
\begin{tabular}{|l|l|}
\hline
Hardware Component & Requirements \\
\hline
Memory (RAM) & Oracle Grid Infrastructure installations: At least 4 gigabyte (GB) of physical RAM for Oracle Grid Infrastructure for a cluster installations, including installations where you plan to install Oracle RAC \\
\hline
\end{tabular}
\end{table}
### 2.4 Server Minimum Storage Requirements

Each system must meet the following minimum storage requirements:

- 1 GB of space in the \%TEMP\% directory.
  
  If the free space available in the \%TEMP\% directory is less than what is required, then complete one of the following steps:
  
  - Delete unnecessary files from the \%TEMP\% directory to make available the space required.
  
  - Extend the file system that contains the \%TEMP\% directory. If necessary, contact your system administrator for information about extending file systems.

- At least 8 GB of space for the Oracle Grid Infrastructure for a cluster home (Grid home). Oracle recommends that you allocate 100 GB to allow additional space for patches.

- At least 3.5 GB of space for the Oracle base of the Oracle Grid Infrastructure Installation user. The Oracle base includes Oracle Clusterware and Oracle ASM log files.

- If you intend to install Oracle Database, then allocate 5.89 GB of disk space for the Oracle home (the location for the Oracle Database software binaries).

  If you plan to configure automated database backups for your Oracle Database, then you require additional space either in a file system or in an Oracle Automatic Storage Management disk group for the Fast Recovery Area.

  **Note:** The base directory for Oracle Grid Infrastructure 12c and the base directory for Oracle RAC 12c must be different from the directories used by the Oracle RAC 11g Release 2 installation.

  **See Also:**
  
  - *Oracle Automatic Storage Management Administrator’s Guide*
  
  - *Oracle Database Backup and Recovery User’s Guide* for more information about Fast Recovery Area sizing

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**Table 2–1 (Cont.) Minimum Hardware and Memory Requirements for Oracle Grid Infrastructure Installation**

<table>
<thead>
<tr>
<th>Hardware Component</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual memory (swap)</td>
<td>If your server has between 4 GB and 16 GB of RAM, then you should configure a paging file of at least the same size as the RAM. If your server has more than 16 GB of RAM, then the paging file should be 16 GB.</td>
</tr>
<tr>
<td>Video adapter</td>
<td>256 color and at least 1024 x 768 display resolution, so that OUI displays correctly while performing a system console-based installation</td>
</tr>
</tbody>
</table>
| Processor                   | x64: Intel Extended Memory 64 Technology (EM64T) or AMD 64  
  The minimum processor speed is 1 gigahertz (GHz) for Windows Server 2008; for Windows Server 2008 R2, the minimum supported processor speed is 1.4 GHz. |
2.4.1 Disk Format Requirements

Oracle recommends that you install Oracle software, or binaries, on New Technology File System (NTFS) formatted drives or partitions. Because it is difficult for OUI to estimate NTFS and file allocation table (FAT) disk sizes on Windows, the system requirements documented in this section are likely more accurate than the values reported on the OUI Summary screen.

---

**Note:** Oracle Grid Infrastructure software is not supported on Network File System (NFS).

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You cannot use NTFS formatted disks or partitions for Oracle Clusterware files or data files because they cannot be shared. Oracle Clusterware shared files and Oracle Database data files can be placed on unformatted basic disks or disk partitions, called **raw partitions**, managed by Oracle ASM.

Oracle ASM is recommended for storing Oracle Clusterware and Oracle Database data files.
This chapter describes the operating system configuration tasks you must complete on your servers before you install Oracle Grid Infrastructure for a cluster and Oracle Real Application Clusters (Oracle RAC).

This chapter contains the following topics:

- Reviewing Operating System and Software Upgrade Best Practices
- Reviewing Operating System Security Common Practices
- Logging In To a Remote Windows Server
- Checking Hardware and Software Certification on My Oracle Support
- Identifying Software Requirements
- Oracle Enterprise Manager Requirements
- Installation Requirements for Web Browsers
- Configuring Time Synchronization for the Cluster

### 3.1 Reviewing Operating System and Software Upgrade Best Practices

Review the following information regarding upgrades:

- General Upgrade Best Practices
- Oracle ASM Upgrade Notifications
- Rolling Upgrade Procedure Notifications

#### 3.1.1 General Upgrade Best Practices

If you have an existing Oracle installation, then do the following:

- Record the release numbers, patches, and other configuration information
- Review upgrade procedures for your existing installation
- Review Oracle upgrade documentation before proceeding with installation, to decide how you want to proceed

**Caution:** Always create a backup of existing databases before starting any configuration change.
To find the most recent software updates, and to find best practices recommendations about preupgrade, postupgrade, compatibility, and interoperability, see Oracle 12c Upgrade Companion (My Oracle Support Note 1462240.1):

https://support.oracle.com/CSP/main/article?cmd=show&type=NOT&id=1462240.1

See Also: Appendix D, "How to Upgrade to Oracle Grid Infrastructure 12c Release 1"

### 3.1.2 Oracle ASM Upgrade Notifications

Be aware of the following issues regarding Oracle ASM upgrades:

- You can upgrade Oracle Automatic Storage Management (Oracle ASM) 11g Release 1 (11.1) and later without shutting down an Oracle RAC database by performing a rolling upgrade either of individual nodes, or of a set of nodes in the cluster. However, if you have a standalone database on a cluster that uses Oracle ASM, then you must shut down the standalone database before upgrading. If you are upgrading from Oracle ASM 10g, then you must shut down the entire Oracle ASM cluster to perform the upgrade.

- The location of the Oracle ASM home changed in Oracle Grid Infrastructure 11g Release 2 (11.2) so that Oracle ASM is installed with Oracle Clusterware in the Oracle Grid Infrastructure home (Grid home).

  If you have an existing Oracle ASM home from a previous release, then you may want to consider other configuration changes to simplify or customize storage administration.

- You must be an Administrator user to upgrade Oracle ASM.

### 3.1.3 Rolling Upgrade Procedure Notifications

Be aware of the following information regarding rolling upgrades:

- During rolling upgrades of the operating system, Oracle supports using different operating system binaries when both versions of the operating system are certified with the Oracle Database release you are using.

- Using mixed operating system versions is supported during upgrade only

  Be aware that mixed operating systems are supported only supported for the duration of an upgrade, over the period of a few hours.

- Oracle Clusterware does not support nodes that have processors with different instruction set architectures (ISAs) in the same cluster. Each node must be binary compatible with the other nodes in the cluster.

  For example, you cannot have one node using an Intel 64 processor and another node using an IA-64 (Itanium) processor in the same cluster. You could have one node using an Intel 64 processor and another node using an AMD64 processor in the same cluster because the processors use the same x86-64 ISA and run the same binary release of Oracle software.

**Note:** Your cluster can have nodes with processors of different manufacturers, speeds, or sizes, but this is not recommended.
3.2 Reviewing Operating System Security Common Practices

Secure operating systems are an important basis for general system security. Ensure that your operating system deployment is in compliance with common security practices as described in your operating system vendor security guide.

3.3 Logging In To a Remote Windows Server

During installation, you are required to perform tasks as an Administrator user on the cluster nodes. Complete the following procedure for user accounts that you want to enable for remote display.

This section contains these topics:

- Windows Telnet Services Support
- Configuring Remote Desktop Services and Remote Desktop Connections

3.3.1 Windows Telnet Services Support

Microsoft changed the name from Terminal Services to Remote Desktop Services with the release of Windows Server 2008 R2. Microsoft also introduced the Remote Desktop Connections client, which can be used to connect to a Windows server that has Terminal Services installed.

---

**Note:** Ensure that the Telnet service is installed and started.

---

3.3.2 Configuring Remote Desktop Services and Remote Desktop Connections

On Windows, Oracle supports installing, configuring, and running Oracle Database software through Remote Desktop Services (formerly known as Terminal Services). If you do not use Terminal Services in console mode, then you might encounter problems with configuration assistants after the installation or with starting Oracle Clusterware components after installation.

3.3.2.1 Configuring Remote Desktop Connections with Windows Server 2008 or Windows Server 2008 R2

Due to changes in Windows 2008 and Windows Server 2008 R2, you no longer need to connect to session 0 for installation. Use the Remote Desktop Connection client, but do not specify the /console switch, as shown in the following example:

```
msatc /v:servername /f
``` 

3.4 Checking Hardware and Software Certification on My Oracle Support

The hardware and software requirements included in this installation guide were current at the time this guide was published. However, because new platforms and operating system software versions might be certified after this guide is published, review the certification matrix on the My Oracle Support website for the most up-to-date list of certified hardware platforms and operating system versions. This website also provides compatible client and database releases, patches, and workaround information for bugs.

You can view certification on both Oracle Technology Network (OTN) and My Oracle Support.
The OTN certification page can be found on the following website:

You can view hardware certification details for Microsoft Windows platforms on Oracle Technology Network, at the following URL:

My Oracle Support contains guidance about supported hardware options that can assist you with your purchasing decisions and installation planning. The My Oracle Support certifications page contains more detailed information about certified hardware and has information specific to each release and platform. My Oracle Support is available at the following URL:
http://support.oracle.com/

You must register online before using My Oracle Support. Use the steps described in the support document "Locate Oracle Database Server Certification Information for Microsoft Windows Platforms (Doc ID 1062972.1)” to locate the certification information for your Windows operating system.

---

**Note:** Contact your Oracle sales representative if you do not have a My Oracle Support account.

---

### 3.5 Identifying Software Requirements

Depending on the products that you intend to install, verify that the following operating system software listed in Table 3–1, ”Oracle Grid Software Requirements for Windows Systems” is installed on each node of your cluster. Table 3–1 lists the software requirements for Oracle Grid Infrastructure and Oracle RAC 12c Release 1 (12.1).

Requirements listed in this document are current as of the date listed on the title page. To obtain the most current information about operating system requirements, see the online version on the Oracle Technology Network (OTN) at the following URL:

OUI performs checks on your system to verify that it meets the listed operating system requirements. To ensure that these checks complete successfully, verify the requirements before you start OUI.

---

**Note:** Oracle does not support running different operating system versions on cluster members, unless an operating system is being upgraded. You cannot run different operating system version binaries on members of the same cluster, even if each operating system is supported.
If you are currently running an operating system version that is not supported by Oracle Database 12c Release 1 (12.1), such as Windows Server 2003 x86, then see Oracle Database Platform Guide for Microsoft Windows for upgrade instructions.

### 3.5.1 Windows Firewall Feature on Windows Servers

When installing Oracle Grid Infrastructure software or Oracle RAC software on Windows servers, it is mandatory to disable the Windows Firewall feature. If the windows firewall is enabled, then remote copy and configuration assistants such as virtual IP configuration assistant (VIPCA), Network Configuration Assistant (NETCA) and Oracle Database Configuration Assistant (DBCA) will fail during Oracle RAC installation. Thus, the firewall must be disabled on all the nodes of a cluster before performing an Oracle RAC installation.

**Note:** The Windows Firewall should never be enabled on a NIC that is used as a cluster interconnect (private network interface) or for accessing an Oracle ASM network.

After the installation is successful, you can enable the Windows Firewall for the public connections. However, to ensure correct operation of the Oracle software, you must add certain executables and ports to the Firewall exception list on all the nodes of a cluster. See Section 8.1.3, "Configure Exceptions for the Windows Firewall" for details.
Additionally, the Windows Firewall must be disabled on all the nodes in the cluster before performing any clusterwide configuration changes, such as:

- Adding a node
- Deleting a node
- Upgrading to patch release
- Applying a patch bundle or an emergency patch

If you do not disable the Windows Firewall before performing these actions, then the changes might not be propagated correctly to all the nodes of the cluster.

### 3.6 Oracle Enterprise Manager Requirements

All Oracle Enterprise Manager products that you use on your system must be of the same release. Oracle Database 12c Release 1 (12.1) does not support releases of Enterprise Manager earlier than Oracle Enterprise Manager Cloud Control 12c.

**See Also:** Oracle Enterprise Manager Cloud Control Basic Installation Guide available on the Enterprise Manager Cloud Control installation media

### 3.7 Installation Requirements for Web Browsers

Web browsers are required to use Oracle Enterprise Manager Database Express and Oracle Enterprise Manager Cloud Control. Web browsers must support Java Script, and the HTML 4.0 and CSS 1.0 standards. For a list of browsers that meet these requirements, see the Oracle Enterprise Manager certification matrix on My Oracle Support:

https://support.oracle.com

### 3.8 Configuring Time Synchronization for the Cluster

Oracle Clusterware requires the same time zone setting on all cluster nodes. During installation, the installation process picks up the time zone environment variable setting of the Oracle Installation user for Oracle Grid Infrastructure on the node where OUI runs, and uses that time zone value on all nodes as the default TZ environment variable setting for all processes managed by Oracle Clusterware. The time zone default is used for databases, Oracle ASM, and any other managed processes.

You have three options for time synchronization between cluster nodes:

- Windows Time service
- An operating system configured network time protocol (NTP)
- Oracle Cluster Time Synchronization Service

Oracle Cluster Time Synchronization Service is designed for organizations whose cluster servers are unable to access NTP services. If you use NTP, then the Oracle Cluster Time Synchronization daemon (ctssd) starts in observer mode. If neither NTP or the Windows Time service is found, then ctssd starts in active mode and synchronizes time among cluster members without contacting an external time server.
Follow the instructions in one of the following sections to configure time synchronization for your cluster nodes:

- Configuring the Windows Time Service
- Configuring Network Time Protocol
- Configuring Cluster Time Synchronization Service

### 3.8.1 Configuring the Windows Time Service

The Windows Time service (W32Time) provides network clock synchronization on computers running Microsoft Windows. If you are using Windows Time service, and you prefer to continue using it instead of Cluster Time Synchronization Service, then you must modify the Windows Time service settings to jumps in time and allow the time to gradually match with the reference time. Restart the Windows Time service after you complete this task.

To configure Windows Time service, use the following command on each node:

```
C:\> W32tm /register
```

To modify the Windows Time service to work in an Oracle RAC environment, perform the following steps:

1. Open the Registry Editor (`regedit`).
2. Locate the `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W32Time\Config` key.
3. Set the following Windows Time service parameters to these values:
   - `MaxPosPhaseCorrection` to 600
   - `MaxNegPhaseCorrection` to 600
   - `MaxAllowedPhaseOffset` to 600

   These parameter settings specify that small time adjustments are allowed when the time difference between the reference and cluster nodes is under 10 minutes.

   **Note:** You should configure the Windows Time service to meet the requirements of your environment, with assistance from Microsoft, if necessary. The recommended settings provided for the three parameters are the settings that Oracle recommends to allow time adjustments to happen through *slewing* (gradually adjusting the clock using small changes) rather than in large *steps* (setting the clock to a new time). Large time adjustments in a single step are not supported.

4. To put the changes into effect, use the following command:

```
C:\>W32tm /config /update
```
3.8.2 Configuring Network Time Protocol

The Network Time Protocol (NTP) is a client/server application. Each server must have NTP client software installed and configured to synchronize its clock to the network time server. The Windows Time service is not an exact implementation of the NTP, but it based on the NTP specifications.

If you decide to use NTP instead of the Windows Time service, then, after you have installed the NTP client software on each cluster node, you must start the NTP service with the `-x` option to prevent time from being adjusted backward. Restart the network time protocol service after you complete this task.

To ensure the NTP service is running with the `-x` option, perform the following steps:

1. Use the registry editor to edit the value for the `ntpd` executable under HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\NTP
2. Add the `-x` option to the ImagePath key value, behind `%INSTALLDIR%\ntpd.exe`.
3. Restart the NTP service using the following commands:

   ```
   net stop NTP
   net start NTP
   ```

3.8.3 Configuring Cluster Time Synchronization Service

To use Cluster Time Synchronization Service to provide synchronization service in the cluster, disable the Windows Time service and stop the NTP service. If you have an NTP service on your server but you cannot use the service to synchronize time with a time server, then you must deactivate and deinstall the NTP to use Cluster Time Synchronization Service.

When OUI discovers that neither the Windows Time or NTP services are active, the Cluster Time Synchronization Service is installed in active mode and synchronizes the time across the nodes. If the Windows Time service or NTP service is found on the server, then the Cluster Time Synchronization Service is started in observer mode, and no active time synchronization is performed by the Cluster Time Synchronization Service within the cluster.

To confirm that the Cluster Time Synchronization Service is active after installation, enter the following command as the Oracle Grid Infrastructure installation owner:

```bash
crsctl check ctss
```
Configuring Networks for Oracle Grid Infrastructure and Oracle RAC

Review the following sections to check that you have the networking hardware and internet protocol (IP) addresses required for an Oracle Grid Infrastructure for a cluster installation:

- Network Interface Hardware Requirements
- Oracle Grid Infrastructure IP Name and Address Requirements
- Intended Use of Network Adapters
- Broadcast Requirements for Networks Used by Oracle Grid Infrastructure
- Multicast Requirements for Networks Used by Oracle Grid Infrastructure

---

**Note:** For the most up-to-date information about supported network protocols and hardware for Oracle RAC installations, refer to the Certify pages on the My Oracle Support website. See Section 3.4, "Checking Hardware and Software Certification on My Oracle Support" for instructions.

---

**4.1 Network Interface Hardware Requirements**

The following is a list of general requirements for network configuration on each node:

- Network Requirements for Each Node
- Network Requirements for the Private Network
- Network Requirements for the Public Network
- Network Requirements for the ASM Network Interface
- IPv6 Protocol Support for Windows
- Using Multiple Public Network Adapters
- Disabling Windows Media Sensing
- Setting the Bind Order for Network Adapters
- Verify Privileges for Copying Files in the Cluster
- Network Interface Configuration Options for Performance
4.1.1 Network Requirements for Each Node

- The host name of each node must use only the characters a-z, A-Z, 0-9, and the dash or minus sign (-). Host names using underscores (_) are not supported.

- Each node must have at least two network adapters or network interface cards (NICs): one for the public network interface, and one for the private network interface, or the interconnect. Each network adapter has a network connection name.

  Note: Do not use the names PUBLIC and PRIVATE (all caps) for the public or private (interconnect) network connection names.

- If you plan to use Oracle ASM running in a different cluster for storage, then you must either have a third network adapter for accessing the ASM network, or use the same network adapter that is used for the private network interface.

4.1.2 Network Requirements for the Private Network

The following is a list of requirements for the private network configuration:

- The private network connection names must be different from the network connection names used for the public network.

- The private network connection name cannot contain any multibyte language characters. The private network connection names are case-sensitive.

- If you use OUI to install Oracle Grid Infrastructure, then the private network connection names associated with the private network adapters must be the same on all nodes.

  For example, if you have a two-node cluster, and PrivNIC is the private network connection name for node1, then PrivNIC must be the private network connection name for node2.

- For the private network, the network adapters must use high-speed network adapters and switches that support TCP/IP (minimum requirement is 1 Gigabit Ethernet).

  Note: TCP is the interconnect protocol for Oracle Clusterware. You must use a switch for the interconnect. Oracle recommends that you use a dedicated switch.

  Oracle does not support token-rings or crossover cables for the interconnect.

- For the private network adapters, the endpoints of all designated network connection names must be completely reachable on the network. There should be no node that is not connected to every other node on the private network. You can test if an interconnect interface is reachable using ping.

4.1.3 Network Requirements for the Public Network

The following is a list of requirements for the private network configuration:

- The public network connection names must be different from the private network connection names.
Public network connection names are case-sensitive.

The public network connection name cannot contain any multibyte language characters.

If you use OUI to install Oracle Grid Infrastructure, then the public network connection names associated with the public network adapters for each network must be the same on all nodes.

For example, if you have a two-node cluster, you cannot configure network adapters on node1 with NIC1 as the public network connection name and on node2 have NIC2 as the public network connection name. Public network connection names must be the same, so you must configure NIC1 as the public network connection name on both nodes.

For the public network, each network adapter must support transmission control protocol and internet protocol (TCP/IP).

### 4.1.4 Network Requirements for the ASM Network Interface

Oracle Flex ASM enables an Oracle ASM instance to run on a separate physical server from the database servers. Many Oracle ASM instances can be clustered to support numerous database clients. If you use this configuration, then you must either have a third network adapter for accessing the ASM network, or use the same network adapter that is used for the private network interface.

Review the following list of requirements for nodes that use a third network adapter for the ASM network:

- The ASM network connection names must be different from both the public and private network connection names.
- ASM network connection names are case-sensitive.
- The ASM network connection name cannot contain any multibyte language characters.
- For the ASM network, each network adapter must support transmission control protocol and internet protocol (TCP/IP).

### 4.1.5 IPv6 Protocol Support for Windows

IPv6 is not supported for Oracle Grid Infrastructure or Oracle RAC on Windows in the first release of Oracle RAC 12c.

**See Also:**

- *Oracle Database Net Services Administrator’s Guide* for more information about network communication and IP address protocol options

### 4.1.6 Using Multiple Public Network Adapters

To configure multiple public network adapters, use a third-party technology for your platform to aggregate the multiple public network adapters before you start installation, and then select the single network connection name for the combined network adapters as the public interface. Oracle recommends that you do not identify multiple public network connection names during Oracle Grid Infrastructure installation. Note that if you configure two network adapters as public network adapters in the cluster without using an aggregation technology, the failure of one
public network adapter on a node does not result in automatic VIP failover to the other public network adapter.

4.1.7 Deconfigure DNS Registration for Public Network Adapter

Due to a change in functionality in the Windows Server 2008 operating system, the DNS client service registers all of the network connections of a computer in DNS. In previous versions of Windows Server, only the DNS client service registered only the primary, or first, network adapter IP address in DNS.

To prevent Windows Server 2008 from potentially registering the wrong IP addresses for the node in DNS after a server restart, you must deconfigure the "Register this connection's addresses in DNS" option for the public network adapters. Use the following steps to perform this task:

1. Start the Windows Server Manager application.
2. Select View Network Connections.
3. Right-click the network adapter that provides the Public network interface and select Properties.
5. Click Properties.
7. Select the DNS tab.
8. Unselect Register this connection's addresses in DNS.

**Note:** If you configure this setting in IPv4, then Windows automatically configures the same setting for IPv6.

5. Click Properties.
7. Select the DNS tab.
8. Unselect Register this connection's addresses in DNS.

**See Also:** "Best Practices Analyzer for Domain Name System: Configuration" on Microsoft Technet, specifically http://technet.microsoft.com/en-us/library/ff807401(v=ws.10).aspx

4.1.8 Disabling Windows Media Sensing

Windows Media Sensing must be disabled for the private network adapters.

To disable Windows Media Sensing for TCP/IP, you must set the value of the DisableDHCPMediaSense parameter to 1 on each node. Because you must modify the Windows registry to disable Media Sensing, you should first backup the registry and confirm that you can restore it, using the methods described in your Windows documentation.

Disable Media Sensing by completing the following steps on each node of your cluster:

1. Backup the Windows registry.
2. Use Registry Editor to view the following key in the registry:

   HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Tcpip\Parameters

3. Add a new DWORD value to the Parameters subkey:

   Value Name: DisableDHCPMediaSense
Oracle Grid Infrastructure IP Name and Address Requirements

4. Exit the Registry Editor and restart the computer.

4.1.9 Setting the Bind Order for Network Adapters
In Windows Networking Properties, the public network connection on each node must be listed first in the bind order (the order in which network services access the node). The private network connection should be listed second.

To ensure that your public adapter is first in the bind order, follow these steps:
1. Right click My Network Places and choose Properties.
2. In the Advanced menu, click Advanced Settings.
3. If the public network connection name is not the first name listed under the Adapters and Bindings tab, then select it and click the arrow to move it to the top of the list.
4. Click OK to save the settings and then exit the network setup dialog.

The names used for each class of network adapter (such as public) must be consistent across all nodes. You can use nondefault names for the network adapter, for example, PublicLAN, if the same names are used for the same class of network adapters on each node in the network.

4.1.10 Verify Privileges for Copying Files in the Cluster
During installation, OUI copies the software from the local node to the remote nodes in the cluster. Verify that you have Administrator privileges on the other nodes in the cluster by running the following command on each node, where nodename is the name of the remote node:

```bash
net use \nodename\C$
```

If your system does not use the net share shown in the above example, then you can remove the unused net share using the following command:

```bash
net use \nodename\C$ /delete
```

4.1.11 Network Interface Configuration Options for Performance
The precise configuration you choose for your network depends on the size and use of the cluster you want to configure, and the level of availability you require.

If you access Oracle ASM remotely, or a certified Network-attached Storage (NAS) is used for Oracle RAC and this storage is connected through Ethernet-based networks, then you must have a third network interface for data communications. Failing to provide three separate network interfaces in this case can cause performance and stability problems under heavy system loads.

4.2 Oracle Grid Infrastructure IP Name and Address Requirements
For small clusters, you can use a static configuration of IP addresses. For large clusters, manually maintaining the large number of required IP addresses becomes too cumbersome. The Oracle Grid Naming Service (GNS) is used with large clusters to ease network administration costs.
This section contains the following topics:

- About Oracle Grid Infrastructure Name Resolution Options
- Cluster Name and SCAN Requirements
- IP Name and Address Requirements For Standard Grid Naming Service (GNS)
- IP Name and Address Requirements For Multi-Cluster GNS
- Grid Naming Service for a Traditional Cluster Configuration Example
- Configuring DNS for Domain Delegation to Grid Naming Service
- IP Address Requirements for Manual Configuration
- Manual IP Address Configuration Example

### 4.2.1 About Oracle Grid Infrastructure Name Resolution Options

Before starting the installation, you must have at least two interfaces configured on each node: One for the private IP address and one for the public IP address.

You can configure IP addresses for Oracle Grid Infrastructure and Oracle RAC with one of the following options:

- **Dynamic IP address assignment using Multi-cluster or standard Oracle Grid Naming Service (GNS).** If you select this option, then network administrators delegate a subdomain to be resolved by GNS (standard or multicluster). Requirements for GNS are different depending on whether you choose to configure GNS with zone delegation (resolution of a domain delegated to GNS), or without zone delegation (a GNS virtual IP address without domain delegation):
  - **For GNS with zone delegation:**
    - For IPv4, a DHCP service running on the public network the cluster uses
    - For IPv6, an autoconfiguration service running on the public network the cluster uses
    - Enough DHCP addresses to provide 1 IP address for each node, and 3 IP addresses for the cluster used by the Single Client Access Name (SCAN) for the cluster
  - **For GNS without zone delegation:**
    Configure a GNS virtual IP address (VIP) for the cluster.

- **Use an existing GNS configuration.** Starting with Oracle Grid Infrastructure12c Release 1 (12.1), a single GNS instance can be used by multiple clusters. To use GNS for multiple clusters, the DNS administrator must have delegated a zone for use by GNS. Also, there must be an instance of GNS started somewhere on the network and the GNS instance must be accessible (not blocked by a firewall). All of the node names registered with the GNS instance must be unique.

- **Static IP address assignment using DNS or host file resolution.** If you select this option, then network administrators assign a fixed IP address for each physical host name in the cluster and for IPs for the Oracle Clusterware managed VIPs. In addition, domain name system (DNS)-based static name resolution is used for each node, or host files for both the clusters and clients have to be updated, and SCAN functionality is limited. Selecting this option requires that you request network administration updates when you modify the cluster.
For clusters using single interfaces for private networks, each node’s private interface for interconnects must be on the same subnet, and that subnet must connect to every node of the cluster. For example, if the private interfaces have a subnet mask of 255.255.255.0, then your private network is in the range 192.168.0.0--192.168.0.255, and your private addresses must be in the range of 192.168.0.[0-255]. If the private interfaces have a subnet mask of 255.255.0.0, then your private addresses can be in the range of 192.168.[0-255].[0-255].

For clusters using Redundant Interconnect usage, each private interface can be on a different subnet. However, each cluster member node must have an interface on each private interconnect subnet, and these subnets must connect to every node of the cluster. For example, you can have private networks on subnets 192.168.0 and 10.0.0, but each cluster member node must have an interface connected to the 192.168.0 and 10.0.0 subnets.

4.2.2 Cluster Name and SCAN Requirements

The cluster name must be unique across your enterprise, must be at least one character long and no more than 15 characters in length, must be alphanumeric, cannot begin with a numeral, and may contain hyphens (-). Underscore characters (_) are not allowed.

If you configure a Standard cluster, and choose a Typical install, then the SCAN is also the name of the cluster. In that case, the SCAN must meet the requirements for a cluster name. The SCAN can be no longer than 15 characters.

In an Advanced installation, the SCAN and cluster name are entered in separate fields during installation, so cluster name requirements do not apply to the name used for the SCAN. The SCAN can be longer than 15 characters. If you enter a domain with the SCAN name, and you want to use GNS with zone delegation, then the domain must be the GNS domain.

Note: Select your name carefully. After installation, you can only change the cluster name by reinstalling Oracle Grid Infrastructure.

4.2.3 IP Name and Address Requirements For Standard Grid Naming Service (GNS)

If you enable standard Grid Naming Service (GNS), then name resolution requests to the cluster are delegated to the GNS, which listens on the GNS VIP address. You define this address in the DNS domain before installation. The DNS must be configured to delegate resolution requests for cluster names (any names in the subdomain delegated to the cluster) to the GNS. When a request comes to the domain, GNS processes the requests and responds with the appropriate addresses for the name requested.

To use GNS, before installation the DNS administrator must establish DNS Lookup to direct DNS resolution of a subdomain to the cluster. If you enable GNS, then you must
have a DHCP server on the public network that allows the cluster to dynamically allocate the VIP addresses as required by the cluster.

---

**Note:** You cannot use GNS with another multicast DNS. To use GNS, disable any third party mDNS daemons on your system.

---

**See Also:** Section 4.2.8.2, "Configuring DNS for Domain Delegation to Grid Naming Service" for information on how to configure DNS delegation

### 4.2.4 IP Name and Address Requirements For Multi-Cluster GNS

Review the following requirements for using Multi-cluster GNS:

- **About Multi-Cluster GNS Networks**
- **Configuring GNS Server Clusters**
- **Configuring GNS Client Clusters**
- **Creating and Using a GNS Client Data File**

#### 4.2.4.1 About Multi-Cluster GNS Networks

The general requirements for Multi-cluster GNS are similar to those for standard GNS. Multi-cluster GNS differs from standard GNS in that Multi-cluster GNS provides a single networking service across a set of clusters, rather than a networking service for a single cluster.

To provide networking service, Multi-cluster GNS is configured using DHCP addresses, and name advertisement and resolution is carried out with the following components:

- **The GNS Server cluster** performs address resolution for GNS Client clusters. A GNS Server cluster is the cluster where Multi-cluster GNS runs, and where name resolution takes place for the subdomain delegated to the set of clusters.

- **GNS Client clusters** receive address resolution from the GNS Server cluster. A GNS Client cluster is a cluster that advertises its cluster member node names using the GNS Server cluster.

#### 4.2.4.2 Configuring GNS Server Clusters

To use this option, your network administrators must have delegated a subdomain to GNS for resolution.

Before installation, create a static IP address for the GNS VIP address, and provide a subdomain that your DNS servers delegate to that static GNS IP address for resolution.

#### 4.2.4.3 Configuring GNS Client Clusters

To configure a GNS Client cluster, check to ensure all of the following requirements are completed:

- A GNS Server instance must be running on your network, and it must be accessible (for example, not blocked by a firewall)

- All of the node names in the GNS domain must be unique; address ranges and cluster names must be unique for both GNS Server and GNS Client clusters.
■ You must have a GNS Client data file that you generated on the GNS Server cluster, so that the GNS Client cluster has the information needed to delegate its name resolution to the GNS Server cluster, and you must have copied that file to the GNS Client cluster member node on which you run the Oracle Grid Infrastructure installation.

4.2.4.4 Creating and Using a GNS Client Data File

On a GNS Server cluster member, run the following command, where path_to_file is the name and path location of the GNS Client data file you create:

```
srvctl export gns -clientdata path_to_file
```

For example:

```
C:\> srvctl export gns -clientdata C:\Users\grid\gns_client_data
```

Copy the GNS Client data file to a secure path on the GNS Client node where you run the GNS Client cluster installation. The Oracle Installation user must have permissions to access that file. Oracle recommends that no other user is granted permissions to access the GNS Client data file. During installation, you are prompted to provide a path to that file.

After you have completed the GNS Client cluster installation, you must run the following command on one of the GNS Server cluster members to start GNS service, where path_to_file is the name and path location of the GNS Client data file:

```
srvctl add gns -clientdata path_to_file
```

For example:

```
C:\> srvctl add gns -clientdata C:\Users\grid\gns_client_data
```

---

See Also: Oracle Clusterware Administration and Deployment Guide for more information about GNS Server and GNS Client administration

4.2.5 IP Address Requirements for Manual Configuration

If you do not enable GNS, then the public and VIP addresses for each node must be static IP addresses. Public, VIP and SCAN addresses must be on the same subnet.

IP addresses on the subnet you identify as private are assigned as private IP addresses for cluster member nodes. Oracle Clusterware manages private IP addresses in the private subnet. You do not have to configure these addresses manually in a hosts file.

The cluster must have the following addresses configured:

■ A public IP address for each node configured before installation, and resolvable to that node before installation
■ A VIP address for each node configured before installation, but not currently in use
■ Three static IP addresses configured on the domain name server (DNS) before installation so that the three IP addresses are associated with the name provided as the SCAN, and all three addresses are returned in random order by the DNS to the requestor. These addresses must be configured before installation in the DNS to resolve to addresses that are not currently in use. The SCAN name must meet the requirements specified in Section 4.2.2, "Cluster Name and SCAN Requirements."
A private IP address for each node configured before installation, but on a separate, private network, with its own subnet. The IP address should not be resolvable except by other cluster member nodes.

A set of one or more networks over which Oracle ASM serves its clients. The ASM network does not have to be a physical network; it can be a virtual network. The ASM network must use either a third NIC, or share a private network adapter. The NIC can be a virtual NIC.

---

**Note:** Oracle strongly recommends that you do not configure SCAN VIP addresses in the `hosts` file. Use DNS resolution for SCAN VIPs. If you use the `hosts` file to resolve SCANs, then you will only be able to resolve to one IP address and you will have only one SCAN address.

Configuring SCANs in a DNS or a `hosts` file is the only supported configuration. Configuring SCANs in a Network Information Service (NIS) is not supported.

---

**See Also:** Section C.1.6, "Understanding Network Addresses" for more information about network addresses.

### 4.2.6 Confirming the DNS Configuration for SCAN

You can use the `nslookup` command to confirm that the DNS is correctly associating the SCAN with the addresses. For example:

```
C:\> nslookup mycluster-scan
Server:         dns3.example.com
Address:        192.0.2.001
Name:   mycluster-scan.example.com
Address: 192.0.2.201
Name:   mycluster-scan.example.com
Address: 192.0.2.202
Name:   mycluster-scan.example.com
Address: 192.0.2.203
```

After installation, when a client sends a request to the cluster, the Oracle Clusterware SCAN listeners redirect client requests to servers in the cluster.

### 4.2.7 Grid Naming Service for a Traditional Cluster Configuration Example

To use GNS, you must specify a static IP address for the GNS VIP address, and you must have a subdomain configured on your domain name servers (DNS) to delegate resolution for that subdomain to the static GNS IP address.

As nodes are added to the cluster, your organization’s DHCP server can provide addresses for these nodes dynamically. These addresses are then registered automatically in GNS, and GNS provides resolution within the subdomain to cluster node addresses registered with GNS.

Because allocation and configuration of addresses is performed automatically with GNS, no further configuration is required. Oracle Clusterware provides dynamic network configuration as nodes are added to or removed from the cluster. The following example is provided only for information.

Assuming a two node cluster where you have defined the GNS VIP, after installation you might have a configuration similar to that shown in Table 4–1, where the cluster
name is mycluster, the GNS parent domain is gns.example.com, the subdomain is cluster01.example.com, the 192.0.2 portion of the IP addresses represents the cluster public IP address subdomain, and 192.168.0 represents the private IP address subdomain.

4.2.8 Domain Delegation to Grid Naming Service

If you are configuring Grid Naming Service (GNS) for a standard cluster, then before installing Oracle Grid Infrastructure you must configure DNS to send to GNS any name resolution requests for the subdomain served by GNS. The subdomain that GNS serves represents the cluster member nodes.

4.2.8.1 Choosing a Subdomain Name for Use with Grid Naming Service

To implement GNS, your network administrator must configure the DNS to set up a domain for the cluster, and delegate resolution of that domain to the GNS VIP. You can use a separate domain, or you can create a subdomain of an existing domain for the cluster. The subdomain name, can be any supported DNS name such as sales-cluster.rac.com.

Oracle recommends that the subdomain name be distinct from your corporate domain. For example, if your corporate domain is mycorp.example.com, the subdomain for GNS might be rac-gns.com.

Table 4–1  Example of a Grid Naming Service Network Configuration

<table>
<thead>
<tr>
<th>Identity</th>
<th>Home Node</th>
<th>Host Node</th>
<th>Given Name</th>
<th>Type</th>
<th>Address</th>
<th>Address Assigned By</th>
<th>Resolved By</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNS VIP</td>
<td>None</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-gns-vip.example.com</td>
<td>Virtual</td>
<td>192.0.2.1</td>
<td>Fixed by network administrator</td>
<td>DNS</td>
</tr>
<tr>
<td>Node 1 Public</td>
<td>Node 1</td>
<td>node1</td>
<td>node1</td>
<td>Public</td>
<td>192.0.2.101</td>
<td>Fixed</td>
<td>GNS</td>
</tr>
<tr>
<td>Node 1 VIP</td>
<td>Node 1</td>
<td>Selected by Oracle Clusterware</td>
<td>node1-vip</td>
<td>Virtual</td>
<td>192.0.2.104</td>
<td>DHCP</td>
<td>GNS</td>
</tr>
<tr>
<td>Node 1 Private</td>
<td>Node 1</td>
<td>node1</td>
<td>node1-priv</td>
<td>Private</td>
<td>192.168.0.1</td>
<td>Fixed or DHCP</td>
<td>GNS</td>
</tr>
<tr>
<td>Node 2 Public</td>
<td>Node 2</td>
<td>node2</td>
<td>node2</td>
<td>Public</td>
<td>192.0.2.102</td>
<td>Fixed</td>
<td>GNS</td>
</tr>
<tr>
<td>Node 2 VIP</td>
<td>Node 2</td>
<td>Selected by Oracle Clusterware</td>
<td>node2-vip</td>
<td>Virtual</td>
<td>192.0.2.105</td>
<td>DHCP</td>
<td>GNS</td>
</tr>
<tr>
<td>Node 2 Private</td>
<td>Node 2</td>
<td>node2</td>
<td>node2-priv</td>
<td>Private</td>
<td>192.168.0.2</td>
<td>Fixed or DHCP</td>
<td>GNS</td>
</tr>
<tr>
<td>SCAN VIP 1</td>
<td>none</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-scan.cluster01.example.com</td>
<td>Virtual</td>
<td>192.0.2.201</td>
<td>DHCP</td>
<td>GNS</td>
</tr>
<tr>
<td>SCAN VIP 2</td>
<td>none</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-scan.cluster01.example.com</td>
<td>Virtual</td>
<td>192.0.2.202</td>
<td>DHCP</td>
<td>GNS</td>
</tr>
<tr>
<td>SCAN VIP 3</td>
<td>none</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-scan.cluster01.example.com</td>
<td>Virtual</td>
<td>192.0.2.203</td>
<td>DHCP</td>
<td>GNS</td>
</tr>
</tbody>
</table>

1  Node host names may resolve to multiple addresses, including VIP addresses currently running on that host.
If the subdomain is not distinct, then it should be for the exclusive use of GNS. For example, if you delegate the subdomain `mydomain.example.com` to GNS, then there should be no other domains that share it such as `lab1.mydomain.example.com`.

**See Also:**
- *Oracle Clusterware Administration and Deployment Guide* for more information about GNS
- Section 4.2.2, "Cluster Name and SCAN Requirements" for information about choosing network identification names

### 4.2.8.2 Configuring DNS for Domain Delegation to Grid Naming Service

You must configure the DNS to send GNS name resolution requests using DNS forwarders. If the DNS server is running on a Windows server that you administer, then the following steps must be performed to configure DNS:

1. Click **Start**, then select **Programs**. Select **Administrative Tools** and then click **DNS manager**. The DNS server configuration wizard starts automatically.

2. Use the wizard to create an entry for the GNS virtual IP address, where the address is a valid DNS name. For example, if the cluster name is `mycluster`, and the domain name is `example.com`, and the IP address is `192.0.2.1`, you could create an entry similar to the following:

   `mycluster-gns-vip.example.com: 192.0.2.1`

   The address you provide must be routable.

3. To configure DNS forwarders, click **Start**, select **Administrative Tools**, and then select **DNS**.

4. Right-click **ServerName**, where **ServerName** is the name of the server, and then click the **Forwarders** tab.

5. Click **New**, then type the name of the DNS domain for which you want to forward queries in the DNS domain box, for example, `clusterdomain.example.com`. Click **OK**.

6. In the selected domain’s forwarder IP address box, type the GNS VIP address, and then click **Add**.

7. Click **OK** to exit.

If the DNS server is running on a different operating system, then refer to the *Oracle Grid Infrastructure Installation Guide* for that platform, or your operating system documentation.
4.2.9 Manual IP Address Configuration Example

If you choose not to use GNS, then before installation you must configure public, virtual, and private IP addresses. Also, check that the default gateway can be accessed by a ping command. To find the default gateway, use the ipconfig command, as described in your operating system's help utility.

For example, with a two node cluster where the cluster name is mycluster, and each node has one public and one private interface, and you have defined a SCAN domain address to resolve on your DNS to one of three IP addresses, you might have the configuration shown in Table 4–2 for your network interfaces.

### Table 4–2 Manual Network Configuration Example

<table>
<thead>
<tr>
<th>Identity</th>
<th>Home Node</th>
<th>Host Node</th>
<th>Given Name</th>
<th>Type</th>
<th>Address</th>
<th>Address Assigned By</th>
<th>Resolved By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node 1 Public</td>
<td>Node 1</td>
<td>node1</td>
<td>node1¹</td>
<td>Public</td>
<td>192.0.2.101</td>
<td>Fixed</td>
<td>DNS</td>
</tr>
<tr>
<td>Node 1 VIP</td>
<td>Node 1</td>
<td>Selected by Oracle Clusterware</td>
<td>node1-vip</td>
<td>Virtual</td>
<td>192.0.2.104</td>
<td>Fixed</td>
<td>DNS, hosts file</td>
</tr>
<tr>
<td>Node 1 Private</td>
<td>Node 1</td>
<td>node1</td>
<td>node1-priv</td>
<td>Private</td>
<td>192.168.0.1</td>
<td>Fixed</td>
<td>DNS, hosts file, or none</td>
</tr>
<tr>
<td>Node 2 Public</td>
<td>Node 2</td>
<td>node2</td>
<td>node2¹</td>
<td>Public</td>
<td>192.0.2.102</td>
<td>Fixed</td>
<td>DNS</td>
</tr>
<tr>
<td>Node 2 VIP</td>
<td>Node 2</td>
<td>Selected by Oracle Clusterware</td>
<td>node2-vip</td>
<td>Virtual</td>
<td>192.0.2.105</td>
<td>Fixed</td>
<td>DNS, hosts file</td>
</tr>
<tr>
<td>Node 2 Private</td>
<td>Node 2</td>
<td>node2</td>
<td>node2-priv</td>
<td>Private</td>
<td>192.168.0.2</td>
<td>Fixed</td>
<td>DNS, hosts file, or none</td>
</tr>
<tr>
<td>SCAN VIP 1</td>
<td>none</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-scan</td>
<td>Virtual</td>
<td>192.0.2.201</td>
<td>Fixed</td>
<td>DNS</td>
</tr>
<tr>
<td>SCAN VIP 2</td>
<td>none</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-scan</td>
<td>Virtual</td>
<td>192.0.2.202</td>
<td>Fixed</td>
<td>DNS</td>
</tr>
<tr>
<td>SCAN VIP 3</td>
<td>none</td>
<td>Selected by Oracle Clusterware</td>
<td>mycluster-scan</td>
<td>Virtual</td>
<td>192.0.2.203</td>
<td>Fixed</td>
<td>DNS</td>
</tr>
</tbody>
</table>

¹ Node host names may resolve to multiple addresses.

You do not have to provide a private name for the interconnect. If you want name resolution for the interconnect, then you can configure private IP names in the system hosts file or DNS. However, Oracle Clusterware assigns interconnect addresses on the interface defined during installation as the private interface (Local Area Connection 2, for example), and to the subnet used for the private subnet.
The addresses to which the SCAN resolves are assigned by Oracle Clusterware, so they are not fixed to a particular node. To enable VIP failover, the configuration shown in Table 4-2 defines the SCAN addresses and the public and VIP addresses of both nodes on the same subnet, 192.0.2.

---

**Note:** All host names must conform to the Internet Engineering Task Force RFC 952 standard, which permits alphanumeric characters. Host names using underscores ("_") are not allowed.

---

### 4.3 Intended Use of Network Adapters

During installation, you are asked to identify the planned use for each network adapter (or network interface) that Oracle Universal Installer (OUI) detects on your cluster node. Each NIC performs only one of the following roles:

- **Public**
- **Private**
- **Do Not Use**

You must use the same private adapters for both Oracle Clusterware and Oracle RAC. The precise configuration you choose for your network depends on the size and use of the cluster you want to configure, and the level of availability you require. Network interfaces must be at least 1 GbE.

For network adapters that you plan to use for other purposes—for example, an adapter dedicated to a non-Oracle network file system—you must identify those network adapters as "do not use" adapters so that Oracle Clusterware ignores them.

If certified Network-attached Storage (NAS) is used for Oracle RAC and this storage is connected through Ethernet-based networks, then you must have a third network interface for NAS I/O. Failing to provide three separate interfaces in this case can cause performance and stability problems under load.

Redundant interconnect usage cannot protect network adapters used for public communication. If you require high availability or load balancing for public adapters, then use a third party solution. Typically, bonding, trunking or similar technologies can be used for this purpose.

You can enable redundant interconnect usage for the private network by selecting multiple network adapters to use as private adapters. Redundant interconnect usage creates a redundant interconnect when you identify more than one network adapter as private.

### 4.4 Broadcast Requirements for Networks Used by Oracle Grid Infrastructure

Broadcast communications (address resolution protocol (ARP) must work properly across all the public and private interfaces configured for use by Oracle Grid Infrastructure. The broadcast communications must work across any configured virtual local area networks (VLANs) that the public or private network interfaces uses.

**See Also:** Section 8.1.2, "Configure the Oracle ARP Driver"
4.5 Multicast Requirements for Networks Used by Oracle Grid Infrastructure

On each cluster member node the Oracle multicast DNS (mDNS) daemon uses multicasting on all network interfaces to communicate with other nodes in the cluster. Multicasting is required on the private interconnect. For this reason, at a minimum, you must enable multicasting for the cluster for the following:

- Across the broadcast domain as defined for the private interconnect
- On the IP address subnet ranges 224.0.0.0/24 and 230.0.1.0/24

You do not need to enable multicast communications across routers.
This chapter describes the users, groups and environment settings used during Oracle Grid Infrastructure for a Cluster and Oracle Real Application Clusters installations.

This chapter contains the following topics:

- Creating Groups and Users for Oracle Grid Infrastructure and Oracle RAC
- Configuring User Accounts
- Creating Oracle Software Directories
- Enabling Intelligent Platform Management Interface (IPMI)

5.1 Creating Groups and Users for Oracle Grid Infrastructure and Oracle RAC

Log in as an Administrator user, and use the following instructions to create the Oracle Installation user for Oracle Grid Infrastructure:

- About the Oracle Installation User
- About the Oracle Home User for the Oracle Grid Infrastructure Installation
- About the Oracle Home User for the Oracle RAC Installation
- When to Create an Oracle Home User
- Oracle Home User Configurations for Oracle Installations
- Understanding the Oracle Inventory Directory and the Oracle Inventory Group
- Operating System Groups Created During Installation
- Operating System Groups and Users for Job Role Separation
- Example of Using Role-Allocated Groups and Users

Note: During an Oracle Grid Infrastructure installation, both Oracle Clusterware and Oracle Automatic Storage Management (Oracle ASM) are installed. You no longer can have separate Oracle Clusterware installation owners and Oracle ASM installation owners.
5.1.1 About the Oracle Installation User

To install the Oracle Grid Infrastructure or Oracle Database software, you must use either a local or domain user that is a member of the Administrators group. This user is the Oracle Installation User. If you use a local user account for installing Oracle Grid Infrastructure, then the user account must exist on all nodes in the cluster and the user name and password must be the same on all nodes. However, if you use a local user to install Oracle Grid Infrastructure, OUI displays a warning message.

The domain user must be explicitly declared as a member of the local Administrators group on each node in the cluster. It is not sufficient if the domain user has inherited membership from another group. Also, the user performing the installation must be in the same domain on each node. For example, you cannot have use the DBADMIN\dba1 user on the first node and the RACDBA\dba1 user on the second node.

5.1.2 About the Oracle Home User for the Oracle Grid Infrastructure Installation

During installation of Oracle Grid Infrastructure, you can specify an optional Oracle Home user associated with the Oracle Grid home. For example, assume that you use an Administrator user named OraSys to install the software (Oracle Installation user), then you can specify the ORADOMAIN\OraGrid domain user as the Oracle Home user for this installation. The specified Oracle Home domain user must exist before you install the Oracle Grid Infrastructure software.

If you choose to use an Oracle Home user for your Oracle Grid Infrastructure installation, then the Windows User Account you specify must be a domain user. When you use an Oracle Home User, a secure wallet in Oracle Cluster Registry (created automatically) stores the Oracle Home User name and password information. If you decide not to create an Oracle Home user, then the Windows built-in account is used as Oracle Home User.

**Note:** You cannot change the Oracle Home User after the installation is complete. If you must change the Oracle Home User, then you must reinstall the Oracle Grid Infrastructure software.

If you choose the Oracle Grid Infrastructure Management Repository option during installation, then use of an Oracle Home user is mandatory. Similarly, if you perform a software-only installation of Oracle Grid Infrastructure, then you must choose a Windows Domain User account to configure the Oracle Grid Infrastructure Management Repository after installation.

During installation, the installer creates the software services and configures the Access Control Lists (ACLs) based on the information you provided about the Oracle Home User. See the section "About File Permissions" in Oracle Database Platform Guide for Microsoft Windows for more information.

**See Also:** Oracle Database Platform Guide for Microsoft Windows for more information about the Oracle Home User and how database services run in this user account

5.1.3 About the Oracle Home User for the Oracle RAC Installation

During installation of Oracle RAC, you can either use a Windows built-in account or specify an optional, non-Administrator user that is a Windows domain user to be the Oracle Home User associated with the Oracle RAC home. The Oracle Home User for Oracle RAC can be different from the Oracle Home User you specified during the
Oracle Grid Infrastructure installation. If a Windows domain user account is chosen, then it should be an existing domain user account with no administration privileges.

For Oracle RAC installations, Oracle recommends that you use a Windows domain user (instead of Windows built-in account) as the Oracle Home User for enhanced security.

The services created for the Oracle RAC software run using the privileges of the Oracle Home User for Oracle RAC, or the Local System built-in Windows account if you did not specify an Oracle Home User during installation. OUI creates the ORA_DBA group on all nodes and the user performing the installation is automatically added to this group. For more information about the Oracle Home User implementation for Oracle Database, see Oracle Database Platform Guide for Microsoft Windows.

For an administrator-managed database, you have the option of storing Oracle Home User password in a secure wallet (stored in Oracle Cluster Registry). Use the following CRSCTL command to create this secure wallet for storing the Windows operating system user name and password:

```
crsctl add wallet -osuser -passwd
```

If the wallet (stored in Oracle Cluster Registry) exists, then Oracle administration tools automatically use the password from the wallet without prompting the administrator to enter the password of Oracle Home User for performing administrative operations.

A policy-managed database mandates the storage of Oracle Home User password in the wallet (stored in Oracle Cluster Registry). When a policy-managed database is created, DBCA automatically creates the wallet, if one does not exist.

---

Note: If you choose to use an Oracle Home user for your Oracle RAC installation, then the Windows User Account you specify must be a domain user.

---

5.1.4 When to Create an Oracle Home User

You must create an Oracle Home User in the following circumstances:

- If an Oracle Home User exists, but you want to use a different operating system user, with different group membership, to give database administrative privileges to those groups in a new Oracle Database installation
- If you have created an Oracle Home User for Oracle Grid Infrastructure, such as grid, and you want to create a separate Oracle Home User for Oracle Database software, such as oracle
- If you choose the option to install and configure the Grid Management Repository during the Oracle Grid Infrastructure installation

5.1.4.1 Restrictions and Guidelines for Oracle Home Users

Review the following restrictions and guidelines for Oracle Home Users for Oracle software installations:

- If you intend to use multiple Oracle Home Users for different Oracle Database homes, then Oracle recommends that you create a separate Oracle Home User for Oracle Grid Infrastructure software (Oracle Clusterware and Oracle ASM).
- If you plan to install Oracle Database or Oracle RAC, then Oracle recommends that you create separate Oracle Home Users for the Oracle Grid Infrastructure and the Oracle Database installations. If you use one Oracle Home User, then when
you want to perform administration tasks, you must select the utilities from the 
%ORACLE_HOME% for the instance you want to administer (Oracle ASM, in the Oracle Grid Infrastructure home, or the database in the Oracle home), or change the 
default %ORACLE_HOME% value to the location of the Oracle Home from which the instance runs.

- If you try to administer an Oracle home or Grid home instance using sqlplus, 
  lsnrctl, or asmcmd commands while the environment variable %ORACLE_HOME% is 
  set to a different Oracle home or Grid home path, then you encounter errors. For 
  example, when you start SRVCTL from a database home, %ORACLE_HOME% should 
  be set to that database home, or SRVCTL fails. The exception is when you are 
  using SRVCTL in the Oracle Grid Infrastructure home. In that case, SRVTCL 
  ignores %ORACLE_HOME%, and the Oracle home environment variable does not affect 
  SRVCTL commands. In all other cases, using the Start menu, you must start the 
  utilities from the %ORACLE_HOME% of the instance that you want to administer, or set 
  the value of %ORACLE_HOME% to the correct Oracle home path before starting the 
  utility.

5.1.4.2 Determining if an Oracle Home User Exists

To determine whether an Oracle Home user named oracle or grid exists, do the 
following:

1. Open the Control Panel window.
2. Select User Accounts.
3. Select Manage User Accounts. Scroll through the list of names until you find the 
   ones you are looking for. If the names do not appear in the list, then the user has 
   not yet been created.

You must decide to use an existing user, or create a new user. See one of the following 
sections for more information:

- Creating an Oracle Home User
- Using an Existing Oracle Software Owner User

5.1.4.3 Creating an Oracle Home User

Use the Manage User Accounts window to create a new user.

1. Open the Control Panel window.
2. Select User Accounts.
3. Select Manage User Accounts.

The user must not be a member of the Administrators group. If you creating an Oracle 
Home User for an Oracle RAC installation, then the user must be a Windows domain 
user, and the user must be a member of the same domain on each node in the cluster.

See Also:  Oracle Database Platform Guide for Microsoft Windows for 
information about the Oracle Home User Control utility

5.1.4.4 Using an Existing Oracle Software Owner User

If the user you have decided to use as an Oracle Home user exists, then you can use 
this user as the Oracle Home user for a different installation. During the software 
installation, OUI creates the appropriate group memberships.

Oracle does not support changing the ownership of an existing Oracle Database home 
from one Oracle Home user to a different user.
5.1.5 Oracle Home User Configurations for Oracle Installations

When the Oracle software installation completes, you will have one of the following configurations:

<table>
<thead>
<tr>
<th>Installation Type</th>
<th>Oracle Home user configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Grid Infrastructure with the</td>
<td>The Oracle Home user owns the Oracle Grid Infrastructure Management Repository service. The other services are run under the built-in Administrator account, except for the listeners, which run as LocalService (a built-in Windows account).</td>
</tr>
<tr>
<td>Oracle Grid Infrastructure Management Repository option</td>
<td></td>
</tr>
<tr>
<td>Oracle Grid Infrastructure (without the</td>
<td>The Oracle Grid Infrastructure services are run under the built-in Administrator account, except for the listeners, which run as LocalService.</td>
</tr>
<tr>
<td>Oracle Grid Infrastructure Management Repository option</td>
<td></td>
</tr>
<tr>
<td>Oracle RAC with specified Oracle Home User</td>
<td>The Oracle Home User owns all the services run by the Oracle Database software.</td>
</tr>
<tr>
<td>Oracle RAC with Built-in Oracle Home user</td>
<td>The services run under the built-in LocalSystem account.</td>
</tr>
</tbody>
</table>

**Note:** You cannot change the Oracle Home User after installation to a different Oracle Home User. Only out-of-place upgrade or move allows the Oracle Home User to be changed to or from the built-in Windows account.

Thus, if you plan to configure the Oracle Grid Infrastructure Management Repository in the future, then specify an Oracle Home user (a domain user) during installation of Oracle Grid Infrastructure to avoid having to reconfigure the Oracle Home User at a later date.

5.1.6 Understanding the Oracle Inventory Directory and the Oracle Inventory Group

The location of the Oracle central inventory on Windows is always %SYSTEM_DRIVE%\Program Files\Oracle\Inventory. When you install Oracle software on the system for the first time, OUI creates the directories for the Oracle central inventory and the Oracle Inventory group, ORA_INSTALL. The ORA_INSTALL group contains all the Oracle Home users for all Oracle homes on the server.

Whether you are performing the first installation of Oracle software on this server, or are performing an installation of additional Oracle software on the server, you do not need to create the Oracle central inventory or the ORA_INSTALL group; the Oracle Universal Installer creates them automatically. You cannot change the name of the Oracle Inventory group - it is always ORA_INSTALL.

5.1.7 Operating System Groups Created During Installation

When you install either Oracle Grid Infrastructure or Oracle RAC, the user groups listed in Table 5–1 are created, if they do not already exist.
<table>
<thead>
<tr>
<th>Operating System Group Names</th>
<th>System Privileges</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORA_ASMADMIN</td>
<td>SYSASM system privileges for Oracle ASM administration</td>
<td>The OSASM group for the Oracle ASM instance. Using this group and the SYSASM system privileges enables the separation of SYSDBA database administration privileges from Oracle ASM storage administration privileges. Members of the OSASM group are authorized to connect using the SYSASM privilege and have full access to Oracle ASM, including administrative access to all disk groups that the Oracle ASM instance manages.</td>
</tr>
<tr>
<td>ORA_ASMDBA</td>
<td>SYSDBA system privileges on the Oracle ASM instance</td>
<td>The OSDBA group for the Oracle ASM instance. Members of this group are granted SYSDBA for ASM system privileges, which grant access to data stored on Oracle ASM disks. During installation, the Oracle Installation user is added to this group. After you create an Oracle Database, the database service ID of that database is added to this group to uniquely identify data files from that database.</td>
</tr>
<tr>
<td>ORA_ASMOPER</td>
<td>SYSOPER for ASM system privileges</td>
<td>The OSOPER group for the Oracle ASM instance. Members of this group are granted SYSOPER system privileges on the Oracle ASM instance, which permits a user to perform operations such as startup, shutdown, mount, dismount, and check disk group. This group has a subset of the privileges of the OSASM group. Similar to the ORA_HOMENAME_OPER group, this group does not have any members after installation, but you can manually add users to this group after the installation completes.</td>
</tr>
<tr>
<td>ORA_GRIDHM_DBADbA</td>
<td>SYSDBA system privileges for the Oracle Grid Infrastructure Management Repository database</td>
<td>Members of this group are granted the SYSDBA system privileges for managing the Oracle Grid Infrastructure Management Repository database, where GRIDHM is the name of the Oracle Grid Infrastructure home. The default home name is OraGrid12Home1, so the default group name is ORA_OraGrid12Home1_DBA.</td>
</tr>
<tr>
<td>ORA_GRIDHM_OPER</td>
<td>SYSOPER system privileges for the Oracle Grid Infrastructure Management Repository database</td>
<td>Members of this group are granted the SYSOPER system privileges for managing the Oracle Grid Infrastructure Management Repository database, where GRIDHM is the name of the Oracle Grid Infrastructure home. If you use the default Grid home name of OraGrid12Home1, then the default operating system group name is ORA_OraGrid12Home1_OPER.</td>
</tr>
<tr>
<td>ORA_DBA</td>
<td>SYSDBA system privileges for all Oracle Database installations on the server</td>
<td>A special OSDBA group for the Windows operating system. Members of this group are granted SYSDBA system privileges for all Oracle Databases installed on the server.</td>
</tr>
</tbody>
</table>
During installation, the `gridconfig.bat` script creates the services and groups on each node of the cluster. The installed files and permissions are owned by the Oracle Installation user, and require the Administrator privilege.

Oracle creates and populates the groups listed in Table 5–1 during installation to ensure proper operation of Oracle products. You can manually add other users to these groups to assign these database privileges to other Windows users.

### Table 5–1 (Cont.) Operating System Groups Created During Installation

<table>
<thead>
<tr>
<th>Operating System Group Names</th>
<th>System Privileges</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORA_OPER</td>
<td>SYSOPER system privileges for all Oracle databases installed on the server</td>
<td>A special OSOPER group for the Windows operating system. Members of this group are granted SYSOPER system privileges all Oracle Databases installed on the server. This group does not have any members after installation, but you can manually add users to this group after the installation completes.</td>
</tr>
<tr>
<td>ORA_HOMENAME_DBA</td>
<td>SYSDBA system privileges for all database instances that run from the Oracle home with the name <code>HOMENAME</code></td>
<td>An OSDBA group for a specific Oracle Home with a name of <code>HOMENAME</code>. Members of this group can use operating system authentication to gain SYSDBA system privileges for any database that runs from the specific Oracle home. If you specified an Oracle Home User during installation, the user is added to this group during installation.</td>
</tr>
<tr>
<td>ORA_HOMENAME_OPER</td>
<td>SYSOPER system privileges for all database instances that run from the Oracle home with the name <code>HOMENAME</code></td>
<td>An OSDBA group for the Oracle Home with a name of <code>HOMENAME</code>. Members of this group can use operating system authentication to gain SYSOPER system privileges for any database that runs from the specific Oracle home. This group does not have any members after installation, but you can manually add users to this group after the installation completes.</td>
</tr>
<tr>
<td>ORA_HOMENAME_SYSBACKUP</td>
<td>SYSBACKUP system privileges for all database instances that run from the Oracle home with a name of <code>HOMENAME</code></td>
<td>OSBACKUPDBA group for a specific Oracle Home with a name of <code>HOMENAME</code>. Members of this group have privileges necessary for performing database backup and recovery tasks on all database instances that run from the specified Oracle Home directory.</td>
</tr>
<tr>
<td>ORA_HOMENAME_SYSDG</td>
<td>SYSDG system privileges for all database instances that run from the Oracle home with a name of <code>HOMENAME</code></td>
<td>OSDGDBA group for a specific Oracle Home with a name of <code>HOMENAME</code>. Members of this group have privileges necessary for performing Data Guard administrative tasks on all database instances that run from the specified Oracle Home directory.</td>
</tr>
<tr>
<td>ORA_HOMENAME_SYSKM</td>
<td>SYSKM system privileges for all database instances that run from the Oracle home with a name of <code>HOMENAME</code></td>
<td>OSKMDBA group for a specific Oracle Home with a name of <code>HOMENAME</code>. Members of this group have privileges necessary for performing encryption key management tasks on all database instances that run from the specified Oracle Home directory.</td>
</tr>
</tbody>
</table>
Members of the ORA_DBA group can use operating system authentication to administer all Oracle databases installed on the server. Members of the ORA_HOMENAME_DBA, where HOMENAME is the name of a specific Oracle installation, can use operating system authentication to manage only the databases that run from that Oracle home.

See Also: Section C.1.5, "Understanding Operating System Groups and User Privileges" for more information about the available operating system groups and associated privileges.

5.1.8 Operating System Groups and Users for Job Role Separation

A job role separation configuration of Oracle Database and Oracle ASM is a configuration with groups and users to provide separate groups for operating system authentication.

This section contains the following topics:

- About Job Role Separation Operating System Privileges Groups and Users
- Oracle Software Owner for Each Oracle Software Product
- Standard Oracle Database Groups for Job Role Separation
- Extended Oracle Database Groups for Job Role Separation
- Oracle ASM Groups for Job Role Separation

5.1.8.1 About Job Role Separation Operating System Privileges Groups and Users

With Oracle Database job role separation, each Oracle Database installation has separate operating system groups to provide authentication for system privileges on that Oracle Database, so multiple databases can be installed on the cluster without sharing operating system authentication for system privileges. In addition, each Oracle software installation is associated with an Oracle Installation user, to provide operating system user authentication for modifications to Oracle Database binaries.

With Oracle Grid Infrastructure job role separation, Oracle ASM has separate operating system groups that provide operating system authentication for Oracle ASM system privileges for storage tier administration. This operating system authentication is separated from Oracle Database operating system authentication. In addition, the Oracle Grid Infrastructure Installation user provides operating system user authentication for modifications to Oracle Grid Infrastructure binaries.

During the Oracle Database installation, the OSDBA, OSOPER, OSBACKUPDBA, OSDGDBA and OSKMDBA groups are created and users assigned to these groups. Members of these groups are granted operating system authentication for the set of database system privileges each group authorizes. Oracle recommends that you use different operating system groups for each set of system privileges.

Note: This configuration is optional, to restrict user access to Oracle software by responsibility areas for different administrator users.

Note: To configure users for installation that are on a network directory service such as Network Information Services (NIS), refer to your directory service documentation.
5.1.8.2 Oracle Software Owner for Each Oracle Software Product

Oracle recommends that you use the following operating system groups and users for all installations where you specify separate Oracle Home Users:

**Separate Oracle Installation users for each Oracle software product** (typically, oracle, for the Oracle Database software, and grid for the Oracle Grid Infrastructure software.

You must create at least one Oracle Installation user the first time you install Oracle software on the system. This user owns the Oracle binaries of the Oracle Grid Infrastructure software, and you can also use this same user as the Oracle Installation user for the Oracle Database or Oracle RAC binaries.

The Oracle Installation user for Oracle Database software has full administrative privileges for Oracle instances and is added to the ORA_DBA, ORA_ASMDBA, ORA_HOMENAME_SYSBACKUP, ORA_HOMENAME_SYSDG, and ORA_HOMENAME_SYSKM groups. Oracle Home users are added to the ORA_HOMENAME_DBA group for the Oracle home created during the installation. The ORA_OPER and ORA_HOMENAME_OPER groups are created, but no users are added to these groups during installation.

See Also: *Oracle Database Security Guide* for more information about the available operating system groups and the privileges associated with each group

5.1.8.3 Standard Oracle Database Groups for Job Role Separation

The following is a list of operating system groups for Oracle Database. These groups provide operating system authentication for database administration system privileges:

- **OSDBA group (ORA_DBA)**

  The installation process creates this group the first time you install Oracle Database software on the system. This group identifies operating system user accounts that have database administrative privileges (the SYSDBA system privilege) for all database instances running on the server.

  Members of the ORA_DBA group do not have SYSASM system privilege on Oracle ASM instances, which are needed for mounting and dismounting disk groups.

- **OSOPER group for Oracle Database (ORA_OPER)**

  Use this group if you want a separate group of operating system users to have a limited set of database administrative privileges for starting up and shutting down the database (the SYSOPER system privilege).

- **OSDBA group for a particular Oracle home (ORA_HOMENAME_DBA)**

  This group is created the first time you install Oracle Database software into a new Oracle home. This group identifies operating system user accounts that have database administrative privileges (the SYSDBA system privilege) for the database instances that run from that Oracle home.

See Also: *Oracle Database Administrator’s Guide* for more information about planning for system privileges authentication

*Oracle Automatic Storage Management Administrator’s Guide* for more information about Oracle ASM operating system authentication

See Also: *Oracle Database Security Guide* for more information about the available operating system groups and the privileges associated with each group
- **OSOPER group for a particular Oracle home** *(ORA_HOMENAME_OPER)*

  Use this group if you want a separate group of operating system users to have a limited set of database administrative privileges for starting up and shutting down the database instances that run from a particular Oracle home (the SYSOPER system privilege).

### 5.1.8.4 Extended Oracle Database Groups for Job Role Separation

Starting with Oracle Database 12c Release 1 (12.1), in addition to the SYSOPER system privilege to start and shut down the database, you can create new administrative privileges that are more task-specific and less privileged than the ORA_DBA group (or SYSDBA system privilege) to support specific administrative privileges tasks required for everyday database operation. Users granted these system privileges are also authenticated through operating system group membership.

The installer automatically creates operating system groups whose members are granted these system privileges. The OSDBA subset job role separation privileges and groups consist of the following:

- **OSBACKUPDBA group for Oracle Database** *(ORA_HOMENAME_SYSBACKUP)*

  Assign users to this group if you want a separate group of operating system users to have a limited set of database backup and recovery related administrative privileges (the SYSBACKUP privilege).

- **OSDGDBA group for Oracle Data Guard** *(ORA_HOMENAME_SYSDG)*

  Assign users to this group if you want a separate group of operating system users to have a limited set of privileges to administer and monitor Oracle Data Guard (the SYSDG privilege).

- **OSKMDBA group for encryption key management** *(ORA_HOMENAME_SYSKM)*

  Assign users to this group if you want a separate group of operating system users to have a limited set of privileges for encryption key management such as Oracle Wallet Manager management (the SYSKM privilege).

  **See Also:** *Oracle Database Installation Guide for Microsoft Windows* for information about these groups.

### 5.1.8.5 Oracle ASM Groups for Job Role Separation

The SYSASM, SYSOPER for ASM, and SYSDBA for ASM system privileges enables the separation of the Oracle ASM storage administration privileges from SYSDBA.

During installation, the following groups are created for Oracle ASM:

- **OSASM Group for Oracle ASM Administration** *(ORA_ASMADMIN)*

  Use this separate group to have separate administration privilege groups for Oracle ASM and Oracle Database administrators. Members of this group are granted the SYSASM system privilege to administer Oracle ASM. In Oracle documentation, the operating system group whose members are granted privileges is called the OSASM group. During installation, the Oracle Installation User for Oracle Grid Infrastructure is configured as a member of this group.

  Members of the OSASM group can use SQL to connect to an Oracle ASM instance as SYSASM using operating system authentication. The SYSASM system privilege permits mounting and dismounting disk groups, and other storage administration tasks. SYSASM system privileges do not grant access privileges on an Oracle Database instance.
- **OSDBA for ASM Database Administrator group** *(ORA_ASMDBA)*
  Members of the ASM Database Administrator group (OSDBA for ASM) are granted read and write access to files managed by Oracle ASM. During installation, the Oracle Installation Users and Oracle Database Service IDs are configured as members of this group.

- **OSOPER for ASM Group for ASM Operators** *(ORA_ASMOPER)*
  This is an optional group. Use this group if you want a separate group of operating system users to have a limited set of Oracle ASM instance administrative privileges (the SYSOPER for ASM system privilege), including starting up and stopping the Oracle ASM instance. By default, members of the OSASM group also have all privileges granted by the SYSOPER for ASM system privilege.

  To use the Oracle ASM Operator group to create an Oracle ASM administrator with fewer privileges than those granted by the SYSASM system privilege you must assign the user to this group after installation.

### 5.1.9 Example of Using Role-Allocated Groups and Users

The following is an example of how to use role-allocated groups and users that is compliant with an Optimal Flexible Architecture (OFA) deployment.

**Assumptions:**
- The user installing the Oracle Grid Infrastructure software is named **RACDOMAIN\grid**. This user was created before starting the installation.
- An Oracle Home user is not specified during the Oracle Grid Infrastructure installation. The name of the home directory for the Oracle Grid Infrastructure installation is **OraGrid12c**.
- The user installing the Oracle RAC software is named **oracle**. This user was created before starting the installation.
- During installation of Oracle RAC, an Oracle Home user named **RACDOMAIN\oradba1** is specified. The oradba1 user is a Windows domain user that was created before the installation was started.
- The name of the Oracle home for this installation is **OraRAC12c_home1**.
- The Oracle Grid Infrastructure software is installed in the directory **C:\app\12.1.0\grid**. The base directory for the Oracle Grid Infrastructure installation is **C:\app\grid**. You did not select the option to create an Oracle Grid Infrastructure Management Repository database.
- The Oracle RAC software installation uses the base directory **C:\app\oracle**.
- You have a second, Oracle Database installation (not Oracle RAC) on this server. The installation was performed by the **oracle** user. The Oracle Home user is **oradba2**, and this user was not created before starting the installation.
- The Oracle Home name is **OraDB12c_home1**.
- Both the Oracle databases and Oracle Clusterware are configured to use Oracle ASM for data storage.

After installing the Oracle software, you have the following groups and users:
Configuring User Accounts

If there are no users listed for an operating system group, then that means the group has no members.

5.2 Configuring User Accounts

When installing Oracle Grid Infrastructure for a cluster, you run the installer software as an Administrator user. During installation, you can specify an Oracle Home user. Before starting the installation, there are a few checks you need to perform for the Oracle Installation users, to ensure the installation will succeed.

This section contains the following topics:

- Configuring Environment Variables for the Oracle Installation User
- Verifying User Privileges to Update Remote Nodes
- Managing User Accounts with User Account Control

5.2.1 Configuring Environment Variables for the Oracle Installation User

Before starting the Oracle Grid Infrastructure installation, ensure the %TEMP% environment variable is set correctly. See Section 2.1.6, "Checking the Available TEMP Disk Space".
5.2.2 Verifying User Privileges to Update Remote Nodes

Before running OUI, from the node where you intend to run the installer, verify that the user account you are using for the installation is configured as a member of the Administrators group on each node in the cluster. Enter the following command for each node that is a part of the cluster where `nodename` is the node name:

```
net use \nodename\C$
```

If you will be using other disk drives in addition to the C: drive, then repeat this command for every node in the cluster, substituting the drive letter for each drive you plan to use.

The installation user must also be able to update the Windows registry on each node in the cluster. To verify the installation user is configured, perform the following steps:

1. Run `regedit` from the Run menu or the command prompt.
2. From the File menu select Connect Network Registry.
3. In the ‘Enter the object name…‘ edit box enter the name of a remote node in the cluster, then click OK.

If the remote node does not appear in the registry tree or you are prompted to fill in a username and password, then you must resolve the permissions issue at the operating system level before proceeding with the Oracle Grid Infrastructure installation.

---

**Note:** For the installation to be successful, you must use the same user name and password on each node in a cluster or use a domain user. You must explicitly grant membership in the local Administrators group to domain users on all of the nodes in your cluster.

---

5.2.3 Managing User Accounts with User Account Control

To ensure that only trusted applications run on your computer, Windows Server 2008 and Windows Server 2008 R2 provide User Account Control. If you have enabled this security feature, then depending on how you have configured it, OUI prompts you for either your consent or your credentials when installing Oracle Database. Provide either the consent or your Windows Administrator credentials as appropriate.

You must have Administrator privileges to run some Oracle tools, such as DBCA, NETCA, and OPatch, or to run any tool or application that writes to any directory within the Oracle home. If User Account Control is enabled and you are logged in as the local Administrator, then you can successfully run each of these commands. However, if you are logged in as "a member of the Administrators group," then you must explicitly run these tools with Windows Administrator privileges.

All of the Oracle shortcuts that require Administrator privileges are automatically run as an "Administrator" user when you click the shortcuts. However, if you run the previously mentioned tools from a Windows command prompt, then you must run them from an Administrator command prompt. OPatch does not have a shortcut and must be run from an Administrator command prompt.
5.3 Creating Oracle Software Directories

During installation, you are prompted to provide a path to a home directory to store Oracle Grid Infrastructure software. You also need to provide a home directory when installation Oracle RAC. Each directory has certain requirements that must be met for the software to work correctly.

Oracle Universal Installer creates the directories during installation if they do not exist.

- **About the Directories Used During Installation of Oracle Grid Infrastructure**
- **Requirements for the Oracle Grid Infrastructure Home Directory**
- **Creating the Oracle Base Directory Path**

5.3.1 About the Directories Used During Installation of Oracle Grid Infrastructure

OUI uses several directories during installation of Oracle Grid Infrastructure.

- **Temporary Directories**
- **Grid Home Directory**
- **Oracle Base Directory**
- **Oracle Inventory Directory**

See Section 5.3, "Creating Oracle Software Directories" for more information about creating the software directories.

---

**Note:** The base directory for Oracle Grid Infrastructure 12c and the base directory for Oracle RAC 12c must be different from the directories used by the Oracle RAC 11g Release 2 installation.

---

5.3.1.1 Temporary Directories

To install properly across all nodes, OUI uses the temporary folders defined within Microsoft Windows. The TEMP and TMP environment variables should point to the same local directory on all nodes in the cluster. By default, these settings are defined as %USERPROFILE%\Local Settings\Temp and %USERPROFILE%\Local Settings\Tmp in the Environment Settings of My Computer. It is recommended to explicitly redefine these as %WINDIR%\temp and %WINDIR%\tmp, for example, C:\Windows\temp or C:\Windows\tmp for all nodes, if Windows is installed on the C drive.

5.3.1.2 Grid Home Directory

The directory that Oracle Grid Infrastructure is installed in is the Grid home. When installing Oracle Grid Infrastructure, you must determine the location of the Grid home. Oracle ASM is also installed in this home directory.

If you plan to install Oracle RAC, you must choose a different directory in which to install the Oracle Database software. The location of the Oracle RAC installation is the Oracle home.

---

**Note:** For installations with Oracle Grid Infrastructure only, Oracle recommends that you let OUI create the Grid home and Oracle Inventory directories.
5.3.1.3 Oracle Base Directory

During installation, you are prompted to specify an Oracle base location, which is owned by the user performing the installation. You can choose a location with an existing Oracle home, or choose another directory location that does not have the structure for an Oracle base directory.

If you install Oracle Database 12c Release 1 (12.1) on a computer with no other Oracle software installed, OUI creates an Oracle base directory for you. If Oracle software is already installed, then one or more Oracle base directories already exist. In the latter case, OUI offers you a choice of Oracle base directories to use during installation.

---

**Caution:** After installing Oracle Database 12c Release 1 (12.1) (or later) release with a Windows User Account as Oracle Home User, do not install older releases of Oracle Databases that share the same Oracle Base Directory. During installation of the software for older releases, the ACLs are reset and Oracle Database 12c Release 1 (12.1) (or later) services may not be able to access the Oracle Base directory and files.

---

In a default Windows installation, the Oracle base directory appears as follows, where $X$ represents a disk drive and $username$ is the name of the currently logged in user:

$X:\app\username$

Using the Oracle base directory path helps to facilitate the organization of Oracle installations, and helps to ensure that installations of multiple databases maintain an Optimal Flexible Architecture (OFA) configuration.

The Oracle base directory for the Oracle Grid Infrastructure installation is the location where diagnostic and administrative logs, and other logs associated with Oracle ASM and Oracle Clusterware are stored. For Oracle installations other than Oracle Grid Infrastructure for a cluster, the Oracle base directory is also the location under which an Oracle home is placed.

However, for an Oracle Grid Infrastructure installation, you must create a different path for the Grid home, so that the path for Oracle base remains available for other Oracle installations. You can have only one active Oracle Grid Infrastructure installation on a cluster, and all upgrades are out-of-place upgrades. Because of this, Oracle recommends that you create both an Oracle base for the Grid Installation User (grid), and an Oracle home for the Oracle Grid Infrastructure binaries using the release number of that installation. For example, use the following path to create an Oracle Grid Infrastructure home (Grid home):

$D:\app\12.1.0\grid$

During installation, ownership of the path to the Grid home is changed to the LocalSystem user. If you do not create a unique path to the Grid home, then after the Oracle Grid Infrastructure installation, you might encounter permission errors for other installations, including any existing installations under the same path.
Oracle recommends that you let the Oracle Universal Installer create the Oracle Grid Infrastructure Grid home and Oracle base directories.

**Caution:** For Oracle Grid Infrastructure (for a cluster) installations, note the following restrictions for the Oracle Grid Infrastructure home (the Grid home directory for Oracle Grid Infrastructure):

- It must not be placed under one of the Oracle base directories, including the Oracle base directory of the Oracle Grid Infrastructure installation owner.

- It must not be placed in the home directory of an installation owner.

These requirements are specific to Oracle Grid Infrastructure for a cluster installations. Oracle Grid Infrastructure for a standalone server (Oracle Restart) can be installed under the Oracle base for the Oracle Database installation.

Oracle recommends that you install Oracle Grid Infrastructure locally, on each cluster member node. Using a shared Grid home prevents rolling upgrades, and creates a single point of failure for the cluster.

### 5.3.1.4 Oracle Inventory Directory

The **Oracle Inventory directory** is the central inventory location for all Oracle software installed on a server. By default, the location of the Oracle Inventory directory is `C:\Program Files\Oracle\Inventory`. This directory is created automatically the first time you install Oracle software on a Windows server.

### 5.3.2 Requirements for the Oracle Grid Infrastructure Home Directory

Ensure that the directory path you specify meets the following requirements:

- It is located in a path outside existing Oracle homes, including Oracle Clusterware homes.

- It is not located in a user home directory.

- If you create the path before installation, then the Oracle Installation user for Oracle Grid Infrastructure can create the directories in the path.

Oracle recommends that you install Oracle Grid Infrastructure on local homes, rather than using a shared home on shared storage.

For installations with Oracle Grid Infrastructure only, Oracle recommends that you create a path compliant with Oracle Optimal Flexible Architecture (OFA) guidelines, so that Oracle Universal Installer (OUI) can select that directory during installation.
Enabling Intelligent Platform Management Interface (IPMI)

5.3.3 Creating the Oracle Base Directory Path

The Oracle base directory for the Oracle Installation User for Oracle Grid Infrastructure is the location where diagnostic and administrative logs, and other logs associated with Oracle ASM and Oracle Clusterware are stored. If the directory or path you specify during installation for the Grid home does not exist, then OUI creates the directory.

---

**Note:**

Oracle Grid Infrastructure homes can be placed in a local home on servers, even if your existing Oracle Clusterware home from a prior release is in a shared location.

If you are installing Oracle Grid Infrastructure for a database (Oracle Restart), then the home directory for Oracle Restart can be under the Oracle base directory for the Oracle Installation user for Oracle Database. Refer to Oracle Database Installation Guide for your platform for more information about Oracle Restart.

---

5.4 Enabling Intelligent Platform Management Interface (IPMI)

Intelligent Platform Management Interface (IPMI) provides a set of common interfaces to computer hardware and firmware that system administrators can use to monitor system health and manage the system. Oracle Clusterware can integrate IPMI to provide failure isolation support and to ensure cluster integrity.

You can configure node-termination with IPMI during installation by selecting a node-termination protocol, such as IPMI. You can also configure IPMI after installation with crsctl commands.

---

**See Also:** Oracle Clusterware Administration and Deployment Guide for information about how to configure IPMI after installation

---

5.4.1 Requirements for Enabling IPMI

You must have the following hardware and software configured to enable cluster nodes to be managed with IPMI:

- Each cluster member node requires a Baseboard Management Controller (BMC) running firmware compatible with IPMI version 1.5 or greater, which supports IPMI over local area networks (LANs), and configured for remote control using LAN.
Each cluster member node requires an IPMI driver installed on each node.

The cluster requires a management network for IPMI. This can be a shared network, but Oracle recommends that you configure a dedicated network.

Each cluster member node’s Ethernet port used by BMC must be connected to the IPMI management network.

Each cluster member must be connected to the management network.

Some server platforms put their network interfaces into a power saving mode when they are powered off. In this case, they may operate only at a lower link speed (for example, 100 megabyte (MB), instead of 1 GB). For these platforms, the network switch port to which the BMC is connected must be able to auto-negotiate down to the lower speed, or IPMI will not function properly.

5.4.2 Configuring the IPMI Management Network

You can configure the BMC for DHCP, or for static IP addresses. Oracle recommends that you configure the BMC for dynamic IP address assignment using DHCP. To use this option, you must have a DHCP server configured to assign the BMC IP addresses.

### Note:
If you configure IPMI, and you use GNS, then you still must configure separate addresses for the IPMI interfaces. Because the IPMI adapter is not seen directly by the host, the IPMI adapter is not visible to GNS as an address on the host.

5.4.3 Configuring the IPMI Driver

For Oracle Clusterware to communicate with the BMC, the IPMI driver must be installed permanently on each node, so that it is available on system restarts. On Windows systems, the implementation assumes the Microsoft IPMI driver (ipmidrv.sys) is installed, which is included with the Windows Server 2008 and later versions of the Windows operating system. The driver is included as part of the Hardware Management feature, which includes the driver and the Windows Management Interface (WMI).

### Note:
An alternate driver (imbdrv.sys) is available from Intel as part of Intel Server Control, but this driver has not been tested with Oracle Clusterware.

5.4.3.1 Configuring the Hardware Management Component

Hardware management is installed using the Add/Remove Windows Components Wizard.

1. Press **Start**, then select **Control Panel**.
2. Select **Add or Remove Programs**.
3. Click Add/Remove Windows Components.

4. Select (but do not check) Management and Monitoring Tools and click the Details button to display the detailed components selection window.

5. Select the Hardware Management option.

   If a BMC is detected through the system management BIOS (SMBIOS) Table Type 38h, then a dialog box will be displayed instructing you to remove any third party drivers. If no third party IPMI drivers are installed or they have been removed from the system, then click OK to continue.

   **Note:** The Microsoft driver is incompatible with other drivers. Any third party drivers must be removed

6. Click OK to select the Hardware Management Component, and then click Next.

   Hardware Management (including Windows Remote Management, or WinRM) will be installed.

   After the driver and hardware management have been installed, the BMC should be visible in the Windows Device Manager under System devices with the label "Microsoft Generic IPMI Compliant Device". If the BMC is not automatically detected by the plug and play system, then the device must be created manually.

   To create the IPMI device, run the following command:

   ```
rundll32 ipmisetp.dll,AddTheDevice
   ```
This chapter describes the storage configuration tasks that you must complete before you start the installer to install Oracle Clusterware and Oracle Automatic Storage Management (Oracle ASM), and that you must complete before adding an Oracle Real Application Clusters (Oracle RAC) installation to the cluster.

**Note:** If you are currently using OCFS for Windows as your shared storage, then you must migrate to using Oracle ASM before the upgrade of Oracle Database and Oracle Grid Infrastructure.

This chapter contains the following topics:

- Reviewing Oracle Grid Infrastructure Storage Options
- Guidelines for Choosing a Shared Storage Option
- Supported Storage Options for Oracle Grid Infrastructure and Oracle RAC
- Storage Requirements for Oracle Clusterware and Oracle RAC
- After You Have Selected the Shared Storage Options
- Preliminary Shared Disk Preparation
- Configuring Shared Storage for Oracle ASM
- Configuring Direct NFS Client for Oracle RAC Data Files
- Upgrading or Migrating Existing Oracle ASM Instances
- Configuring Oracle Automatic Storage Management Cluster File System

### 6.1 Reviewing Oracle Grid Infrastructure Storage Options

This section describes the supported storage options for Oracle Grid Infrastructure for a cluster, and for features running on Oracle Grid Infrastructure. It includes the following topics:

- Supported Storage Options for Oracle Grid Infrastructure and Oracle RAC
- General Storage Considerations for Oracle Grid Infrastructure
- General Storage Considerations for Oracle RAC
- About Oracle ASM Clusters
- About Oracle ACFS and Oracle ADVM
6.1.1 Supported Storage Options for Oracle Grid Infrastructure and Oracle RAC

Both Oracle Clusterware and the Oracle RAC database use files that must be available to all the nodes in the cluster. The following table shows the storage options supported for storing Oracle Clusterware and Oracle RAC files.

<table>
<thead>
<tr>
<th>Storage Option</th>
<th>OCR and Voting Files</th>
<th>Oracle Grid Infrastructure Home</th>
<th>Oracle RAC Home</th>
<th>Oracle RAC Database Files</th>
<th>Oracle RAC Recovery Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Automatic Storage Management (Oracle ASM)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Oracle Automatic Storage Management Cluster File System (Oracle ACFS)</td>
<td>No</td>
<td>No</td>
<td>Yes on Standard configuration or admin-managed Oracle Database Release 12.1 and later.</td>
<td>Yes (Oracle Database 12c Release 12.1 and later) except on Windows platforms</td>
<td>Yes (Oracle Database 12c Release 12.1 and later) except on Windows platforms</td>
</tr>
<tr>
<td>Direct NFS Client access to a certified network attached storage (NAS) filer</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Note: NFS or Direct NFS Client cannot be used for Oracle Clusterware files.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared disk partitions (raw devices)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Local file system (NTFS formatted disk)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

6.1.2 General Storage Considerations for Oracle Grid Infrastructure

Oracle Clusterware uses voting files to monitor cluster node status, and the Oracle Cluster Registry (OCR) is a file that contains the configuration information and status of the cluster. The installer automatically initializes the OCR during the Oracle Clusterware installation. Oracle Database Configuration Assistant (DBCA) uses the OCR for storing the configurations for the cluster databases that it creates.

Use the following guidelines when choosing storage options for the Oracle Clusterware files:

- The Oracle Grid Infrastructure home (Grid home) cannot be stored on a shared file system; it must be installed on a local disk.
- You can choose any combination of the supported storage options for each file type if you satisfy all requirements listed for the chosen storage options.
- You can store Oracle Cluster Registry (OCR) and voting files in Oracle ASM disk groups. You can also store a backup of the OCR file in a disk group.

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

- For a storage option to meet high availability requirements, the files stored on the disk must be protected by data redundancy, so that if one or more disks fail, then...
the data stored on the failed disks can be recovered. This redundancy can be provided externally using Redundant Array of Independent Disks (RAID) devices, or logical volumes on multiple physical devices and implement the stripe-and-mirror-everything methodology, also known as SAME.

- If you do not have a RAID devices or logical volumes to provide redundancy, then you can create additional copies, or mirrors, of the files on different file systems. If you choose to mirror the files, then you must provide disk space for additional OCR files and at least two additional voting files.
- Each OCR location should be placed on a different disk.
- For voting files, ensure that each file does not share any hardware device or disk, or other single point of failure with the other voting files. Any node that does not have available to it an absolute majority of voting files (more than half, or a quorum) configured will be restarted.
- If you do not have a storage option that provides external file redundancy, then you must use Oracle ASM, or configure at least three voting file locations to provide redundancy.
- Except when using external redundancy, Oracle ASM mirrors all Oracle Clusterware files in separate failure groups within a disk group. A quorum failure group, a special type of failure group, contains mirror copies of voting files when voting files are stored in normal or high redundancy disk groups.
- Oracle recommends that you create a Oracle Grid Infrastructure Management Repository. This repository is an optional component, but if you do not select this feature during installation, then you lose access to Oracle Database Quality of Service management, Memory Guard, and Cluster Health Monitor. You cannot enable these features after installation except by reinstalling Oracle Grid Infrastructure.

6.1.2.1 Storage Requirements When Using Oracle ASM for Oracle Clusterware Files

Be aware of the following requirements and recommendations when using Oracle ASM to store the Oracle Clusterware files:

- You can store Oracle Cluster Registry (OCR) and voting files in Oracle ASM disk groups. You can also store a backup of the OCR file in a disk group.
- The Oracle ASM instance must be clustered and the disks available to all the nodes in the cluster. Any node that does not have access to an absolute majority of voting files (more than half) will be restarted.
- To store the Oracle Clusterware files in an Oracle ASM disk group, the disk group compatibility must be at least 11.2.

| Note: | If you are upgrading an Oracle ASM installation, then see Oracle Automatic Storage Management Administrator’s Guide for more information about disk group compatibility. |

6.1.3 General Storage Considerations for Oracle RAC

For all Oracle RAC installations, you must choose the shared storage options to use for Oracle Database files. Oracle Database files include data files, control files, redo log files, the server parameter file, and the password file.
If you plan to configure automated backups, then you must also choose a shared storage option to use for recovery files (the fast recovery area). Oracle recommends that you choose Oracle ASM as the shared storage option for the database data files and recovery files. The shared storage option that you choose for recovery files can be the same as or different from the shared storage option that you choose for the data files.

If you do not use Oracle ASM, then Oracle recommends that you place the data files and the Fast Recovery Area in shared storage located outside of the Oracle home, in separate locations, so that a hardware failure does not affect availability.

Use the following guidelines when choosing storage options for the Oracle RAC files:

- You can choose any combination of the supported storage options for each file type if you satisfy all requirements listed for the chosen storage options.
- Oracle recommends that you choose Oracle ASM as the storage option for database and recovery files.
- If you intend to use Oracle ASM with Oracle RAC, and you are configuring a new Oracle ASM instance, then your system must meet the following conditions:
  - All the nodes in the cluster must have Oracle Clusterware and Oracle ASM 12c Release 1 (12.1) installed as part of an Oracle Grid Infrastructure for a cluster installation.
  - Any existing Oracle ASM instance on any node in the cluster is shut down before installing Oracle RAC or creating the Oracle RAC database.
- For Standard Edition Oracle RAC installations, Oracle ASM is the only supported shared storage option for database or recovery files. You must use Oracle ASM for the storage of Oracle RAC data files, online redo logs, archived redo logs, control files, server parameter file (SPFILE), and the fast recovery area.

6.1.4 About Oracle ASM Clusters

When using Oracle Grid Infrastructure 11g Release 2 (11.2), if you used Oracle ASM for storing either Oracle Clusterware or Oracle Database files, then there was an Oracle ASM instance running on every cluster node. Starting with Oracle Grid Infrastructure 12c Release 1 (12.1), if you choose Oracle ASM for the shared storage services, then you need only a few Oracle ASM instances in a cluster. You can dynamically configure the number of Oracle ASM instances in a cluster. Oracle Clusterware and Oracle Database, referred to as Oracle ASM clients, communicate with the Oracle ASM instances over a new network called the Oracle ASM network.

6.1.5 About Oracle ACFS and Oracle ADVM

Oracle Automatic Storage Management Cluster File System (Oracle ACFS) and Oracle ASM Dynamic Volume Manager (Oracle ADVM) are the main components of Oracle Cloud File System (Oracle CloudFS).

Oracle ACFS extends Oracle ASM technology to support of all of your application data in both single instance and cluster configurations. Oracle ADVM provides volume management services and a standard disk device driver interface to clients. Oracle Automatic Storage Management Cluster File System communicates with Oracle ASM through the Oracle Automatic Storage Management Dynamic Volume Manager interface.
6.2 Guidelines for Choosing a Shared Storage Option

You can choose any combination of the supported shared storage options for each file type if you satisfy all requirements listed for the chosen storage option.

- Guidelines for Using Oracle ASM Disk Groups for Storage
- Guidelines for Using Direct Network File System (NFS) with Oracle RAC
- Guidelines for Using Oracle ACFS with Oracle RAC
- Guidelines for Using Oracle ACFS with Oracle Restart
- Guidelines for Placing Recovery Files on a File System

6.2.1 Guidelines for Using Oracle ASM Disk Groups for Storage

During Oracle Grid Infrastructure installation, you can create one disk group. After the Oracle Grid Infrastructure installation, you can create additional disk groups using Oracle Automatic Storage Management Configuration Assistant (ASMCA), SQL*Plus, or Automatic Storage Management Command-Line Utility (ASMCMD). Note that with Oracle Database 11g Release 2 (11.2) and later releases, Oracle Database Configuration Assistant (DBCA) does not have the functionality to create disk groups for Oracle ASM.

If you install Oracle Database or Oracle RAC after you install Oracle Grid Infrastructure, then you can either use the same disk group for database files, OCR, and voting files, or you can use different disk groups. If you create multiple disk groups before installing Oracle RAC or before creating a database, then you can decide whether you want to:

- Place the data files in the same disk group as the Oracle Clusterware files.
- Use the same Oracle ASM disk group for data files and recovery files.
- Use different disk groups for each file type.

If you create only one disk group for storage, then the OCR and voting files, database files, and recovery files are contained in the one disk group. If you create multiple disk groups for storage, then you can choose to place files in different disk groups.

See Also:

- Oracle Database Installation Guide for Microsoft Windows for information about configuring a database to use Oracle ASM storage
- Oracle Automatic Storage Management Administrator’s Guide for information about creating disk groups
6.2.2 Guidelines for Using Direct Network File System (NFS) with Oracle RAC

Network attached storage (NAS) systems use a network file system (NFS) to access data. You can store Oracle RAC data files and recovery files on a supported NAS server using the Direct NFS Client.

NFS file systems must be mounted and available over NFS mounts before you start the Oracle RAC installation. See your vendor documentation for NFS configuration and mounting information.

Note that the performance of Oracle Database software and the databases that use NFS storage depend on the performance of the network connection between the database server and the NAS device. For this reason, Oracle recommends that you connect the database server (or cluster node) to the NAS device using a private, dedicated, network connection, which should be Gigabit Ethernet or better.

6.2.3 Guidelines for Using Oracle ACFS with Oracle RAC

Oracle Automatic Storage Management Cluster File System (Oracle ACFS) provides a general purpose file system. Oracle ACFS extends Oracle ASM technology to support of all of your application data in both single instance and cluster configurations. Oracle ADVM provides volume management services and a standard disk device driver interface to clients. Oracle Automatic Storage Management Cluster File System communicates with Oracle ASM through the Oracle Automatic Storage Management Dynamic Volume Manager interface.

You can place the Oracle home for Oracle Database 12c Release 1 (12.1) software on Oracle ACFS, but you cannot place Oracle Clusterware files on Oracle ACFS.

Note the following about Oracle ACFS:

- You cannot put Oracle Clusterware executable files or shared files on Oracle ACFS.
- You must use a domain user when installing Oracle Grid Infrastructure if you plan to use Oracle ACFS.
- You can put Oracle Database binaries and administrative files (for example, trace files) on Oracle ACFS.
- When creating Oracle ACFS file systems on Windows, log on as a Windows domain user. Also, when creating files in an Oracle ACFS file system on Windows, you should be logged in as a Windows domain user to ensure that the files are accessible by all nodes.

When using a file system across cluster nodes, the best practice is to mount the file system using a domain user, to ensure that the security identifier is the same across cluster nodes. Windows security identifiers, which are used in defining access rights to files and directories, use information which identifies the user. Local users are only known in the context of the local node. Oracle ACFS uses this information during the first file system mount to set the default access rights to the file system.

6.2.4 Guidelines for Using Oracle ACFS with Oracle Restart

Oracle Restart does not support Oracle Clusterware resources. For this reason, the following restrictions apply if you run Oracle ACFS on an Oracle Restart Configuration:

- You must manually load and unload Oracle ACFS drivers.
You must manually mount and unmount Oracle ACFS file systems after starting the Oracle ASM instance.

With Oracle Restart, Oracle Grid Infrastructure resources cannot be defined for file systems. Therefore Oracle ACFS file systems cannot be used for Oracle Database homes.

You cannot place Oracle ACFS file systems for Oracle Database homes into the Oracle ACFS mount registry. The mount registry is entirely removed starting with Oracle Grid Infrastructure 12c Release 1 (12.1).

### 6.2.5 Guidelines for Placing Recovery Files on a File System

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

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

**Note:** Alternatively use an Oracle ASM disk group with a normal or high redundancy level for data files, recovery files, or both file types, or use external redundancy.

- The cluster file system that you choose should have at least 3 GB of free disk space.

  The disk space requirement is the default disk quota configured for the fast recovery area (specified by the `DB_RECOVERY_FILE_DEST_SIZE` initialization parameter).

  If you choose the Advanced database configuration option, then you can specify a different disk quota value. After you create the database, you can also use Oracle Enterprise Manager to specify a different value.

  **See Also:** Oracle Database Backup and Recovery User’s Guide for more information about sizing the fast recovery area.

### 6.3 Storage Requirements for Oracle Clusterware and Oracle RAC

Each supported file system type has additional requirements that must be met to support Oracle Clusterware and Oracle RAC. Use the following sections to help you select your storage option:

- Requirements for Using a Cluster File System for Oracle Database Files
- Identifying Storage Requirements for Using Oracle ASM for Shared Storage
- Restrictions for Disk Partitions Used By Oracle ASM
- Preparing Your System to Use Oracle ASM for Shared Storage
- Requirements for Using a Shared File System
- Requirements for Files Managed by Oracle

### 6.3.1 Requirements for Using a Cluster File System for Oracle Database Files

If you choose to place your Oracle Database software or data files on a clustered file system, then one of the following should be true:
- The disks used for the file system are on a highly available storage device, (for example, a RAID device).
- You use at least two independent file systems, with the database files on one file system, and the recovery files on a different file system.

The user account with which you perform the installation must be able to create the files in the path that you specify.

---

**Note:** On Windows platforms, the only supported method for storing Oracle Clusterware files is Oracle ASM.

---

### 6.3.2 Identifying Storage Requirements for Using Oracle ASM for Shared Storage

When Oracle ASM provides redundancy, you must have sufficient capacity in each disk group to manage a re-creation of data that is lost after a failure of one or two failure groups. Before installing Oracle Grid Infrastructure, you must identify and determine how many devices are available for use by Oracle ASM, the amount of free disk space available on each disk, and the redundancy level to use with Oracle ASM.

**Tip:** As you progress through the following steps, make a list of the raw device names you intend to use to create the Oracle ASM disk groups and have this information available during the Oracle Grid Infrastructure installation or when creating your Oracle RAC database.

1. Determine whether you want to use Oracle ASM for Oracle Clusterware files (OCR and voting files), Oracle Database data files, recovery files, or all file types.

---

**Note:**

- You do not have to use the same storage mechanism for data files and recovery files. You can store one type of file in a cluster file system while storing the other file type within Oracle ASM. If you plan to use Oracle ASM for both data files and recovery files, then you should create separate Oracle ASM disk groups for the data files and the recovery files.

- There are two types of Oracle Clusterware files: OCR files and voting files. Each type of file can be stored on either Oracle ASM or a cluster file system. All the OCR files or all the voting files must use the same type of storage. You cannot have some OCR files stored in Oracle ASM and other OCR files in a cluster file system. However, you can use one type of storage for the OCR files and a different type of storage for the voting files if all files of each type use the same type of storage.

---

2. Choose the Oracle ASM redundancy level to use for the Oracle ASM disk group.

   The redundancy level that you choose for the Oracle ASM disk group determines how Oracle ASM mirrors files in the disk group, and determines the number of disks and amount of disk space that you require. If the voting files are in a disk group, then the disk groups that contain Oracle Clusterware files (OCR and voting files) have a higher minimum number of failure groups than other disk groups because the voting files are stored in quorum failure groups.
A quorum failure group is a special type of failure group that stores the Oracle Clusterware voting files. The quorum failure group ensures that a quorum of the specified failure groups are available. When Oracle ASM mounts a disk group that contains Oracle Clusterware files, the quorum failure group determines if the disk group can be mounted in the event of the loss of one or more failure groups. Disks in the quorum failure group do not contain user data, therefore a quorum failure group is not considered when determining redundancy requirements in respect to storing user data.

The redundancy levels are 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 Oracle ASM does not mirror data in an external redundancy disk group, Oracle recommends that you use external redundancy with storage devices such as RAID, or other similar devices that provide their own data protection mechanisms.

- **Normal redundancy**
  
  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 Oracle Clusterware files, a normal redundancy disk group requires a minimum of three disk devices (failure groups use two of the three disks and the quorum failure group uses all three disks) and provides three voting files and one OCR and mirror of the OCR. When using a normal redundancy disk group, the cluster can survive the loss of one failure group.
  
  For most installations, Oracle recommends that you select normal redundancy disk groups.

- **High redundancy**
  
  In a high redundancy disk group, Oracle 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.
  
  For Oracle Clusterware files, a high redundancy disk group requires a minimum of five disk devices (failure groups use three of the five disks and the quorum failure group uses all five disks) and provides five voting files and one OCR and two mirrors of the OCR. With high redundancy, the cluster can survive the loss of two failure groups.

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

---

**Note:** After a disk group is created, you cannot alter the redundancy level of the disk group.

---

3. Determine the total amount of disk space that you require for the Oracle Clusterware files using Oracle ASM for shared storage.
Use Table 6–2, "Oracle Clusterware Storage Required by Redundancy Type" and Table 6–3, "Oracle Clusterware Storage Required by Redundancy Type When Oracle Grid Infrastructure Management Repository is Selected" to determine the minimum number of disks and the minimum disk space requirements for installing Oracle Clusterware using Oracle ASM for shared storage:

### Table 6–2  Oracle Clusterware Storage Required by Redundancy Type

<table>
<thead>
<tr>
<th>Redundancy Level</th>
<th>Minimum Number of Disks</th>
<th>Oracle Cluster Registry (OCR) Files</th>
<th>Voting Files</th>
<th>Both File Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>1</td>
<td>400 MB</td>
<td>300 MB</td>
<td>700 MB(^1)</td>
</tr>
<tr>
<td>Normal</td>
<td>3</td>
<td>At least 400 MB for each failure group, or 800 MB</td>
<td>900 MB</td>
<td>1.7 GB</td>
</tr>
<tr>
<td>High</td>
<td>5</td>
<td>At least 400 MB for each failure group, or 1.2 GB</td>
<td>1.5 GB</td>
<td>2.7 GB</td>
</tr>
</tbody>
</table>

\(^1\) If you create a disk group during installation, then it must be at least 2 GB.

### Table 6–3  Oracle Clusterware Storage Required by Redundancy Type When Oracle Grid Infrastructure Management Repository is Selected

<table>
<thead>
<tr>
<th>Redundancy Level</th>
<th>Minimum Number of Disks</th>
<th>OCR and Repository</th>
<th>Voting File</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>1</td>
<td>At least 3.7 GB for the OCR volume that contains the Oracle Grid Infrastructure Management Repository. The size includes:</td>
<td>300 MB</td>
<td>At least 4 GB for a cluster with 4 nodes or less (3.3 GB + 400 MB + 300 MB). Additional space required for clusters with 5 or more nodes. For example, a six-node cluster allocation should be at least 5 GB: (3.3 GB + 2 * (500 MB) + 400 MB + 300 MB).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ 3.3 GB for the Oracle Grid Infrastructure Management Repository, plus 500 MB for each node for clusters greater than four nodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ 400 MB for the OCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>3</td>
<td>2 * (3.3 GB for the Oracle Grid Infrastructure Management Repository, plus 500 MB for each node for clusters greater than four nodes)</td>
<td>At least 300 MB for each voting file</td>
<td>At least 8.3 GB for a cluster with 4 nodes or less (6.6 GB + 2 * 400 MB + 3 * 300 MB). Additional space required for clusters with 5 or more nodes. For example, for a six-node cluster allocation should be at least 10.5 GB: (2 * (3.3 GB + 2 * (500 MB)) + (2 * 400 MB) + (3 * 300 MB).</td>
</tr>
</tbody>
</table>
To ensure high availability of Oracle Clusterware files on Oracle ASM, you must have at least 2 GB of disk space for Oracle Clusterware files in three separate failure groups, with at least three physical disks. Each disk must have at least 1 GB of capacity to ensure that there is sufficient space to create Oracle Clusterware files.

4. Determine an allocation unit size. Every Oracle ASM disk is divided into allocation units (AU). An allocation unit is the fundamental unit of allocation within a disk group. You can select the AU Size value from 1, 2, 4, 8, 16, 32 or 64 MB, depending on the specific disk group compatibility level. The default value is set to 1 MB.

5. For Oracle Clusterware installations, you must also add additional disk space for the Oracle ASM metadata. You can use the following formula to calculate the disk space requirements (in MB) for OCR and voting files, and the Oracle ASM metadata:

\[
\text{total} = [2 \times \text{ausize} \times \text{disks}] + [\text{redundancy} \times (\text{ausize} \times (\text{nodes} \times (\text{clients} + 1) + 30) + (64 \times \text{nodes}) + 533)]
\]

Where:

- redundancy = Number of mirrors: external = 1, normal = 2, high = 3
- ausize = Metadata AU size in megabytes (default is 1 MB)
- nodes = Number of nodes in cluster

---

### Table 6–3 (Cont.) Oracle Clusterware Storage Required by Redundancy Type When Oracle Grid Infrastructure Management Repository is Selected

<table>
<thead>
<tr>
<th>Redundancy Level</th>
<th>Minimum Number of Disks</th>
<th>OCR and Repository</th>
<th>Voting File</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>5</td>
<td>3 * (3.3 GB for the Oracle Grid Infrastructure Management Repository, plus 500 MB for each node for clusters greater than four nodes)</td>
<td>At least 300 MB for each voting file</td>
<td>At least 12.6 GB for a cluster with 4 nodes or less (3 * 3.3 GB + 3 * 400 MB + 5 * 300 MB). Additional space required for clusters with 5 or more nodes. For example, for a six-node cluster allocation should be at least 15.6 GB: (3 * (3.3 GB + 2 *(500 MB)) + (3 * 400 MB) + (5 * 300 MB).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At least 1.2 GB for the OCR and its two copies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** If the voting files are in a disk group, then the disk groups that contain Oracle Clusterware files (OCR and voting files) have a higher minimum number of failure groups than other disk groups.

If you create a disk group for the OCR and voting files as part of the installation, then the installer requires that you create these files on a disk group with at least 2 GB of available space.

To ensure high availability of Oracle Clusterware files on Oracle ASM, you must have at least 2 GB of disk space for Oracle Clusterware files in three separate failure groups, with at least three physical disks. Each disk must have at least 1 GB of capacity to ensure that there is sufficient space to create Oracle Clusterware files.
- clients = Number of database instances for each node
- disks = Number of disks in disk group

For example, for a four-node Oracle RAC installation, using three disks in a normal redundancy disk group, and a default AU size of 1 MB, you require an additional 1684 MB of space:

\[2 \times 1 \times 3 + [2 \times (1 \times (4 \times (4 + 1) + 30) + (64 \times 4) + 533)] = 1684 \text{ MB}\]

To ensure high availability of Oracle Clusterware files on Oracle ASM, you need to have at least 2 GB of disk space for Oracle Clusterware files in three separate failure groups, with at least three physical disks. Each disk must have at least 1 GB of capacity to ensure that there is sufficient space to create Oracle Clusterware files.

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

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

   **Table 6–4 Total Oracle Database Storage Space Required by Redundancy Type**

<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>1.5 GB</td>
<td>3 GB</td>
<td>4.5 GB</td>
</tr>
<tr>
<td>Normal</td>
<td>2</td>
<td>3 GB</td>
<td>6 GB</td>
<td>9 GB</td>
</tr>
<tr>
<td>High</td>
<td>3</td>
<td>4.5 GB</td>
<td>9 GB</td>
<td>13.5 GB</td>
</tr>
</tbody>
</table>

   **Note:** The file sizes listed in the previous table are estimates of minimum requirements for a new installation (or a database without any user data). The file sizes for your database will be larger.

7. Determine if you can use an existing disk group.

   If an Oracle ASM instance currently exists on the system, then you can use an existing disk group to meet these storage requirements. If necessary, you can add disks to an existing disk group during the installation. See Section 6.3.3.1, "Identifying Existing Oracle ASM Disk Groups to Use" for more information about using an existing disk group.

8. If there is no existing Oracle ASM disk group to use, then create one or more Oracle ASM disk groups, as needed, before installing Oracle RAC. See Section 6.3.3.2, "Selecting Disks to use with Oracle ASM Disk Groups" for more information about selecting disks to use in a disk group.

9. Optionally, identify failure groups for the Oracle ASM disk group devices.

   **Note:** You only have to complete this step if you plan to use an installation method that includes configuring Oracle ASM disk groups before installing Oracle RAC, or creating an Oracle RAC database.

If you intend to use a normal or high redundancy disk group, then you can further protect your database against hardware failure by associating a set of disk devices in a custom failure group. **Failure groups** define Oracle ASM disks that share a
common potential failure mechanism. By default, each device comprises its own failure group. If you choose to define custom failure groups, then note the following:

- You must specify a minimum of two failure groups for normal redundancy disk groups and three failure groups for high redundancy disk groups.

- If the disk group contains data files and Oracle Clusterware files, including the voting files, then you must specify a minimum of three failure groups for normal redundancy disk groups and five failure groups for high redundancy disk groups.

- Disk groups containing voting files must have at least three failure groups for normal redundancy or at least five failure groups for high redundancy. If the disk group does not contain the voting files, then the minimum number of required failure groups is two for normal redundancy and three for high redundancy. The minimum number of failure groups applies whether or not they are custom failure groups.

If two disk devices in a normal redundancy disk group are attached to the same small computer system interface (SCSI) controller, then the disk group becomes unavailable if the controller fails. The SCSI 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 enables the disk group to tolerate the failure of one SCSI controller.

---

**Note:** You can define custom failure groups after installation of Oracle Grid Infrastructure using the GUI tool ASMCA, the command-line tool `asmcmd`, or SQL*Plus commands.

---

For more information about Oracle ASM failure groups, refer to *Oracle Automatic Storage Management Administrator’s Guide*.

### 6.3.3 Preparing Your System to Use Oracle ASM for Shared Storage

To use Oracle ASM as the shared storage solution for Oracle Clusterware or Oracle RAC files, you must perform certain tasks before you begin the software installation.

- Identifying Existing Oracle ASM Disk Groups to Use
- Selecting Disks to use with Oracle ASM Disk Groups
- Restrictions for Disk Partitions Used By Oracle ASM
- Specifying the Oracle ASM Disk Discovery String

#### 6.3.3.1 Identifying Existing Oracle ASM Disk Groups to Use

To use Oracle ASM as the storage option for either database or recovery files, you must use an existing Oracle ASM disk group, or use ASMCA to create the necessary disk groups before installing Oracle Database 12c Release 1 (12.1) and creating an Oracle RAC database.

To determine if an Oracle ASM disk group currently exists, or to determine whether there is sufficient disk space in an existing disk group, the Oracle ASM command line tool (`asmcmd`), or Oracle Enterprise Manager Cloud Control. Alternatively, you can use the following procedure:
1. In the **Services** Control Panel, ensure that the `OracleASMService+ASMn` service, where `n` is the node number, has started.

2. Open a Windows command prompt and temporarily set the `ORACLE_SID` environment variable to specify the appropriate value for the Oracle ASM instance to use.

   For example, if the Oracle ASM system identifier (SID) is named `+ASM1`, then enter a setting similar to the following:
   
   ```
   C:\> set ORACLE_SID=+ASM1
   ```

3. If the `ORACLE_HOME` environment variable is not set to the Grid home, then temporarily set this variable to the location of the Grid home using a command similar to the following:

   ```
   C:\> set ORACLE_HOME=C:\app\12.1.0\grid
   ```

4. Use ASMCMD to connect to the Oracle ASM instance and start the instance if necessary with a command similar to the following:

   ```
   C:\> %ORACLE_HOME%\bin\asmcmd
   ASMCMD> startup
   ```

5. Enter one of the following commands to view the existing disk groups, their redundancy level, and the amount of free disk space in each disk group:

   ```
   ASMCMD> lsdg
   ```

   or:

   ```
   C:\> %ORACLE_HOME%\bin\asmcmd -p lsdg
   ```

6. From the output, identify a disk group with the appropriate redundancy level and note the free space that it contains.

7. If necessary, install, or identify the additional disk devices required to meet the storage requirements listed in the previous section.

---

**Note:** If you are adding devices to an existing disk group, then Oracle recommends that you use devices that have the same size and performance characteristics as the existing devices in that disk group.

---

### 6.3.3.2 Selecting Disks to use with Oracle ASM Disk Groups

If you are sure that a suitable disk group does not exist on the system, then install or identify appropriate disk devices to add to a new disk group. Use the following guidelines when identifying appropriate disk devices:

- All of the devices in an Oracle ASM disk group should be the same size and have the same performance characteristics.

- Do not specify multiple partitions on a single physical disk as a disk group device. Oracle ASM expects each disk group device to be on a separate physical disk.

- Nonshared logical partitions are not supported with Oracle RAC. To use logical partitions for your Oracle RAC database, you must use shared logical volumes created by a logical volume manager such as `diskpart.msc`.

- Although you can specify a logical volume as a device in an Oracle ASM disk group, Oracle does not recommend their use because it adds a layer of complexity that is unnecessary with Oracle ASM. In addition, Oracle RAC requires a cluster
logical volume manager in case you decide to use a logical volume with Oracle ASM and Oracle RAC.

See Also:
- Section 6.5, "Preliminary Shared Disk Preparation"
- Section 6.6, "Configuring Shared Storage for Oracle ASM"

6.3.3.3 Specifying the Oracle ASM Disk Discovery String

When an Oracle ASM instance is initialized, Oracle ASM discovers and examines the contents of all of the disks that are in the paths that you designated with values in the \texttt{ASM\_DISKSTRING} initialization parameter. The value for the \texttt{ASM\_DISKSTRING} initialization parameter is an operating system–dependent value that Oracle ASM uses to limit the set of paths that the discovery process uses to search for disks. The exact syntax of a discovery string depends on the platform, ASMLib libraries, and whether Oracle Exadata disks are used. The path names that an operating system accepts are always usable as discovery strings.

The default value of \texttt{ASM\_DISKSTRING} might not find all disks in all situations. If your site is using a third-party vendor ASMLib, then the vendor might have discovery string conventions that you must use for \texttt{ASM\_DISKSTRING}. In addition, if your installation uses multipathing software, then the software might place pseudo-devices in a path that is different from the operating system default. See "Oracle ASM and Multipathing" and consult the multipathing vendor documentation for details.

See Also:
- \textit{Oracle Automatic Storage Management Administrator's Guide} for more information about the initialization parameter \texttt{ASM\_DISKSTRING}
- \textit{Oracle Automatic Storage Management Administrator's Guide} for information about configuring Oracle ASM to work with multipathing

6.3.4 Restrictions for Disk Partitions Used By Oracle ASM

Be aware of the following restrictions when configuring disk partitions for use with Oracle ASM:

- You cannot use primary partitions for storing Oracle Clusterware files while running OUI to install Oracle Clusterware as described in Chapter 7, "Installing Oracle Grid Infrastructure for a Cluster". You must create logical drives inside extended partitions for the disks to be used by Oracle Clusterware files and Oracle ASM.
- With x64 Windows, you can create up to 128 primary partitions for each disk.
- You can create shared directories only on primary partitions and logical drives.
- Oracle recommends that you limit the number of partitions you create on a single disk to prevent disk contention. Therefore, you may prefer to use extended partitions rather than primary partitions.

For these reasons, you might prefer to use extended partitions for storing Oracle software files and not primary partitions.
6.3.5 Requirements for Using a Shared File System

To use a shared file system for Oracle RAC, the file system must comply with the following requirements:

- To use NFS, it must be on a certified network attached storage (NAS) device. Access the My Oracle Support website as described in Section 3.4, "Checking Hardware and Software Certification on My Oracle Support" to find a list of certified NAS devices.

- If placing the Oracle RAC data files on a shared file system, then one of the following should be true:
  - The disks used for the file system are on a highly available storage device, (for example, a RAID device).
  - The file systems consist of at least two independent file systems, with the data files on one file system, and the recovery files on a different file system.

- The user account with which you perform the installation must be able to create the files in the path that you specify for the shared storage.

**Note:**

If you are upgrading Oracle Clusterware, and your existing cluster uses 100 MB OCR and 20 MB voting file partitions, then you must extend these partitions to at least 300 MB. Oracle recommends that you do not use partitions, but instead place OCR and voting files in Oracle ASM disk groups marked as QUORUM disk groups.

All storage products must be supported by both your server and storage vendors.

Use Table 6–5 to determine the minimum size for shared file systems:

**Table 6–5  Oracle RAC Shared File System Volume Size Requirements**

<table>
<thead>
<tr>
<th>File Types Stored</th>
<th>Number of Volumes</th>
<th>Volume Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle Database data files</td>
<td>1</td>
<td>At least 1.5 GB for each volume</td>
</tr>
<tr>
<td>Recovery files</td>
<td>1</td>
<td>At least 2 GB for each volume</td>
</tr>
</tbody>
</table>

**Note:** Recovery files must be on a different volume than database files

In Table 6–5, the total required volume size is cumulative. For example, if you use one volume for data files and one volume for recovery files, then you should have at least 3.5 GB of available storage over two volumes.

6.3.6 Requirements for Files Managed by Oracle

If you use Oracle ASM for your database files, then Oracle creates the database with Oracle Managed files by default. When using the Oracle Managed files feature, you need specify only the database object name instead of file names when creating or deleting database files.

Configuration procedures are required to enable Oracle Managed Files.
6.4 After You Have Selected the Shared Storage Options

When you have determined your disk storage options, first perform the steps listed in the section Section 6.5, "Preliminary Shared Disk Preparation", then configure the shared storage:

- To use Oracle ASM, refer to Section 6.6, "Configuring Shared Storage for Oracle ASM".
- To use a file system, refer to Section 6.7, "Configuring Disk Partitions on Shared Storage".

6.5 Preliminary Shared Disk Preparation

Complete the following steps to prepare shared disks for storage:

- Disabling Write Caching
- Enabling Automounting for Windows

6.5.1 Disabling Write Caching

You must disable write caching on all disks that will be used to share data between the nodes in your cluster. Perform these steps to disable write caching:

1. Click Start, then select Control Panel, then Administrative Tools, then Computer Management, then Device Manager, and then Disk drives
2. Expand the Disk drives and double-click the first drive listed.
3. Under the Policies tab for the selected drive, uncheck the option that enables write caching.
4. Double-click each of the other drives that will be used by Oracle Clusterware and Oracle RAC and disable write caching as described in the previous step.

---

**Caution:** Any disks that you use to store files, including database files, that will be shared between nodes, must have write caching disabled.

---

6.5.2 Enabling Automounting for Windows

Even though the automount feature is enabled by default, you should verify that automount is enabled.

You must enable automounting when using:

- Raw partitions for Oracle ASM
- Oracle Clusterware
- Logical drives for Oracle ASM
To determine if automatic mounting of new volumes is enabled, use the following commands:

c:\> diskpart
DISKPART> automount
Automatic mounting of new volumes disabled.

To enable automounting:

1. Enter the following commands at a command prompt:
   
c:\> diskpart
   DISKPART> automount enable
   Automatic mounting of new volumes enabled.

2. Type `exit` to end the diskpart session
3. Repeat steps 1 and 2 for each node in the cluster.
4. You must restart each node after enabling disk automounting. After it is enabled and the node is restarted, automatic mounting remains active until it is disabled.

---

Note: Raw partitions are supported only when upgrading an existing installation using the configured partitions. On new installations, using raw partitions is not supported by ASMCA or OUI, but is supported by the software if you perform manual configuration

---

6.6 Configuring Shared Storage for Oracle ASM

The installer does not suggest a default location for the OCR or the voting file. If you choose to create these files on Oracle ASM, then you must first create and configure disk partitions to be used in the Oracle ASM disk group.

The following sections describe how to create and configure disk partitions to be used by Oracle ASM for storing Oracle Clusterware files or Oracle Database data files:

- Create Disk Partitions for Use With Oracle ASM
- Marking Disk Partitions for Oracle ASM Before Installation

6.6.1 Create Disk Partitions for Use With Oracle ASM

The following steps outline the procedure for creating disk partitions for use with Oracle ASM:

1. Use Microsoft Computer Management utility or the command line tool `diskpart` to create an extended partition. Use a basic disk; dynamic disks are not supported.

2. Create at least one logical partition for the Oracle Clusterware files. You do not have to create separate partitions for the OCR and voting file; Oracle Clusterware creates individual files for the OCR and voting file in the specified location.
3. If your file system does not use a redundant array of inexpensive disks (RAID), then create an additional extended partition and logical partition for each partition that will be used by Oracle Clusterware files, to provide redundancy.

To create the required partitions, use the Disk Management utilities available with Microsoft Windows. Use a basic disk with a Master Boot Record (MBR) partition style as an extended partition for creating partitions.

1. From an existing node in the cluster, run the Windows disk administration tool as follows:

   See Section 6.7, "Configuring Disk Partitions on Shared Storage" for instructions on creating disk partitions using the DISKPART utility.

2. On each node in the cluster, ensure that the partitions are visible and that none of the disk partitions created for shared storage have drive letters assigned. If any partitions have drive letters assigned, then remove them by performing these steps:

   ■ Right-click the partition in the Windows disk administration tool
   ■ Select "Change Drive Letters and Paths" from the menu
   ■ Click Remove in the "Change Drive Letter and Paths" window

   See Also:
   ■ Section 6.6, "Configuring Shared Storage for Oracle ASM"
   ■ Section 6.7, "Configuring Disk Partitions on Shared Storage"

### 6.6.2 Marking Disk Partitions for Oracle ASM Before Installation

The only partitions that OUI displays for Windows systems are logical drives that are on disks that do not contain a primary partition, and have been marked (or stamped) with `asmtool`. Configure the disks before installation either by using `asmtoolg` (graphical user interface (GUI) version) or using `asmtool` (command line version). You also have the option of using the `asmtoolg` utility during Oracle Grid Infrastructure for a cluster installation.

The `asmtoolg` and `asmtool` utilities only work on partitioned disks; you cannot use Oracle ASM on unpartitioned disks. You can also use these tools to reconfigure the disks after installation. These utilities are installed automatically as part of Oracle Grid Infrastructure.

| Note: | On Windows Server 2008 and Windows Server 2008 R2, if user account control (UAC) is enabled, then running `asmtoolg` or `asmtool` requires administrator-level permissions. |

### 6.6.2.1 Overview of `asmtoolg` and `asmtool`

The `asmtoolg` and `asmtool` tools associate meaningful, persistent names with disks to facilitate using those disks with Oracle ASM. Oracle ASM uses disk strings to operate more easily on groups of disks at the same time. The names that `asmtoolg` or `asmtool` create make this easier than using Windows drive letters.

All disk names created by `asmtoolg` or `asmtool` begin with the prefix `ORCLDISK` followed by a user-defined prefix (the default is `DATA`), and by a disk number for identification purposes. You can use them as raw devices in the Oracle ASM instance by specifying a name `\\.ORCLDISK\prefix\n`, where `prefix` either can be `DATA`, or a value you supply, and where `n` represents the disk number.
To configure your disks with `asmtoolg`, see one of the following sections:

- **Section 6.6.2.2, "Using asmtoolg (Graphical User Interface) To Mark Disks"**
- **Section 6.6.2.4, "Using asmtool (Command Line) To Mark Disks"**

### 6.6.2.2 Using asmtoolg (Graphical User Interface) To Mark Disks

Use `asmtoolg` (GUI version) to create device names; use `asmtool` to add, change, delete, and examine the devices available for use in Oracle ASM.

To add or change disk stamps:

1. In the installation media for Oracle Grid Infrastructure, go the `asmtool` folder and double-click `asmtoolg`.

   If Oracle Clusterware is installed, then go to the `Grid_home\bin` folder and double-click `asmtoolg.exe`.

   On Windows Server 2008 and Windows Server 2008 R2, if user access control (UAC) is enabled, then you must create a desktop shortcut to a command window. Open the command window using the **Run as Administrator**, right-click the context menu, and launch `asmtoolg`.

2. Select the **Add or change label** option, and then click **Next**.

   `asmtoolg` shows the devices available on the system. Unrecognized disks have a status of "Candidate device", stamped disks have a status of "Stamped ASM device," and disks that have had their stamp deleted have a status of "Unstamped ASM device." The tool also shows disks that are recognized by Windows as a file system (such as NTFS). These disks are not available for use as Oracle ASM disks, and cannot be selected. In addition, Microsoft Dynamic disks are not available for use as Oracle ASM disks.

   If necessary, follow the steps under **Section 6.6.1, "Create Disk Partitions for Use With Oracle ASM"** to create disk partitions for the Oracle ASM instance.

3. On the Stamp Disks window, select the disks you want to use with Oracle ASM.

   For ease of use, Oracle ASM can generate unique stamps for all of the devices selected for a given prefix. The stamps are generated by concatenating a number with the prefix specified. For example, if the prefix is `DATA`, then the first Oracle ASM link name is `ORCLDISKDATA0`.

   You can also specify the stamps of individual devices.

4. Optionally, select a disk to edit the individual stamp (Oracle ASM link name).

5. Click **Next**.

6. Click **Finish**.

### 6.6.2.3 Using asmtoolg To Remove Disk Stamps

To delete disk stamps:

1. In the installation media for Oracle Grid Infrastructure, go the `asmtool` folder and double-click `asmtoolg`.

   If Oracle Clusterware is installed, then go to the `Grid_home\bin` folder and double-click `asmtoolg.exe`.

   On Windows Server 2008 and Windows Server 2008 R2, if user access control (UAC) is enabled, then you must create a desktop shortcut to a command window. Open the command window using the **Run as Administrator**, right-click the context menu, and launch `asmtoolg`.
window. Open the command window using the Run as Administrator, right-click
the context menu, and launch asmtoolg.

2. Select the Delete labels option, then click Next.
   The delete option is only available if disks exist with stamps. The delete screen
   shows all stamped Oracle ASM disks.

3. On the Delete Stamps screen, select the disks to unstamp.

4. Click Next.

5. Click Finish.

6.6.2.4 Using asmtool (Command Line) To Mark Disks

asmtool is a command-line interface for marking (or stamping) disks to be used with
Oracle ASM. It has the following options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| -add    | Adds or changes stamps. You must specify the hard disk, partition, and new stamp name. If the disk is a raw device or has an existing Oracle ASM stamp, then you must specify the -force option. If necessary, follow the steps under Section 6.6.1, "Create Disk Partitions for Use With Oracle ASM" to create disk partitions for the Oracle ASM instance. | asmtool -add [-force] \\Device\Harddisk1\Partition1 ORCLDISKASM0 \\Device\Harddisk2\Partition1 ORCLDISKASM2 ...
| -addprefix | Adds or changes stamps using a common prefix to generate stamps automatically. The stamps are generated by concatenating a number with the prefix specified. If the disk is a raw device or has an existing Oracle ASM stamp, then you must specify the -force option. | asmtool -addprefix ORCLDISKASM [-force] \\Device\Harddisk1\Partition1 \\Device\Harddisk2\Partition1 ...
| -create | Creates an Oracle ASM disk device from a file instead of a partition. Note: Usage of this command is not supported for production environments. | asmtool -create \\server\share\file 1000
asmtool -create D:\asm\asmfile02.asm 240 |
| -list | List available disks. The stamp, windows device name, and disk size in MB are shown. | asmtool -list |
| -delete | Removes existing stamps from disks. | asmtool -delete ORCLDISKASM0 ORCLDISKASM1 ...

On Windows Server 2008 and Windows Server 2008 R2, if user access control (UAC) is enabled, then you must create a desktop shortcut to a command window. Open the command window using the Run as Administrator, right-click the context menu, and launch asmtool.

---

**Note:** If you use -add, -addprefix, or -delete, asmtool notifies the Oracle ASM instance on the local node and on other nodes in the cluster, if available, to rescan the available disks.
6.7 Configuring Disk Partitions on Shared Storage

To use shared disks not managed by Oracle ASM for the Oracle home and data files, the following partitions, at a minimum, must exist before you run OUI to install Oracle Clusterware:

- 5.5 GB or larger partition for the Oracle home, if you want a shared Oracle home
- 3 GB or larger partitions for the Oracle Database data files and recovery files

Log in to Windows using a member of the Administrators group and perform the steps described in this section to set up the shared disk raw partitions. Windows refers to raw partitions as logical drives. If you need more information about creating partitions, then refer to the Windows online help from within the Disk Management utility.

### Note:
Oracle supports installing the database into multiple Oracle Homes on a single system. This allows flexibility in deployment and maintenance of the database software. For example, it enables different releases of the database to run simultaneously on the same system, or it enables you to upgrade specific database or Oracle Automatic Storage Management instances on a system without affecting other running databases.

However, when you have installed multiple Oracle Homes on a single system, there is also some added complexity introduced that you may have to consider. For more information on this topic, refer to Oracle Database Platform Guide for Microsoft Windows and Oracle Real Application Clusters Installation Guide for Microsoft Windows x64 (64-Bit).

To create the required partitions, perform the following steps:

1. From an existing node in the cluster, run the DiskPart utility as follows:
   
   ```
   C:\> diskpart
   DISKPART>
   ```

2. List the available disks. By specifying its disk number (n), select the disk on which you want to create a partition.
   
   ```
   DISKPART> list disk
   DISKPART> select disk n
   ```

3. Create an extended partition:
   
   ```
   DISKPART> create part ext
   ```

4. Create a logical drive of the desired size after the extended partition is created using the following syntax:
   
   ```
   DISKPART> create part log [size=n] [offset=n] [noerr]
   ```

5. Repeat steps 2 through 4 for the second and any additional partitions. An optimal configuration is one partition for the Oracle home and one partition for Oracle Database files.

6. List the available volumes, and remove any drive letters from the logical drives you plan to use.
7. Check all nodes in the cluster to ensure that the partitions are visible on all the nodes and to ensure that none of the Oracle partitions have drive letters assigned. If any partitions have drive letters assigned, then remove them by performing these steps:
   - Right-click the partition in the Windows Disk Management utility
   - Select “Change Drive Letters and Paths” from the menu
   - Click Remove in the “Change Drive Letter and Paths” window

6.8 Configuring Direct NFS Client for Oracle RAC Data Files

Direct NFS Client is an interface for NFS systems provided by Oracle. Refer to the following sections to configure Direct NFS Client:

- About Direct NFS Client Storage
- About the Oranfstab File for Direct NFS Client
- Configurable Attributes for the oranfstab File
- Mounting NFS Storage Devices with Direct NFS Client
- Specifying Network Paths for a NFS Server
- Enabling the Direct NFS Client
- Performing Basic File Operations Using the ORADNFS Utility
- Monitoring Direct NFS Client Usage
- Disabling Oracle Disk Management Control of NFS for the Direct NFS Client

6.8.1 About Direct NFS Client Storage

With Oracle Database, instead of using an operating system NFS client, you can configure Oracle Database to access NFS servers directly using an Oracle internal Direct NFS Client. The Direct NFS Client supports NFSv3, NFSv4 and NFSv4.1 protocols (excluding the Parallel NFS extension) to access the NFS server.

Management of Oracle data files created with Direct NFS Client should be done according to the guidelines specified in Oracle Database Administrator’s Guide. The Oracle database files resident on the NFS server that are served by the Direct NFS Client can also be accessed through a third party NFS client. The volume must be mounted through CIFS or kernel NFS to enable regular windows utilities and commands, such as copy, and so on, access the database files in the remote location. Volumes mounted through CIFS cannot be used for database file storage without configuring Direct NFS Client. The atomic write requirements required for database access are not guaranteed by CIFS protocol. Consequently, CIFS can only be used for operating system level commands, such as copy, move, and so on.

Some NFS file servers require NFS clients to connect using reserved ports. If your filer is running with reserved port checking, then you must disable it for Direct NFS Client to operate. To disable reserved port checking, consult your NFS file server documentation.
Configuring Direct NFS Client for Oracle RAC Data Files

If Oracle Database cannot open an NFS server using Direct NFS Client, then an informational message is logged into the Oracle alert and trace files indicating that Direct NFS Client could not be established.

Note: Direct NFS Client does not work if the backend NFS server does not support a write size (wtmax) of 32768 or larger.

6.8.2 About the oranfstab File for Direct NFS Client

If you use Direct NFS Client, then you must create a configuration file, `oranfstab`, to specify the options, attributes, and parameters that enable Oracle Database to use Direct NFS Client. You must create the `oranfstab` file in the `Oracle_home\dbs` directory. Direct NFS Client looks for the mount point entries in `oranfstab`. It uses the first matched entry as the mount point.

When the `oranfstab` file is placed in `Oracle_home\dbs`, the entries in the file are specific to a single database. For Oracle RAC installations in a shared Oracle home, the `oranfstab` file is globally available to all database instances. All instances that use the shared Oracle home use the same `Oracle_home\dbs\oranfstab` file. For a nonshared Oracle home, because all the Oracle RAC instances use the same `oranfstab` file, you must replicate the `oranfstab` file on all of the nodes. Also, you must keep the `oranfstab` file synchronized on all the nodes.

Note: If you remove an NFS path from `oranfstab` that Oracle Database is using, then you must restart the database for the change to be effective. In addition, the mount point that you use for the file system must be identical on each node.

See Also: Section 6.8.6, "Enabling the Direct NFS Client" for more information about creating the `oranfstab` file

6.8.3 Configurable Attributes for the oranfstab File

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>server</td>
<td>The NFS server name</td>
</tr>
<tr>
<td>path</td>
<td>Up to four network paths to the NFS server, specified either by Internet protocol (IP) address, or by name, as displayed using the <code>ipconfig</code> command on the NFS server</td>
</tr>
<tr>
<td>local</td>
<td>Up to four network interfaces on the database host, specified by IP address, or by name, as displayed using the <code>ipconfig</code> command on the database host.</td>
</tr>
<tr>
<td>export</td>
<td>The exported path from the NFS server. Use a UNIX-style path</td>
</tr>
<tr>
<td>mount</td>
<td>The corresponding local mount point for the exported volume. Use a Windows-style path</td>
</tr>
</tbody>
</table>
6.8.4 Mounting NFS Storage Devices with Direct NFS Client

Direct NFS Client determines mount point settings for NFS storage devices based on the configuration information in oranfstab. Direct NFS Client uses the first matching entry as the mount point. If Oracle Database cannot open an NFS server using Direct NFS Client, then an error message is written into the Oracle alert and trace files indicating that Direct NFS Client could not be established.

Note: You can have only one active Direct NFS Client implementation for each instance. Using Direct NFS Client on an instance will prevent another Direct NFS Client implementation.

Direct NFS Client requires an NFS server supporting NFS read/write buffers of at least 16384 bytes.

Direct NFS Client issues writes at wtmax granularity to the NFS server. Direct NFS Client does not serve an NFS server with a wtmax less than 16384. Oracle recommends that you use the value 32768.

See Also: Section 6.1.1, "Supported Storage Options for Oracle Grid Infrastructure and Oracle RAC" for a list of the file types that are supported with Direct NFS Client

6.8.5 Specifying Network Paths for a NFS Server

Direct NFS Client can use up to four network paths defined in the oranfstab file for an NFS server. The Direct NFS Client performs load balancing across all specified paths. If a specified path fails, then Direct NFS Client re-issues all outstanding requests over any remaining paths.

Note: You can have only one active Direct NFS Client implementation for each instance. Using Direct NFS Client on an instance prevents the use of another Direct NFS Client implementation.

Example 6–1 and Example 6–2 provide examples of configuring network paths for the Direct NFS Client attributes in an oranfstab file.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mnt_timeout</td>
<td>(Optional) Specifies the time (in seconds) for which Direct NFS Client should wait for a successful mount before timing out. The default timeout is 10 minutes (600).</td>
</tr>
<tr>
<td>uid</td>
<td>(Optional) The UNIX user ID to be used by Direct NFS Client to access all NFS servers listed in oranfstab. The default value is uid:65534, which corresponds to user:nobody on the NFS server.</td>
</tr>
<tr>
<td>gid</td>
<td>(Optional) The UNIX group ID to be used by Direct NFS Client to access all NFS servers listed in oranfstab. The default value is gid:65534, which corresponds to group:nogroup on the NFS server.</td>
</tr>
<tr>
<td>nfs_version</td>
<td>(Optional) Specifies the NFS protocol that the Direct NFS Client uses. Possible values are NFSv3, NFSv4, and NFSv4.1. The default version is NFSv3. To specify NFSv4 or NFSv4.1, you must set the nfs_version parameter accordingly in the oranfstab file.</td>
</tr>
</tbody>
</table>

Attribute Description
6.8.6 Enabling the Direct NFS Client

To enable the Direct NFS Client, you must add an oranfstab file to Oracle_home\dbs. When oranfstab is placed in this directory, the entries in this file are specific to one particular database. The Direct NFS Client searches for the mount point entries as they appear in oranfstab. The Direct NFS Client uses the first matched entry as the mount point.

Complete the following procedure to enable the Direct NFS Client:

1. Create an oranfstab file and specify the attributes listed in Section 6.8.3, "Configurable Attributes for the oranfstab File" for each NFS server that the Direct NFS Client accesses:

   See Also: "Limiting Asynchronous I/O in NFS Server Environments" in Oracle Database Performance Tuning Guide

   The mount point specified in the oranfstab file represents the local path where the database files would reside normally, as if Direct NFS Client was not used. For example, if the location for the data files would be C:\app\oracle\oradata\orcl directory if the database did not use Direct NFS Client, then you specify C:\app\oracle\oradata\orcl for the NFS virtual mount point in the corresponding oranfstab file.

   Example 6–1 and Example 6–2 provide examples of how the Direct NFS Client attributes can be used in an oranfstab file.

   Note:
   - Direct NFS Client ignores a uid or gid value of 0.
   - The exported path from the NFS server must be accessible for read/write/execute by the user with the uid, gid specified in oranfstab. If neither uid nor gid is listed, then the exported path must be accessible by the user with uid:65534 and gid:65534.

2. Replace the standard ODM library, oraodm12.dll, with the ODM NFS library.

   Oracle Database uses the ODM library, oranfsodm12.dll, to enable Direct NFS Client. To replace the ODM library, complete the following steps:

   a. Change directory to Oracle_home\bin.
   b. Shut down the Oracle Database instance on a node using the Server Control Utility (SRVCTL).
   c. Enter the following commands:
      
      copy oraodm12.dll oraodm12.dll.orig
      copy /Y oranfsodm12.dll oraodm12.dll
   d. Restart the Oracle Database instance using SRVCTL.
   e. Repeat Step a to Step d for each node in the cluster.

Example 6–1 oranfstab File Using Local and Path NFS Server Entries

The following example of an oranfstab file shows an NFS server entry, where the NFS server, MyDataServer1, uses 2 network paths specified with IP addresses.

server: MyDataServer1
Configuring Direct NFS Client for Oracle RAC Data Files

Example 6–2  oranfstab File Using Network Connection Names

The following example of an oranfstab file shows an NFS server entry, where the NFS server, MyDataServer2, uses 4 network paths specified by the network interface to use, or the network connection name. Multiple export paths are also used in this example.

```
server: MyDataServer2
local: LocalInterface1
path: NfsPath1
local: LocalInterface2
path: NfsPath2
local: LocalInterface3
path: NfsPath3
local: LocalInterface4
path: NfsPath4
export: /vol/oradata2 mount: C:\APP\ORACLE\ORADATA\ORCL2
export: /vol/oradata3 mount: C:\APP\ORACLE\ORADATA\ORCL3
```

6.8.7 Performing Basic File Operations Using the ORADNFS Utility

ORADNFS is a utility which enables the database administrators to perform basic file operations over Direct NFS Client on Microsoft Windows platforms.

ORADNFS is a multi-call binary, which is a single binary that acts like many utilities. You must be a member of the local ORA_DBA group to use ORADNFS. To execute commands using ORADNFS you issue the command as an argument on the command line.

The following command prints a list of commands available with ORADNFS:

```
C:\> oradnfs help
```

To display the list of files in the NFS directory mounted as C:\ORACLE\ORADATA, use the following command:

```
C:\> oradnfs ls C:\ORACLE\ORADATA\ORCL
```

Note: A valid copy of the oranfstab configuration file must be present in Oracle_home\dbs for ORADNFS to operate.

6.8.8 Monitoring Direct NFS Client Usage

Use the following global dynamic performance views for managing Direct NFS Client usage with your Oracle RAC database:

- **GV$DNFS_SERVERS**: Lists the servers that are accessed using Direct NFS Client.
- **GV$DNFS_FILES**: Lists the files that are currently open using Direct NFS Client.
- **GV$DNFS_CHANNELS**: Lists the open network paths, or channels, to servers for which Direct NFS Client is providing files.
6.8.9 Disabling Oracle Disk Management Control of NFS for the Direct NFS Client

Complete the following steps to disable the Direct NFS Client:

1. Log in as the Oracle Grid Infrastructure software owner.
2. Restore the original oraodm12.dll file by reversing the process you completed in Section 6.8.6, “Enabling the Direct NFS Client.”
3. Remove the oranfstab file.

6.9 Upgrading or Migrating Existing Oracle ASM Instances

If you have an Oracle ASM installation from a prior release installed on your server, or in an existing Oracle Clusterware installation, then you can use ASMCA to upgrade the existing Oracle ASM instance to Oracle ASM 12c Release 1 (12.1). You can also use ASMCA to configure failure groups, Oracle ASM volumes and Oracle ACFS.

Note: You must first shut down all database instances and applications on the node with the existing Oracle ASM instance before upgrading it.

During installation, if you chose to use Oracle ASM and ASMCA detects that there is a prior Oracle ASM release installed in another Oracle ASM home, then after installing the Oracle ASM 12c Release 1 (12.1) binaries, you can start ASMCA to upgrade the existing Oracle ASM instance. You can then choose to configure an Oracle ACFS deployment by creating Oracle ASM volumes and using the upgraded Oracle ASM to create the Oracle ACFS.

If you are upgrading from Oracle ASM 11g Release 2 (11.2.0.1) or later, then Oracle ASM is always upgraded with Oracle Grid Infrastructure as part of the rolling upgrade, and ASMCA is started during the upgrade. ASMCA cannot perform a separate upgrade of Oracle ASM from a prior release to the current release.

On an existing Oracle Clusterware or Oracle RAC installation, if the prior release of Oracle ASM instances on all nodes is Oracle ASM 11g Release 1 or later, then you are provided with the option to perform a rolling upgrade of Oracle ASM instances. If the prior release of the Oracle ASM instances for an Oracle RAC installation are from a release prior to Oracle ASM 11g Release 1, then rolling upgrades cannot be performed. Oracle ASM on all nodes will be upgraded to Oracle ASM 12c Release 1 (12.1).

6.10 Configuring Oracle Automatic Storage Management Cluster File System

Oracle ACFS is installed as part of an Oracle Grid Infrastructure installation (Oracle Clusterware and Oracle Automatic Storage Management) for 12c Release 1 (12.1).

You can also create a General Purpose File System configuration of ACFS using ASMCA.
To create the Oracle home for your Oracle RAC database in Oracle ACFS, perform the following steps:

1. Install Oracle Grid Infrastructure for a cluster (Oracle Clusterware and Oracle ASM).

2. Go to the bin directory in the Grid home, for example:
   ```
   C:\> cd app\12.1.0\grid\bin
   ```

3. Ensure that the Oracle Grid Infrastructure installation owner has read and write permissions on the storage mountpoint you want to use. For example, to use the mountpoint `E:\data\acfsmounts`
   ```
   C:\..bin> dir /Q E:\data\acfsmounts
   ```

4. Start ASMCA as the Oracle Installation user for Oracle Grid Infrastructure, for example:
   ```
   C:\..\bin> asmca
   ```
   The Configure ASM: Disk Groups page is displayed.

5. The Configure ASM: ASM Disk Groups page shows you the Oracle ASM disk group you created during installation. Click the ASM Cluster File Systems tab.

6. On the ASM Cluster File Systems page, right-click the disk group in which you want to create the Oracle ADVM volume, then select Create ACFS for Database Home.

7. In the Create ACFS Hosted Database Home window, enter the following information:
   - **Database Home ADVM Volume Device Name**: Enter the name of the database home. The name must be unique in your enterprise, for example: `racdb_01`
   - **Database Home Mountpoint**: Enter the directory path or logical drive letter for the mountpoint. For example: `M:\acfsdisks\racdb_01`
     Make a note of this mountpoint for future reference.
   - **Database Home Size (GB)**: Enter in gigabytes the size you want the database home to be.
   - **Database Home Owner Name**: Enter the name of the Oracle Installation user you plan to use to install the database. For example: `oracle1`
   - Click OK when you have entered the required information.

8. If prompted, run any scripts as directed by ASMCA as the Local Administrator user.

---

**Note:**
- The compatibility parameters `COMPATIBLE.ASM` and `COMPATIBLE.ADVM` must be set to 11.2 or higher for the disk group to contain an Oracle ADVM volume.

**See Also:** Section 6.2.3, "Guidelines for Using Oracle ACFS with Oracle RAC"
On an Oracle Clusterware environment, the script registers the ACFS as a resource managed by Oracle Clusterware. Registering ACFS as a resource helps Oracle Clusterware to mount the ACFS automatically in the proper order when ACFS is used for an Oracle RAC database home.

9. During Oracle RAC 12c Release 1 (12.1) installation, ensure that you or the database administrator who installs Oracle RAC selects for the Oracle home the mountpoint you provided in the Database Home Mountpoint field (in the preceding example, this was M:\acfsdisks\racdb_01).

**Note:** You cannot place the Oracle home directory for Oracle Database 11g Release 1 or earlier releases on Oracle ACFS.

**See Also:** *Oracle Automatic Storage Management Administrator’s Guide* for more information about configuring and managing your storage with Oracle ACFS.
This chapter describes the procedures for installing Oracle Grid Infrastructure for a cluster. Oracle Grid Infrastructure consists of Oracle Clusterware and Oracle Automatic Storage Management (Oracle ASM). If you plan afterward to install Oracle Database with Oracle Real Application Clusters (Oracle RAC), then this is phase one of a two-phase installation.

This chapter contains the following topics:
- Installing Oracle Grid Infrastructure
- Installing Oracle Grid Infrastructure Using a Software-Only Installation
- Confirming Oracle Clusterware Function
- Confirming Oracle ASM Function for Oracle Clusterware Files
- Understanding Offline Processes in Oracle Grid Infrastructure

### 7.1 Installing Oracle Grid Infrastructure

This section provides information about how to use OUI to install Oracle Grid Infrastructure. It contains the following sections:
- Running OUI to Install Oracle Grid Infrastructure
- Performing a Silent Installation of Oracle Grid Infrastructure

### 7.1.1 Running OUI to Install Oracle Grid Infrastructure

Complete the following steps to install Oracle Grid Infrastructure (Oracle Clusterware and Oracle ASM) on your cluster. You can run OUI from a Virtual Network Computing (VNC) session, or Terminal Services in console mode.

At any time during installation, if you have a question about what you are being asked to do, then click the **Help** button on the OUI page.

1. Log in to Windows using a member of the Administrators group and run the `setup.exe` command from the Oracle Database 12c Release 1 (12.1) installation media.

2. Download software updates. You can use software updates you have previously downloaded for this release, or you can provide your registered My Oracle Support user name and password. You can also proceed without checking for updates.
3. Select one of the following installation options:

- **Install and Configure Oracle Grid Infrastructure for a Cluster**
  
  Select this option to install a standard cluster.

- **Install and Configure Oracle Grid Infrastructure for a Standalone Server**
  
  Select this option to install Oracle Grid Infrastructure in an Oracle Restart configuration. Use this option for single servers supporting Oracle Database and other applications.

  **See Also:** Oracle Database Installation Guide for Microsoft Windows for information about standalone server installations, which is not discussed in this document.

- **Upgrade Oracle Grid Infrastructure or Oracle Automatic Storage Management**
  
  Select this option to upgrade Oracle Grid Infrastructure (Oracle Clusterware and Oracle Grid Infrastructure), or to upgrade Oracle ASM.

  **Note:** Oracle Clusterware must always be the later release, so you cannot upgrade Oracle ASM to a release that is more recent than Oracle Clusterware.

- **Install Oracle Grid Infrastructure Software Only**
  
  Select this option to install Oracle Grid Infrastructure in a Grid home, without configuring the software.

4. Installation screens vary depending on the installation option you select. Respond to the configuration prompts as needed to configure your cluster.

  **Note:** Click Help if you have any questions about the information you are asked to submit during installation.

For cluster member node public and VIP network addresses, provide the information required depending on the kind of cluster you are configuring:

- If you plan to use automatic cluster configuration with DHCP addresses configured and resolved through GNS, then you only need to provide the GNS VIP names as configured on your DNS.

The following is a list of additional information about node IP addresses:

- For the local node only, OUI automatically fills in public and VIP fields. If your system uses vendor clusterware, then OUI may fill additional fields.

- Host names and virtual host names are not domain-qualified. If you provide a domain in the address field during installation, then OUI removes the domain from the address.

- Interfaces identified as private for private IP addresses should not be accessible as public interfaces. Using public interfaces for Cache Fusion can cause performance problems.

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.
5. Provide information as prompted by OUI. If you need assistance during installation, then click Help. After the installation interview, you can click Details to see the log file.

6. After you have specified all the information needed for installation, OUI installs the software. OUI then runs Oracle Net Configuration Assistant (NETCA), Oracle Private Interconnect Configuration Assistant, and Cluster Verification Utility (CVU). These programs run without user intervention.

7. If you selected Oracle ASM as the storage option for the OCR and voting files, then the Oracle Automatic Storage Management Configuration Assistant (ASMCA) configures Oracle ASM as part of the installation process. If you did not select Oracle ASM as the storage option for the Oracle Clusterware files, then you must start ASMCA manually after installation to configure Oracle ASM.

Start ASMCA using the following command, where Grid_home is the Grid home:

```
Grid_home\bin\asmca
```

When you have verified that your Oracle Grid Infrastructure installation has completed successfully, you can either use Oracle Clusterware and Oracle ASM to maintain high availability for other applications, or you can install Oracle Database and Oracle RAC software.

If you intend to install Oracle Database 12c Release 1 (12.1) with Oracle RAC, then see Oracle Real Application Clusters Installation Guide for Microsoft Windows x64 (64-Bit). If you intend to use Oracle Grid Infrastructure on a standalone server (an Oracle Restart deployment), then refer to Oracle Database Installation Guide for Microsoft Windows.

**See Also:**
- Oracle Clusterware Administration and Deployment Guide for cloning Oracle Grid Infrastructure
- Oracle Real Application Clusters Administration and Deployment Guide for information about using cloning and node addition procedures for Oracle RAC nodes

### 7.1.2 Performing a Silent Installation of Oracle Grid Infrastructure

During installation of Oracle Grid Infrastructure, you are given the option either of providing cluster configuration information manually, or of using a cluster configuration file. A cluster configuration file is a text file that you can create before starting OUI, which provides OUI with information about the cluster name and node names that it requires to configure the cluster. When creating the text file, save the file with the extension .ccf because the installer only accepts a file of type of Oracle Cluster Configuration File (.ccf).

Oracle suggests that you consider using a cluster configuration file if you intend to perform repeated installations on a test cluster, or if you intend to perform an installation on many nodes.

There are two steps involved when installing Oracle Grid Infrastructure using the silent method:

- Creating a Cluster Configuration File
- Using a Configuration File to Install Oracle Grid Infrastructure
7.1.2.1 Creating a Cluster Configuration File
To create a cluster configuration file manually, start a text editor, and create a file that provides the name of the public and virtual IP addresses for each cluster member node. Use the following format, where node is the name of the public host name for a node in the cluster, and vip is the VIP address for that node:

node  vip
node  vip
...

For example, if have three nodes for your cluster, with host names RACnode1, RACnode2 and RACnode3, you would create a text file named cluster_config.ccf, with the following contents:

RACnode1  RACnode1-vip
RACnode2  RACnode2-vip
RACnode3  RACnode3-vip

See Also: Appendix B, "Installing and Configuring Oracle Grid Infrastructure Using Response Files" for more information about using configuration files

7.1.2.2 Using a Configuration File to Install Oracle Grid Infrastructure
Complete the following procedure to perform a noninteractive (silent) installation:

1. Create a cluster configuration file as described in the previous section, "Performing a Silent Installation of Oracle Grid Infrastructure".
2. Use the following command syntax to run OUI in silent mode:

   setup.exe -silent -responseFile path_to_your_response_file

   For example:
   
   E:\ setup.exe -silent -responseFile C:\users\oracle\installGrid.rsp

See Also: Appendix B, "Installing and Configuring Oracle Grid Infrastructure Using Response Files" for more information about performing silent installations using configuration files

7.2 Installing Oracle Grid Infrastructure Using a Software-Only Installation
A software-only installation consists of installing Oracle Grid Infrastructure for a cluster on one node. If you use the Install Grid Infrastructure Software Only option during installation, then the Oracle Grid Infrastructure software is installed on the local node. To complete the installation for your cluster, you must perform the additional steps of configuring Oracle Clusterware and Oracle ASM, creating a clone of the local installation, deploying this clone on other nodes, and then adding the other nodes to the cluster.
If you select a software-only installation, then ensure that the Oracle Grid Infrastructure home path is identical on each cluster member node.

Performing a software-only installation involves the following steps:

1. **Installing Only the Oracle Grid Infrastructure Software**

2. Configuring the installed software using one of the following methods:
   - Configuring the Software Binaries Using Configuration Wizard Mode of OUI
   - Configuring the Software Binaries Using a Response File

### 7.2.1 Installing Only the Oracle Grid Infrastructure Software

To perform a software-only installation:

1. Log in to Windows using a member of the Administrators group and run the `setup.exe` command from the Oracle Grid Infrastructure 12c Release 1 (12.1) installation media or download directory.

2. Complete a software-only installation of Oracle Grid Infrastructure for a cluster on the first node, or the local node.

3. Verify that all of the cluster nodes meet the installation requirements using the command `runcluvfy.bat stage -pre crsinst -n node_list`. Ensure that you have completed all storage and server preinstallation requirements.

4. Use OUI as described in steps 1 through 3 to install the Oracle Grid Infrastructure software on every remaining node that you want to include in the cluster, and complete a software-only installation of Oracle Grid Infrastructure on every node.

5. Configure the cluster using the full OUI configuration wizard GUI as described in Section 7.2.2, "Configuring the Software Binaries Using Configuration Wizard Mode of OUI," or configure the cluster using a response file as described in section Section 7.2.3, "Configuring the Software Binaries Using a Response File."

### 7.2.2 Configuring the Software Binaries Using Configuration Wizard Mode of OUI

You can configure the software binaries by starting Oracle Grid Infrastructure configuration wizard in GUI mode.

1. On one of the nodes, log in as the Oracle Installation user, and enter the following command from the `crs\config` directory of the Grid home:

   ```
   C:\..\crs\config> config.bat
   ```

   The configuration script starts OUI in Configuration Wizard mode. Provide information as needed for configuration. Each page shows the same user interface and performs the same validation checks that OUI normally does. However, instead of running an installation, the configuration wizard mode validates inputs and configures the installation on all cluster nodes.

---

**Note:** Oracle recommends that only advanced users perform the software-only installation, because this installation method provides no validation of the installation and this installation option requires manual postinstallation steps to enable the Oracle Grid Infrastructure software.
2. When you complete inputs, OUI shows you the Summary page, listing all inputs you have provided for the cluster. Verify that the summary has the correct information for your cluster, and click **Install** to start configuration of the local node.

When configuration of the local node is complete, OUI copies the Oracle Grid Infrastructure configuration file to other cluster member nodes.

3. OUI checks the cluster configuration status, and starts other configuration tools as needed.

### 7.2.3 Configuring the Software Binaries Using a Response File

When you install or copy Oracle Grid Infrastructure software on any node, you can defer configuration for a later time. This section provides the procedure for completing configuration after the software is installed or copied on nodes, using the configuration wizard utility (**config.bat**).

**See Also:** *Oracle Clusterware Administration and Deployment Guide* for more information about the configuration wizard.

To configure Oracle Grid Infrastructure for a cluster using a response file:

1. As the Oracle Installation user for Oracle Grid Infrastructure (for example, grid), start OUI in Oracle Grid Infrastructure configuration wizard mode from the Oracle Grid Infrastructure software-only home using the following syntax, where **Grid_home** is the Oracle Grid Infrastructure home, and **filename** is the response file name:

   ```
   Grid_home\crs\config\config.bat [-debug] [-silent -responseFile filename]
   ```

   For example:

   ```
   C:\> cd app\12.1.0\grid\crs\config\config.bat -responseFile ..\..\response\installGrid.rsp
   ```

   The configuration script starts OUI in Configuration Wizard mode. Each page shows the same user interface and performs the same validation checks that OUI normally does. However, instead of running an installation, the configuration wizard mode validates inputs and configures the installation on all cluster nodes.

2. When you complete inputs, OUI shows you the Summary page, listing all inputs you have provided for the cluster. Verify that the summary has the correct information for your cluster, and click **Install** to start configuration of the local node.

When configuration of the local node is complete, OUI copies the Oracle Grid Infrastructure configuration file to other cluster member nodes.

3. OUI checks the cluster configuration status, and starts other configuration tools as needed.

To configure and activate a software-only Oracle Grid Infrastructure installation for a standalone server, refer to *Oracle Database Installation Guide for Microsoft Windows*.

### 7.2.4 Configuring the Software Binaries in Silent Mode Using a Response File

This section provides the procedure for completing configuration after the software is installed or copied on nodes, using the configuration wizard utility (**config.bat**) in silent (non-response) mode.
To configure Oracle Grid Infrastructure for a cluster in silent mode using a cluster configuration file:

1. As the Oracle Grid Infrastructure installation owner (grid), start OUI in Oracle Grid Infrastructure configuration wizard mode from the Oracle Grid Infrastructure software-only home using the following syntax, where Grid_home is the Oracle Grid Infrastructure home, and filename is the response file name, as shown in the following example:

   C:\> cd app\12.1.0\grid\crs\config
   C:\> config.bat -responseFile C:\app\12.1.0\grid\response\grid_install.rsp

   The wizard validates the cluster configuration file and proceeds with the configuration. If any of the inputs in the cluster configuration file are found to be invalid, then the Configuration Wizard displays an error and exits. Run the configToolAllCommands scripts as prompted.

2. When configuration of the local node is complete, OUI copies the Oracle Grid Infrastructure configuration file to other cluster member nodes.

3. OUI checks the cluster configuration status, and starts other configuration tools as needed.

### 7.3 Confirming Oracle Clusterware Function

After installation, log in as a member of the Administrators group, and run the following command from the bin directory in the Grid home to confirm that your Oracle Clusterware installation is installed and running correctly:

```bash
crsctl check cluster -all
```

**Example 7-1 Checking the Status of Oracle Clusterware**

To check the status of the Oracle Clusterware components on each node of your cluster, run the following command:

```bash
C:\..\bin\> crsctl check cluster -all
```

The output for this command is similar to the following:

```
*************************************************************************
node1:
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
*************************************************************************
node2:
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
*************************************************************************
```

### 7.4 Confirming Oracle ASM Function for Oracle Clusterware Files

If you installed the OCR and voting files on Oracle ASM, then run the following command from the Grid_home\bin directory to confirm that your Oracle ASM software is operational:

```bash
srvctl status asm
```
Oracle ASM is running only if it is needed for Oracle Clusterware files. If you did not configure Oracle Clusterware storage on Oracle ASM during installation, then the Oracle ASM instance should be down.

**Example 7–2 Checking the Status of Oracle ASM After Installing Oracle Grid Infrastructure**

To verify that your Oracle ASM installation is operational, run the following command, replacing `C:\app\12.1.0\grid` with the location of your Grid home. The text below the command is an example of the output returned by the command.

```
C:\app\12.1.0\grid\BIN> srvctl status asm
ASM is running on node node1
ASM is running on node node2
```

**Note:** To manage Oracle ASM or Oracle Net Services on Oracle Clusterware 12c Release 1 (12.1) or later installations, use the `srvctl` binary in the Oracle Grid Infrastructure home for a cluster (Grid home). If you have Oracle RAC or Oracle Database installed, then you cannot use the `srvctl` program in the database home (Oracle home) to manage Oracle ASM or Oracle Net Services.

### 7.5 Understanding Offline Processes in Oracle Grid Infrastructure

Oracle Grid Infrastructure provides required resources for various Oracle products and components. Some of those products and components are optional, so you can install and enable them after installing Oracle Grid Infrastructure. To simplify postinstallation additions, Oracle Grid Infrastructure preconfigures and registers all required resources for all products available for these products and components, but only activates them when you choose to add them. As a result, some components may be listed as OFFLINE after the installation of Oracle Grid Infrastructure.

Resources listed as TARGET:OFFLINE and STATE:OFFLINE do not need to be monitored. They represent components that are registered, but not enabled, so they do not use any system resources. If an Oracle product or component is installed on the system, and it requires a particular resource to be online, then the software will prompt you to activate the required offline resource.
Oracle Grid Infrastructure Postinstallation Procedures

This chapter describes how to complete the postinstallation tasks after you have installed the Oracle Grid Infrastructure software.

This chapter contains the following topics:

- Required Postinstallation Tasks
- Recommended Postinstallation Tasks
- Using Earlier Oracle Database Releases with Grid Infrastructure
- Modifying Oracle Clusterware Binaries After Installation

8.1 Required Postinstallation Tasks

You must perform the following tasks after completing your installation:

- Download and Install Patch Updates
- Configure the Oracle ARP Driver
- Configure Exceptions for the Windows Firewall

**Note:** Backing up a voting file is no longer required.

8.1.1 Download and Install Patch Updates

Refer to the My Oracle Support website for required patch updates for your installation.

[https://support.oracle.com](https://support.oracle.com)

On a regular basis Oracle provides patch sets that include generic and port specific fixes encountered by customers since the base product was released. Patch sets increment the 4th digit of the release number e.g. 11.2.0.1.0 to 11.2.0.3.0, these patch sets are fully regression tested in the same way that the base release is (i.e. 11.2.0.1.0). Customers are encouraged to apply these fixes.

If a customer encounters a critical problem that requires a fix prior to the next patch set becoming available, they can request that a one off fix is made available on top of the latest patch set. This delivery mechanism is similar to the Microsoft Hot Fixes and is known as an Oracle patch set exception (or interim patch). Unlike Unix platforms these patch set exceptions are delivered in a **patch set exception bundle** (cumulative patch bundle), which includes all fixes since the current patch set. For example, bug
12393432 is a patch set exception bundle, Patch 12, for Oracle Database Release 11.2.0.1 for Microsoft Windows (x64). You should always apply the latest patch bundle available for your release.

The patch set exception bundles also include the fixes for the CPU (Critical Patch Update), DST (Daylight Saving Time), PSU (Patch Set Update) and Recommended Patch Bundles. It is not required to have previous security patches applied before applying the patch set exception bundle. However, you must be on the stated patch set level for a given product home before applying the patch set exception bundle for that release.

Refer to Appendix D, "How to Upgrade to Oracle Grid Infrastructure 12c Release 1" for information about how to stop database processes in preparation for installing patches.

### 8.1.2 Configure the Oracle ARP Driver

Oracle Grid Infrastructure on Windows Server 2008 or Windows Server 2008 R2 requires the Oracle Address Resolution Protocol (ARP) driver.

1. Start the Oracle Grid Infrastructure stack, if it is not started.

   To check the status of the Oracle Grid Infrastructure stack, use:

   ```
   crsctl check crs
   ```

   To start the Oracle Grid Infrastructure stack, use:

   ```
   crsctl start crs
   ```

2. Use the `netcfg` utility to install the Oracle ARP driver, as shown in the following command:

   ```
   %systemroot%\system32\netcfg.exe -l Grid_home\bin\oraarpdrv.inf -c p
   -i orcl_ndisprot
   ```

   If "Oracle America, Inc." is not in list of the trusted publishers for the node, then select **Install** to allow the installation to continue.


   ```
   net.exe start oraarpdrv
   ```

4. Stop the following Oracle Clusterware resources:

   a. If GNS is configured for your cluster, then stop the GNS resource:

      ```
      Grid_home\bin\srvctl stop gns
      ```

      To determine if GNS is configured for your cluster, use the following command:

      ```
      Grid_home\bin\srvctl config gns
      ```

   b. Stop the SCAN resource.

      ```
      Grid_home\bin\srvctl stop scan -f
      ```

   c. Stop all node applications running on the cluster.

      ```
      Grid_home\bin\srvctl stop nodeapps -n nodename -f
      ```

5. Restart the Oracle Clusterware resources in the opposite order.
a. Stop all node applications running on the cluster.
   
   `Grid_home\bin\srvctl start nodeapps -n nodename`

b. Stop the SCAN resource.
   
   `Grid_home\bin\srvctl start scan`

c. If GNS is configured for your cluster, then stop the GNS resource:
   
   `Grid_home\bin\srvctl start gns`

### 8.1.3 Configure Exceptions for the Windows Firewall

If the Windows Firewall feature is enabled on one or more of the nodes in your cluster, then virtually all transmission control protocol (TCP) network ports are blocked to incoming connections. As a result, any Oracle product that listens for incoming connections on a TCP port will not receive any of those connection requests and the clients making those connections will report errors.

You must configure exceptions for the Windows Firewall if your system meets all of the following conditions:

- Oracle server-side components are installed on a computer running a supported version of Microsoft Windows. The list of components includes the Oracle Database, Oracle Grid Infrastructure, Oracle Real Application Clusters (Oracle RAC), network listeners, or any web servers or services.
- The Windows computer in question accepts connections from other computers over the network. If no other computers connect to the Windows computer to access the Oracle software, then no post-installation configuration steps are required and the Oracle software functions as expected.
- The Windows computer in question is configured to run the Windows Firewall. If the Windows Firewall is not enabled, then no post-installation configuration steps are required.

If all of the above conditions are met, then the Windows Firewall must be configured to allow successful incoming connections to the Oracle software. To enable Oracle software to accept connection requests, Windows Firewall must be configured by either opening up specific static TCP ports in the firewall or by creating exceptions for specific executables so they can receive connection requests on any ports they choose. This firewall configuration can be done by one of the following methods:

- Start the Windows Firewall application, select the Exceptions tab and then click either **Add Program** or **Add Port** to create exceptions for the Oracle software.
- From the command prompt, use the `netsh firewall add...` command.
- When Windows notifies you that a foreground application is attempting to listen on a port, and gives you the opportunity to create an exception for that executable. If you choose the create the exception in this way, the effect is the same as creating an exception for the executable either through Control Panel or from the command line.

The following sections list the Oracle Database 11g release 2 (11.2) executables that listen on TCP ports on Windows, along with a brief description of the executable. It is recommended that these executables (if in use and accepting connections from a remote, client computer) be added to the exceptions list for the Windows Firewall to ensure correct operation. In addition, if multiple Oracle homes are in use, firewall...
exceptions may have to be created for the same executable, for example, oracle.exe, multiple times, once for each Oracle home from which that executable loads.

- Firewall Exceptions for Oracle Database
- Firewall Exceptions for Oracle Database Examples (or the Companion CD)
- Firewall Exceptions for Oracle Gateways
- Firewall Exceptions for Oracle Clusterware and Oracle ASM
- Firewall Exceptions for Oracle RAC Database
- Firewall Exceptions for Other Oracle Products

See Also: Section A.11, "Troubleshooting Windows Firewall Exceptions"

8.1.3.1 Firewall Exceptions for Oracle Database

For basic database operation and connectivity from remote clients, such as SQL*Plus, Oracle Call Interface (OCI), Open Database Connectivity (ODBC), and so on, the following executables must be added to the Windows Firewall exception list:

- Oracle_home\bin\oracle.exe - Oracle Database executable
- Oracle_home\bin\tnslsnr.exe - Oracle Listener

If you use remote monitoring capabilities for your database, the following executables must be added to the Windows Firewall exception list:

- Oracle_home\bin\emagent.exe - Oracle Enterprise Manager
- Oracle_home\jdk\bin\java.exe - Java Virtual Machine (JVM) for Oracle Enterprise Manager

8.1.3.2 Firewall Exceptions for Oracle Database Examples (or the Companion CD)

After installing the Oracle Database Companion CD, the following executables must be added to the Windows Firewall exception list:

- Oracle_home\opmn\bin\opmn.exe - Oracle Process Manager
- Oracle_home\jdk\bin\java.exe - JVM

8.1.3.3 Firewall Exceptions for Oracle Gateways

If your Oracle database interacts with non-Oracle software through a gateway, then you must add the gateway executable to the Windows Firewall exception list. Table 8-1 table lists the gateway executables used to access non-Oracle software.

<table>
<thead>
<tr>
<th>Executable Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>omtsgreco.exe</td>
<td>Oracle Services for Microsoft Transaction Server</td>
</tr>
<tr>
<td>dg4sybs.exe</td>
<td>Oracle Database Gateway for Sybase</td>
</tr>
<tr>
<td>dg4tera.exe</td>
<td>Oracle Database Gateway for Teradata</td>
</tr>
<tr>
<td>dg4mysql.exe</td>
<td>Oracle Database Gateway for SQL Server</td>
</tr>
<tr>
<td>dg4db2.exe</td>
<td>Oracle Database Gateway for Distributed Relational Database Architecture (DRDA)</td>
</tr>
<tr>
<td>pg4arv.exe</td>
<td>Oracle Database Gateway for Advanced Program to Program Communication (APPC)</td>
</tr>
</tbody>
</table>
8.1.3.4 Firewall Exceptions for Oracle Clusterware and Oracle ASM

If you installed the Oracle Grid Infrastructure software on the nodes in your cluster, then you can enable the Windows Firewall only after adding the following executables and ports to the Firewall exception list. The Firewall Exception list must be updated on each node.

- `Grid_home\bin\gpnpd.exe` - Grid Plug and Play daemon
- `Grid_home\bin\oracle.exe` - Oracle Automatic Storage Management (Oracle ASM) executable (if using Oracle ASM for storage)
- `Grid_home\bin\racvip.exe` - Virtual Internet Protocol Configuration Assistant
- `Grid_home\bin\evmd.exe` - OracleEVMService
- `Grid_home\bin\crsd.exe` - OracleCRService
- `Grid_home\bin\ocssd.exe` - OracleCSService
- `Grid_home\bin\octssd.exe` - Cluster Time Synchronization Service daemon
- `Grid_home\bin\mDNSResponder.exe` - multicast-domain name system (DNS) Responder Daemon
- `Grid_home\bin\gipcd.exe` - Grid inter-process communication (IPC) daemon
- `Grid_home\bin\gnsd.exe` - Grid Naming Service (GNS) daemon
- `Grid_home\bin\chasd.exe` - OracleOHService
- `Grid_home\bin\TNSLSNR.EXE` - single client access name (SCAN) listener and local listener for Oracle RAC database and Oracle ASM
- `Grid_home\opmn\bin\ons.exe` - Oracle Notification Service (ONS)
- `Grid_home\jdk\jre\bin\java.exe` - JVM

8.1.3.5 Firewall Exceptions for Oracle RAC Database

For the Oracle RAC database, the executables that require exceptions are:

- `Oracle_home\bin\oracle.exe` - Oracle RAC database instance
- `Oracle_home\bin\emagent.exe` - Oracle Enterprise Manager agent
- `Oracle_home\jdk\bin\java.exe` - For the Oracle Enterprise Manager Database Console

In addition, the following ports should be added to the Windows Firewall exception list:

- Microsoft file sharing system management bus (SMB)
  - TCP ports from 135 through 139
- Direct-hosted SMB traffic without a network basic I/O system (NetBIOS)
8.1.3.6 Firewall Exceptions for Other Oracle Products
In addition to all the previously listed exceptions, if you use any of the Oracle software listed in, then you must create an exception for Windows Firewall for the associated executable.

<table>
<thead>
<tr>
<th>Oracle Software Product</th>
<th>Executable Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Guard Manager</td>
<td>dgmgrl.exe</td>
</tr>
<tr>
<td>Oracle Internet Directory lightweight directory access protocol (LDAP) Server</td>
<td>oidldapd.exe</td>
</tr>
<tr>
<td>External Procedural Calls</td>
<td>extproc.exe</td>
</tr>
</tbody>
</table>

8.2 Recommended Postinstallation Tasks
Oracle recommends that you complete the following tasks as needed after installing Oracle Grid Infrastructure:

- Optimize Memory Usage for Programs
- Create a Fast Recovery Area Disk Group
- Checking the SCAN Configuration

8.2.1 Optimize Memory Usage for Programs
The Windows operating system should be optimized for Memory Usage of ‘Programs’ instead of ‘System Caching’. To modify the memory optimization settings, perform the following steps:

1. From the Start Menu, select **Control Panel**, then **System**.
2. In the System Properties window, click the **Advanced** tab.
3. In the Performance section, click **Settings**.
4. In the Performance Options window, click the **Advanced** tab.
5. In the Memory Usage section, ensure Programs is selected.

8.2.2 Create a Fast Recovery Area Disk Group
During installation of Oracle Grid Infrastructure, if you select Oracle ASM for storage, a single disk group is created to store the Oracle Clusterware files. If you plan to create a single-instance database, an Oracle RAC database, or an Oracle RAC One Node database, then this disk group can also be used to store the data files for the database. However, you should create a separate disk group for the fast recovery area.

8.2.2.1 About the Fast Recovery Area and the Fast Recovery Area Disk Group
The fast recovery area is a unified storage location for all Oracle Database files related to recovery. Database administrators can define the **DB_RECOVERY_FILE_DEST** parameter to the path for the fast recovery area to enable on-disk backups, and rapid recovery of data. Enabling rapid backups for recent data can reduce requests to system administrators to retrieve backup tapes for recovery operations.
When you enable the fast recovery area in the database initialization parameter file, all RMAN backups, archive logs, control file automatic backups, and database copies are written to the fast recovery area. RMAN automatically manages files in the fast recovery area by deleting obsolete backups and archive files that are no longer required for recovery.

To use a fast recovery area in Oracle RAC, you must place it on an Oracle ASM disk group, a cluster file system, or on a shared directory that is configured through Direct network file system (NFS) for each Oracle RAC instance. In other words, the fast recovery area must be shared among all of the instances of an Oracle RAC database. Oracle Clusterware files and Oracle Database files can be placed on the same disk group as fast recovery area files. However, Oracle recommends that you create a separate fast recovery area disk group to reduce storage device contention.

The fast recovery area is enabled by setting the parameter `DB_RECOVERY_FILE_DEST` to the same value on all instances. The size of the fast recovery area is set with the parameter `DB_RECOVERY_FILE_DEST_SIZE`. As a general rule, the larger the fast recovery area, the more useful it becomes. For ease of use, Oracle recommends that you create a fast recovery area disk group on storage devices that can contain at least three days of recovery information. Ideally, the fast recovery area should be large enough to hold a copy of all of your data files and control files, the online redo logs, and the archived redo log files needed to recover your database using the data file backups kept under your retention policy.

Multiple databases can use the same fast recovery area. For example, assume you have created one fast recovery area disk group on disks with 150 gigabyte (GB) of storage, shared by three different databases. You can set the size of the fast recovery area for each database depending on the importance of each database. For example, if `test1` is your least important database, `products` is of greater importance and `orders` is of greatest importance, then you can set different `DB_RECOVERY_FILE_DEST_SIZE` settings for each database to meet your retention target for each database: 30 GB for `test1`, 50 GB for `products`, and 70 GB for `orders`.

See Also: Oracle Automatic Storage Management Administrator's Guide

8.2.2.2 Creating the Fast Recovery Area Disk Group

To create an Oracle ASM disk group for the fast recovery area:

1. Navigate to the `bin` directory in the Grid home and start Oracle ASM Configuration Assistant (ASMCA). For example:

   ```
   C:\> cd app\12.1.0\grid\bin
   C:\> asmca
   ```

2. ASMCA opens at the Disk Groups tab. Click Create to create a new disk group.

   The Create Disk Groups window opens.

3. In the Disk Group Name field, enter a descriptive name for the fast recovery area disk group, for example, FRA.

   In the Redundancy section, select the level of redundancy you want to use.

   In the Select Member Disks field, select eligible disks to be added to the fast recovery area, then click OK.

   The Diskgroup Creation window opens to inform you when disk group creation is complete.

4. Click OK to acknowledge the message, then click Exit to quit the application.
8.2.3 Checking the SCAN Configuration

The SCAN is a name that provides service access for clients to the cluster. Because the SCAN is associated with the cluster as a whole, rather than to a particular node, the SCAN makes it possible to add or remove nodes from the cluster without needing to reconfigure clients. It also adds location independence for the databases, so that client configuration does not have to depend on which nodes run a particular database instance. Clients can continue to access the cluster in the same way as with previous releases, but Oracle recommends that clients accessing the cluster use the SCAN.

You can use the command `cluvfy comp scan` located in `Grid_home\bin` to confirm that the DNS is correctly associating the SCAN with the addresses. For example:

```
C:\> cluvfy comp scan
Verifying scan
Checking Single Client Access Name (SCAN)...
Checking TCP connectivity to SCAN Listeners...
TCP connectivity to SCAN Listeners exists on all cluster nodes
Checking name resolution setup for "node1.example.com"...
Verification of SCAN VIP and Listener setup passed
Verification of scan was successful.
```

After installation, when a client sends a request to the cluster, the Oracle Clusterware SCAN listeners redirect client requests to servers in the cluster.

8.3 Configuring Oracle Enterprise Manager Cloud Control After an Upgrade

When upgrading Oracle Grid Infrastructure, one of the scripts run during the installation sets the state of the Windows services for the Oracle Enterprise Manager Database Control and Cloud Control agent to `MANUAL`. So, when you reboot a node, Windows does not restart the Database Control and Cloud Control agents automatically.

If you are managing Oracle Clusterware as target from Database Control or Cloud Control, you must login to all Database Control consoles and Cloud Control Consoles, update the `ORACLE_HOME` property for the Oracle Clusterware, Oracle ASM and Oracle Grid Infrastructure Listener targets to point to the new Grid home using the Monitoring Configuration user interface. If the Windows services for the Database control or Cloud Control agents are not started, you may need to manually start these services, then login to the Database Control consoles and Cloud Control Consoles to update the target properties.

After you modify and save the `ORACLE_HOME` target property of Oracle Clusterware and Oracle ASM targets, you can set the state of the Windows services for the Oracle Enterprise Manager Database Control and Cloud Control agent to `AUTOMATIC`.

8.4 Using Earlier Oracle Database Releases with Grid Infrastructure

Review the following sections for information about using earlier Oracle Database releases with Oracle Grid Infrastructure 12c Release 1 (12.1) installations:

- General Restrictions for Using Earlier Oracle Database Releases
Making Oracle ASM Available to Earlier Oracle Database Releases
Using ASMCA to Administer Disk Groups for Earlier Database Releases
Using the Correct LSNRCTL Commands
Starting and Stopping Cluster Nodes or Oracle Clusterware Resources

8.4.1 General Restrictions for Using Earlier Oracle Database Releases

You can use Oracle Database 10g and Oracle Database 11g with Oracle Clusterware and Oracle ASM 12c Release 1 (12.1). If you upgrade an existing release of Oracle Clusterware and Oracle ASM to Oracle Grid Infrastructure 11g Release 2 (11.2) (which includes Oracle Clusterware and Oracle ASM), and you also plan to upgrade your Oracle RAC database to Oracle Database 12c Release 1 (12.1), then the required configuration of the existing databases is completed automatically when you complete the Oracle RAC upgrade, and this section does not concern you.

However, if you upgrade to Oracle Grid Infrastructure 12c Release 1 (12.1), and you have existing Oracle RAC installations that you do not plan to upgrade, or if you install an earlier release of Oracle RAC (11.2) on a cluster running Oracle Grid Infrastructure 12c Release 1 (12.1), then you must complete additional configuration tasks or apply patches, or both, before the earlier database releases will work correctly with Oracle Grid Infrastructure.

Oracle Database homes can only be stored on Oracle ACFS if the database release is Oracle Database 11g Release 2 or higher. Earlier releases of Oracle Database cannot be installed on Oracle ACFS because these releases were not designed to use Oracle ACFS.

Note: Before you start an Oracle RAC or Oracle Database install on an Oracle Clusterware 12c Release 1 (12.1) installation, if you are upgrading from Oracle Clusterware 11g Release 1 or Oracle Clusterware 10g Release 2, you must first upgrade to Oracle Clusterware 11g Release 2. Then, you must move the OCR and voting files to Oracle ASM storage before upgrading to Oracle Clusterware 12c.

See Also:
- Section 8.1.1, "Download and Install Patch Updates"
- "Oracle 12c Upgrade Companion," which is available through Note 1462240.1 on My Oracle Support:

https://support.oracle.com/CSP/main/article?cmd=show?type=NST&id=1462240.1

8.4.2 Making Oracle ASM Available to Earlier Oracle Database Releases

To use Oracle ASM with Oracle Database releases earlier than Oracle Database 12c, you must use Local ASM or set the cardinality for Flex ASM to ALL, instead of the default of 3. After you install Oracle Grid Infrastructure 12c, to use Oracle ASM to provide storage service for Oracle Database releases that are earlier than Oracle Database 12c, you must use the following command to modify the Oracle ASM resource (ora.asm):

```
srvcnt modify asm -count ALL
```
This setting changes the cardinality of the Oracle ASM resource so that Flex ASM instances run on all cluster nodes. You must change the setting even if you have a cluster with 3 or less nodes to ensure previous release databases can find the `ora.node.sid.inst` instance alias.

### 8.4.3 Using ASMCA to Administer Disk Groups for Earlier Database Releases

Use Oracle ASM Configuration Assistant (ASMCA) to create and modify disk groups when you install earlier Oracle Database and Oracle RAC releases on Oracle Grid Infrastructure 11g installations. Starting with Oracle Grid Infrastructure 11g Release 2, Oracle ASM is installed as part of an Oracle Grid Infrastructure installation, with Oracle Clusterware. You can no longer use Database Configuration Assistant (DBCA) to perform administrative tasks on Oracle ASM.

See Also: *Oracle Automatic Storage Management Administrator’s Guide* for details on configuring disk group compatibility for databases using Oracle Database 11g Release 2 with Oracle Grid Infrastructure 12c Release 1 (12.1)

### 8.4.4 Using the Correct LSNRCTL Commands

To administer local and SCAN listeners using the Listener Control utility (LSNRCTL) in Oracle Clusterware and Oracle ASM 11g Release 2, use the `lsnrctl` program located in the Grid home. Do not attempt to use the `lsnrctl` programs from Oracle home locations for previous releases because they cannot be used with the new release.

### 8.4.5 Starting and Stopping Cluster Nodes or Oracle Clusterware Resources

Before shutting down Oracle Clusterware 12c Release 1 (12.1), if you have an Oracle RAC database registered with Oracle Clusterware, then you must do one of the following:

- Stop the Oracle Database 11g Release 2 database instances first, then stop the Oracle Clusterware stack
- Use the `crsctl stop crs -f` command to shut down the Oracle Clusterware stack and ignore any errors that are raised

If you need to shut down a cluster node that currently has Oracle Database and Oracle Grid Infrastructure running on that node, then you must perform the following steps to cleanly shutdown the cluster node:

- Use the `crsctl stop crs` command to shut down the Oracle Clusterware stack
- After Oracle Clusterware has been stopped, you can shutdown the Windows server using `shutdown -r`.

### 8.5 Modifying Oracle Clusterware Binaries After Installation

After installation, if you must modify the software installed in your Grid home, then you must first stop the Oracle Clusterware stack. For example, to apply a one-off patch, or modify any of the dynamic-link libraries (DLLs) used by Oracle Clusterware or Oracle ASM, you must follow these steps to stop and restart Oracle Clusterware.
Caution:  To put the changes you make to the Oracle Grid Infrastructure home into effect, you must shut down all executables that run in the Grid home directory and then restart them. In addition, shut down any applications that use Oracle shared libraries or DLL files in the Grid home.

Prepare the Oracle Grid Infrastructure home for modification using the following procedure:

1. Log in using a member of the Administrators group and go to the directory `Grid_home\bin`, where `Grid_home` is the path to the Oracle Grid Infrastructure home.
2. Shut down Oracle Clusterware using the following command:
   
   ```
   C:\..\bin> crsctl stop crs -f
   ```
3. After Oracle Clusterware is completely shut down, perform the updates to the software installed in the Grid home.
4. Use the following command to restart Oracle Clusterware:
   
   ```
   C:\..\bin> crsctl start crs
   ```
5. Repeat steps 1 through 4 on each cluster member node.
How to Modify or Deinstall Oracle Grid Infrastructure

This chapter describes how to modify or remove Oracle Clusterware and Oracle Automatic Storage Management (Oracle ASM) software.

This chapter contains the following topics:

- Deciding When to Deinstall Oracle Clusterware
- Migrating Standalone Grid Infrastructure Servers to a Cluster
- Changing the Oracle Grid Infrastructure Home Path
- Unconfiguring Oracle Clusterware Without Removing the Software
- Removing Oracle Clusterware and Oracle ASM Software

See Also: Product-specific documentation for requirements and restrictions to remove an individual product

9.1 Deciding When to Deinstall Oracle Clusterware

Remove installed components in the following situations:

- You have successfully installed Oracle Clusterware, and you want to remove the Oracle Clusterware installation, either in an educational environment, or a test environment.
- You have encountered errors during or after installing or upgrading Oracle Clusterware, and you want to reattempt an installation.
- Your installation or upgrade stopped because of a hardware or operating system failure.
- You are advised by Oracle Support to reinstall Oracle Clusterware.

9.2 Migrating Standalone Grid Infrastructure Servers to a Cluster

If you have an Oracle Database installation using Oracle Restart (an Oracle Grid Infrastructure installation for a standalone server), and you want to configure that server as a cluster member node, then complete the following tasks:

See Also: Oracle Clusterware Administration and Deployment Guide for more information about the configuration wizard.
1. Inspect the Oracle Restart configuration with the Server Control (SRVCTL) utility using the following syntax, where `db_unique_name` is the unique name for the database, and `lsnrname` is the name of the listener for the database:

```
svrctl config database -db db_unique_name
svrctl config service -db db_unique_name
svrctl config listener -listener lsnrname
```

Write down the configuration information for the server; you will need this information in a later step.

2. Stop all of the databases, services, and listeners that you discovered in step 1.

3. If present, unmount all Oracle Automatic Storage Management Cluster File System (Oracle ACFS) file systems.

4. Go to the directory `Grid_home\crs\install`, where `Grid_home` is the location of your Oracle Grid Infrastructure home (Grid home) directory, for example:

```
C:\> cd app\12.1.0\grid\crs\install
```

5. Deconfigure and deinstall the Oracle Grid Infrastructure installation for a standalone server (Oracle Restart) using the following command:

```
C:\..\install> perl roothas.pl -deconfig -force
```

6. Prepare the server for Oracle Clusterware configuration, as described in the previous chapters (Chapter 2 through Chapter 6). In addition, choose to install Oracle Grid Infrastructure for a cluster in the same location as Oracle Restart or in a different location:

   **Installing in the Same Location as Oracle Restart**
   
   a. Use the deinstallation tool to remove the Oracle Restart software, but with all disk groups intact.
   
   b. Proceed to step 7.

   **Installing in a Different Location than Oracle Restart**
   
   a. Install Oracle Grid Infrastructure for a cluster in the new Grid home software location

7. As the Oracle Installation user for Oracle Grid Infrastructure, run Oracle Clusterware Configuration Wizard, and save and stage the response file. For the `-responseFile` parameter, specify the full path name where the response file should be written by the Oracle Clusterware Configuration Wizard, for example:

```
C:\> cd Grid_home\crs\config
C:\..\config> config.bat -silent -responseFile C:\Users\dba1\scripts\GI.rsp
```

8. Mount the Oracle ASM disk group used by Oracle Restart.

9. If you used Oracle ACFS with Oracle Restart, then:

   a. Start Oracle ASM Configuration Assistant (ASMCA). Run the `volenable` command to enable all Oracle Restart disk group volumes.
   
   b. Mount all Oracle ACFS file systems manually.

10. Add back Oracle Clusterware services to the Oracle Clusterware home, using the information you wrote down in step 1, including adding back Oracle ACFS resources, by performing the following tasks:
a. Register the Oracle ACFS resources using a command similar to the following, where `Grid_home` is the location of your Oracle Grid Infrastructure installation:

```
C:\> Grid_home\bin\srvctl add filesystem -device \ORCLDATADISK4
    -diskgroup ORestartData -volume db1 -mountpointpath C:\app\12.1.0\grid\db1 -user grid
```

b. Add the Oracle Database for support by Oracle Grid Infrastructure for a cluster. Use the following command syntax, where `db_unique_name` is the unique name of the database on the node, and `nodename` is the name of the node:

```
srvctl add database -db db_unique_name -oraclehome %ORACLE_HOME% -node nodename
```

For example, for the database name `mydb` on the local node `node1`, first verify that the `ORACLE_HOME` environment variable is set to the location of the database home directory, then enter the following command to register the database with Oracle Clusterware:

```
C:\> srvctl add database -db mydb -oraclehome %ORACLE_HOME% -node node1
```

c. Register each database service, using the command `srvctl add service`. For example, if your database name is `mydb` and you created a service named `myservice` for this database, then enter the following command:

```
C:\> srvctl add service -db mydb -service myservice
```

### 9.3 Changing the Oracle Grid Infrastructure Home Path

After installing Oracle Grid Infrastructure for a cluster, if you need to change the location of the Grid home, then use the following steps as a guide to detach the existing Grid home, and to attach a new Grid home that uses the new location:

**Caution:** Before changing the Grid home, you must shut down all executables that run in the Grid home directory that you are modifying. In addition, shut down all applications that use Oracle shared libraries.

1. Login as an Administrator user or the Oracle Installation user for Oracle Grid Infrastructure (for example, `grid`).

2. Change directory to `Grid_home\bin` and enter the command `crsctl stop crs`. For example:

```
C:\> cd app\12.1.0\grid\BIN
C:\..\BIN> crsctl stop crs
```

3. Detach the existing Grid home by running the following command, where `C:\app\12.1.0\grid` is the existing Grid home location:

```
C:\> cd app\12.1.0\grid\oui\bin
C:\..\bin> setup.exe -silent -detachHome ORACLE_HOME= 'C:\app\12.1.0\grid' -local
```

4. Move the installed files for Oracle Grid Infrastructure from the old Grid home to the new Grid home. For example, if the old Grid home is `C:\app\12.1.0\grid` and the new Grid home is `D:\app\12c\grid`, use the following command:
C:\> xcopy C:\app\12.1.0\grid D:\app\12c\grid /E /I /H /K

5. Clone the Oracle Grid Infrastructure installation, using the instructions provided in "Creating a Cluster by Cloning Oracle Clusterware Step 3: Run the clone.pl Script on Each Destination Node," in Oracle Clusterware Administration and Deployment Guide.

When you navigate to the Grid home\clone\bin directory and run the clone.pl script, provide values for the input parameters that provide the path information for the new Grid home.

6. Enter the following command to start Oracle Clusterware in the new home location:
   
   D:\> cd app\12c\grid\crs\install
   D:\..install\> perl rootcrs.pl -patch -dstcrshome D:\app\12c\grid

7. Repeat steps 1 through 4 on each cluster member node.

   You must reconfigure Oracle Clusterware and Oracle ASM every time you move the Grid home.

9.4 Unconfiguring Oracle Clusterware Without Removing the Software

Running the rootcrs.pl command with the flags -deconfig -force enables you to deconfigure Oracle Clusterware on one or more nodes without removing the installed software. This feature is useful if you encounter an error on one or more cluster nodes during installation, such as incorrectly configured shared storage. By running rootcrs.pl -deconfig -force on nodes where you encounter an installation error, you can deconfigure Oracle Clusterware on those nodes, correct the cause of the error, and then run rootcrs.pl again to reconfigure Oracle Clusterware.

---

**Note:** Before deconfiguring Oracle Clusterware you must:

- Stop any databases, services, and listeners that may be installed and running
- Dismount ACFS file systems
- Disable ADVM volumes

---

**Caution:** Commands used in this section remove the Oracle Grid infrastructure installation for the entire cluster. To remove the installation from an individual node, refer to Oracle Clusterware Administration and Deployment Guide.

---

To deconfigure Oracle Clusterware:

1. Log in using a member of the Administrators group on a node where you encountered an error during installation.

2. Stop any databases, services, and listeners currently running from the Grid home.

3. If present, unmount all Oracle Automatic Storage Management Cluster File System (Oracle ACFS) file systems.

4. Change directory to Grid_home\crs\install. For example:
   
   C:\> cd C:\\app\\12.1.0\\grid\\crs\\install
5. Run `rootcrs.pl` with the `-deconfig -force` flags. For example:
   
   C:\..\install> perl rootcrs.pl -deconfig -force

   Repeat Step 1 through Step 5 on other nodes as required.

   **Note:** The `-force` flag must be specified when running the `rootcrs.pl` script if there exist running resources that depend on the resources started from the Oracle Clusterware home you are deleting, such as databases, services, or listeners. You must also use the `-force` flag if you are removing a partial, or failed installation.

6. If you are deconfiguring Oracle Clusterware on all nodes in the cluster, then on the last node, enter the following command:
   
   C:\..\install> perl rootcrs.pl -deconfig -force -lastnode

   The `-lastnode` flag completes deconfiguration of the cluster, including the Oracle Cluster Registry (OCR) and voting files.

---

9.5 Removing Oracle Clusterware and Oracle ASM Software

The `deinstall` tool removes Oracle Clusterware and Oracle ASM from your server. The following sections describe the deinstallation tool, and provide information about additional options to use with the command:

- About the Deinstallation Tool
- Using the Deinstallation Tool to Remove Oracle Clusterware and Oracle ASM
- Example Response File for Deinstall of Oracle Grid Infrastructure

9.5.1 About the Deinstallation Tool

Starting with Oracle Database 12c Release 1 (12.1), the deinstallation tool is integrated with the database installation media. You can run the deinstallation tool using the `setup.exe` command with the `-deinstall` and `-home` options from the base directory of the database, client or grid infrastructure installation media.

The deinstallation tool is also available as a separate command (`deinstall`) in Oracle home directories after installation. It is located in the `%ORACLE_HOME%\deinstall` directory.

The deinstallation tool uses the information you provide, plus information gathered from the software home to create a response file. You can alternatively supply a response file generated previously by the `deinstall.bat` command using the `-checkonly` flag and `-o` flag. You can also edit a response file template to create a response file.

The deinstallation tool (`deinstall.bat`) stops Oracle software, and removes Oracle software and configuration files on the operating system for a specific Oracle home. If you run the deinstallation tool to remove an Oracle Grid Infrastructure for a cluster home, then the deinstaller prompts you to run the `rootcrs.pl` script as a user that is a member of the Administrators group.
Caution: When you run the deinstall command, if the central inventory contains no other registered homes besides the home that you are deconfiguring and removing, then the deinstallation tool removes the following files and directory contents in the Oracle base directory of the Oracle Installation user:

- admin
- cfgtoollogs
- checkpoints
- diag
- oradata
- fast_recovery_area

Oracle strongly recommends that you configure your installations using an Optimal Flexible Architecture (OFA) configuration, and that you reserve Oracle base and Oracle home paths for exclusive use of Oracle software. If you have any user data in these locations in the Oracle base associated with the Oracle Installation user, then the deinstallation tool deletes this data.

In addition, for Oracle Grid Infrastructure installations:

- Dismount Oracle Automatic Storage Management Cluster File System (Oracle ACFS) and disable Oracle Automatic Storage Management Dynamic Volume Manager (Oracle ADVM) volumes.
- If Grid Naming Service (GNS) is in use, then notify the DNS administrator to delete the entry for the subdomain from DNS.

The default method for running the deinstallation tool is from the deinstall directory in the Oracle home as the Oracle Installation user:

C:\> %ORACLE_HOME%\deinstall\deinstall

The Deinstallation tool uses the following syntax, where variable content is indicated by italics:

deinstall.bat [-silent] [-checkonly] [-local]
[-paramfile complete path of input response file]
[-params name1=value name2=value 
-params "name1=value" [ "name2=value" "name3=value" ...]]
[-o complete path of directory for saving files] [-help]

To run the deinstallation tool from the database installation media, use the setup.exe command with the -deinstall option, followed by the -home option to specify the path of the Oracle home you want to remove. The command uses the following syntax, where variable content is indicated in italics:

setup.exe -deinstall -home complete path of Oracle home [-silent] [-checkonly]
[-local] [-paramfile complete path of input response file]
[-params "name1=value" [ "name2=value" "name3=value" ...]]
[-o complete path of directory for saving files] [-help]

Provide information about your servers as prompted or accept the defaults.

The deinstallation tool stops Oracle software, and removes Oracle software and configuration files on the operating system.
In addition, you can run the deinstallation tool with a response file, or select the following options to run the tool:

- **-home**

  Use this flag to indicate the home path of the Oracle home to check or deinstall. To deinstall Oracle software using the deinstall.bat command in the Oracle home you plan to deinstall, provide a response file in a location outside the Oracle home, and do not use the -home flag.

  If you run deinstall.bat from the Grid_home\deinstall path, then the -home flag is not required because the tool knows from which home it is being run. If you use setup.exe -deinstall from the installation media, then -home is mandatory.

- **-silent**

  Use this flag to run the deinstallation tool in noninteractive mode. This option requires one of the following:

  - A working system that it can access to determine the installation and configuration information; the -silent flag does not work with failed installations.
  
  - A response file that contains the configuration values for the Oracle home that is being deinstalled or deconfigured

  To create a response file, modify the template file deinstall.rsp.tmpl, located in the response folder of the Oracle home.

  If you have a working system, you can generate a response file to use or modify by running the deinstall.bat command with the -checkonly flag. The deinstall.bat command then discovers information from the Oracle home to deinstall and deconfigure. It generates the response file, which you can then use with the -silent option.

- **-checkonly**

  Use this flag to check the status of the Oracle software home configuration. Running the deinstall command with the -checkonly flag does not remove the Oracle configuration. This flag generates a response file that you can use with the deinstall.bat command.

  When you use the -checkonly flag to generate a response file, you are prompted to provide information about your system. You can accept the default value the tool has obtained from your Oracle installation, indicated inside brackets ([]), or you can provide different values. To accept the defaults, press Enter at each prompt.

- **-local**

  Use this flag on a multinode environment to deconfigure Oracle software in a cluster.

  When you run deinstall.bat with this flag, it deconfigures and deinstalls the Oracle software only on the local node (the node on which you run deinstall.bat) for non-shared Oracle home directories.

- **-paramfile complete path of input response file**

  This is an optional flag. You can use this flag to run deinstall.bat with a response file in a location other than the default. When you use this flag, provide the complete path where the response file is located. If you run the deinstall.bat command from the Oracle home that you plan to deinstall, then you do not need to use the -paramfile flag.
The default location of the response file depends on the location of the deinstallation tool:

- From the installation media or stage location: `<Drive>:\staging_location\deinstall\response`
- After installation, from the installed Oracle home: `%ORACLE_HOME%\deinstall\response`.

Use this flag with a response file to override one or more values in a response file that you created.

- `-o complete path of directory for saving response files`

Use this flag to provide a path other than the default location where the response file (`deinstall.rsp.tmpl`) is saved.

The default location of the response file depends on the invocation method of the deinstallation tool:

- From the installation media or stage location: `stagelocation\response`
  where `stagelocation` is the path of the base directory in the installation media, or in the staged files location.
- After installation, from the installed Oracle home: `%ORACLE_HOME%\deinstall\response`.

Use the help option to obtain additional information about the deinstallation tool option flags.

If you use the `deinstall.bat` command located in an Oracle home, then the deinstallation tool writes log files in the `C:\Program Files\Oracle\Inventory\logs` directory. If, however, you are using the `deinstall.bat` command to remove the last Oracle home installed on the server, then the log files are written to:

- `%TEMP%\deinstall<timestamp>\logs` if you run the deinstallation tool from the installer.

### 9.5.2 Using the Deinstallation Tool to Remove Oracle Clusterware and Oracle ASM

This section provides examples of using the Deinstallation tool to remove Oracle Grid Infrastructure software:

- Running `deinstall.bat` From Within the Oracle Home
- Running the Deinstallation Tool Interactively From the Installer
- Running `deinstall.bat` From the Oracle Home Using a Response File
- Generating a Response File For Use With the `deinstall.bat` Command

#### Example 9–1 Running `deinstall.bat` From Within the Oracle Home

The most common method of running the deinstallation tool is to use the version installed in the Oracle home being removed. The deinstallation tool determines the software configuration for the local Oracle home, and then provides default values at each prompt. You can either accept the default value, or override it with a different value. If the software in the Oracle home is not running (for example, after an unsuccessful installation), then the deinstallation tool cannot determine the
configuration, and you must provide all the configuration details either interactively or in a response file.

To use the deinstallation tool located in the Oracle home directory, issue the following commands. Where C:\app\12.1.0\grid is the location of Grid home:

C:\> app\12.1.0\grid\deinstall\deinstall.bat

Provide additional information as prompted. When using the deinstallation tool from a location other than within the Oracle home being removed, you must specify the -home option on the command line.

**Example 9–2 Running the Deinstallation Tool Interactively From the Installer**

If you run the deinstallation tool from the installer in the installation media, then when the deinstall.bat command runs, it uses the information you provide to determine the system configuration and then provides default values at each prompt. You can either accept the default value, or override it with a different value. If the software in the specified Oracle home is not running (for example, after an unsuccessful install attempt), then the deinstallation tool cannot determine the configuration, and you must provide all the configuration details either interactively or in a response file.

In this example, the setup.exe command is in the path /directory_path, where directory_path is the path to the database directory on the installation media, and C:\app\12.1.0\grid is the path to the Grid home that you want to remove. Use the following command while logged in as a member of the Administrators group to remove the Oracle Grid Infrastructure installation from your cluster:

C:\> cd directory_path
C:\..\database> setup.exe -deinstall -home C:\app\12.1.0\grid

Provide additional information as prompted. When using the deinstallation tool from a location other than within the Oracle home being removed, you must specify the -home option on the command line.

**Example 9–3 Running deinstall.bat From the Oracle Home Using a Response File**

To run the deinstall.bat command located in an Oracle Grid Infrastructure home and use a response file located at D:\Users\oracle\paramfile4.tmpl, enter the following commands while logged in as a member of the Administrators group:

C:\> cd %ORACLE_HOME%
C:\..\grid> deinstall\deinstall.bat -paramfile D:\Users\oracle\paramfile4.tmpl

**Example 9–4 Generating a Response File For Use With the deinstall.bat Command**

You can generate the a response file by running the deinstall.bat command with the -checkonly and -o flags before you run the command to deinstall the Oracle home, or you can use the response file template and manually edit it to create the response file.

To generate the response file deinstall_OraCrs11g_home1.rsp using deinstall.bat command located in the Oracle home and the -checkonly flag, enter a command similar to the following, where C:\app\12.1.0\grid is the location of the Grid home and C:\Users\oracle is the directory in which the generated response file is created:

C:\> app\12.1.0\grid\deinstall\deinstall.bat -checkonly -o C:\Users\oracle\
9.5.3 Example Response File for Deinstall of Oracle Grid Infrastructure

You can run the `deinstall` command with the `-paramfile` option. When you use this option, the deinstallation tool uses the values specified in the response file and, if needed, prompts you to supply any missing information.

The following is an example of a response file for a cluster on nodes `node1` and `node2`, in which the Oracle Grid Infrastructure for a cluster is installed by the user `grid`, the Grid home is `C:\app\12.1.0\grid`, the Oracle base (the Oracle base for Oracle Grid Infrastructure, containing Oracle ASM log files, Oracle Clusterware logs, and other administrative files) is `C:\app\grid\`, the central Oracle Inventory home is `C:\Program Files\Oracle\Inventory`, the virtual IP addresses (VIP) are 192.0.2.2 and 192.0.2.4, and the local node (the node on which you run the `deinstall.bat` command) is `node1`:

```bash
#Copyright (c) 2005, 2009 Oracle Corporation. All rights reserved.
VIP1_IP=192.0.2.2
LOCAL_NODE=node1
ORA_VD_DISKGROUPS=+DATA
VIP1_IF=PublicNIC
OCRID=
ObaseCleanupPtrLoc=C:\Temp\OraDeinstall112010-02-11_10-14-30AM\util\...
HELPJAR_NAME=help4.jar
local=false
ORACLE_HOME=C:\app\12.1.0\grid
ASM_HOME=C:\app\12.1.0\grid
ASM_DISK_GROUPS=
ASM_DISK_GROUP=DATA
ORA_DB_INDEX=
ASM_DISCOVERY_STRING=
NEW_HOST_NAME_LIST=
PRIVATE_NAME_LIST=
ASM_DISKSTRING=
CRS_HOME=true
JLIBDIR=C:\app\12.1.0\grid\jlib
OCRLOC=
JEWTJAR_NAME=jewt4.jar
EMBASEJAR_NAME=oemlt.jar
CRS_STORAGE_OPTION=1
ASM_REDUNDANCY=EXTERNAL
GPNPGCONFIGDIR=$ORACLE_HOME
LANGUAGE_ID='AMERICAN_AMERICA.WE8MSWIN1252'
CRS_NODEVIPS='node1-vip/255.255.252.0/PublicNIC,node2-vip/255.255.252.0/PublicNIC'
ORACLE_OWNER=Administrator
OLD_ACTIVE_ORACLE_HOME=
GNS.Allow.Net.List=
silent=false
LOGDIR=C:\Temp\OraDeinstall112010-02-11_10-14-30AM\logs\OCFS_CONFIG=
NODE_NAME_LIST=node1,node2
GNS_DENY_ITF_LIST=
ORA_CRS_HOME=C:\app\12.1.0\grid
JREDIR=C:\app\12.1.0\grid\jdk\jre
ASM_LOCAL_SID=+asm1
ORACLE_BASE=C:\app\oracle\GNS_CONF=false
NETCFGJAR_NAME=netcfg.jar
ORACLE_BINARY_OK=true
OCR_LOCATIONS=NO_VAL
ASM.ORACLE_BASE=C:\app\oracle
OLRLOC=
```
Removing Oracle Clusterware and Oracle ASM Software

GPNPCONFIGDIR=$ORACLE_HOME
ORA_ASM_GROUP=
GNS_DENY_NET_LIST=
OLD_CRS_HOME=
EWITJAR_NAME=ewt3.jar
NEW_NODE_NAME_LIST=
GNS_DOMAIN_LIST=
ASM_UPGRADE=false
NETCA_LISTENERS_REGISTERED_WITH_CRS=LISTENER
CLUSTER_NODES=node1,node2
CLUSTER_GUID=
NEW_PRIVATE_NAME_LIST=
ASM_DIAGNOSTIC_DEST=C:\APP\ORACLE
CLSCFG_MISSCOUNT=
SCAN_PORT=1521
ASM_DROP_DISKGROUPS=true
NETWORKS="PublicNIC"/192.0.2.1:public,"PrivateNIC"/10.0.0.1:cluster_interconnect
OCR_VOTINGDISK_IN_ASM=true
NODELIST=node1,node2
ASM_IN_HOME=true
HOME_TYPE=CRS
GNS_ADDR_LIST=
CLUSTER_NAME=myrac-cluster
SHAREJAR_NAME=share.jar
VOTING_DISKS=NO_VAL
SILENT=false
VNDR_CLUSTER=false
GPNP_PA=
CSSLEASEDURATION=400
REMOTE_NODES=node2
ASM_SPFILE=
HOST_NAME_LIST=node1,node2
SCAN_NAME=myrac-scan
VIP1_MASK=255.255.252.0
INVENTORY_LOCATION=C:\Program Files\Oracle\Inventory

Note: Do not use quotation marks around any of the values in this file, except in the following cases:

- Around addresses for the CRS_NODEVIPS parameter:
  
  CRS_NODEVIPS='node1-vip/255.255.252.0/PublicNIC,node2-vip/..

- Around interface names for the NETWORKS parameters:
  
  NETWORKS="PublicNIC"/192.0.2.1:public,"PrivateNIC"/10.0.0.1:cluster_interconnect
This appendix provides troubleshooting information for installing Oracle Grid Infrastructure.

See Also:

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

This appendix contains the following topics:

- Best Practices for Contacting Oracle Support
- General Installation Issues
- Interpreting CVU "Unknown" Output Messages Using Verbose Mode
- Interpreting CVU Messages About Oracle Grid Infrastructure Setup
- About the Oracle Clusterware Alert Log
- Oracle Clusterware Install Actions Log Errors and Causes
- Performing Cluster Diagnostics During Oracle Grid Infrastructure Installations
- About Using CVU Cluster Healthchecks After Installation
- Interconnect Configuration Issues
- Storage Configuration Issues
- Troubleshooting Windows Firewall Exceptions
- Failed or Incomplete Installations and Upgrades
- Completing Failed or Interrupted Upgrades

A.1 Best Practices for Contacting Oracle Support

If you find that it is necessary for you to contact Oracle Support to report an issue, then Oracle recommends that you follow these guidelines when you enter your service request:

- Provide a clear explanation of the problem, including exact error messages.
- Provide an explanation of any steps you have taken to troubleshoot issues, and the results of these steps.
Provide exact releases (major release and patch release) of the affected software.

Provide a step-by-step procedure of what actions you carried out when you encountered the problem, so that Oracle Support can reproduce the problem.

Provide an evaluation of the effect of the issue, including affected deadlines and costs.

Provide screen shots, logs, Remote Diagnostic Agent (RDA) output, or other relevant information.

A.2 General Installation Issues

The following is a list of examples of types of errors that can occur during installation. It contains the following issues:

- CLSRSC-444: Run `root` script on the Node with OUI session
- Nodes unavailable for selection from the OUI Node Selection screen
- Node nodename is unreachable
- PROT-8: Failed to import data from specified file to the cluster registry
- Timed out waiting for the CRS stack to start

**See Also:** For additional help in resolving error messages, see My Oracle Support. For example, the note with Doc ID 1367631.1 contains some of the most common installation issues for Oracle Grid Infrastructure and Oracle Clusterware.

**CLSRSC-444: Run `root` script on the Node with OUI session**

**Cause:** If this message appears listing a node that is not the one where you are running OUI, then the likely cause is that the named node shut down during or before the `root` script completed its run.

**Action:** Retry the installation from the first node. After you complete Oracle Grid Infrastructure on all or part of the set of planned cluster member nodes, start OUI and deinstall the failed Oracle Grid Infrastructure installation on the node named in the error. When you have deinstalled the failed installation on the node, add that node manually to the cluster.

**See Also:** Oracle Clusterware Administration and Deployment Guide for information about how to add a node.

Failure to start network or VIP resources when Microsoft Failover Cluster is installed

**Cause:** If Microsoft Failover Cluster (MSFC) is installed on a Windows Server 2008 cluster (even if it is not configured) and you attempt to install Oracle Grid Infrastructure, the installation fails during the 'Configuring Grid Infrastructure' phase with an indication that it was unable to start the resource `ora.net1.network` or the VIP resources.

When MSFC is installed, it creates a virtual network adapter and places it at the top of the binding order. This change in the binding order can only be seen in the registry; it is not visible through 'View Network Connections' under Server Manager.

**Action:** The only solution is not to install MSFC and Oracle Grid Infrastructure or Oracle Clusterware on the same Windows Server 2008 cluster.
Nodes unavailable for selection from the OUI Node Selection screen

*Cause:* Oracle Grid Infrastructure is either not installed, or the Oracle Grid Infrastructure services are not up and running.

*Action:* Install Oracle Grid Infrastructure, or review the status of your installation. Consider restarting the nodes, as doing so may resolve the problem.

Node *nodename* is unreachable

*Cause:* Unavailable IP host

*Action:* Attempt the following:

1. At a command prompt, run the command `ipconfig /all`. Compare the output of this command with the contents of the *hosts* file to ensure that the node IP is listed.
2. Run the operating system command `nslookup` to see if the host is reachable.

PROT-8: Failed to import data from specified file to the cluster registry

*Cause:* Insufficient space in an existing Oracle Cluster Registry device partition, which causes a migration failure while performing an upgrade. To confirm, look for the error "utopen:12:Not enough space in the backing store" in the log file `%GRID_HOME%\log\hostname\client\ocrconfig_pid.log`, where `pid` stands for the process id.

*Action:* Identify a storage device that has 400 MB or more available space. Oracle recommends that you allocate the entire disk to Oracle ASM.

Timed out waiting for the CRS stack to start

*Cause:* If a configuration issue prevents the Oracle Grid Infrastructure software from installing successfully on all nodes, then you may see error messages such as "Timed out waiting for the CRS stack to start," or you may notice that Oracle Clusterware-managed resources were not create on some nodes after you exit the installer. You also may notice that resources have a status other than ONLINE.

*Action:* Unconfigure the Oracle Grid Infrastructure installation without removing binaries, and review log files to determine the cause of the configuration issue. After you have fixed the configuration issue, rerun the scripts used during installation to configure Oracle Clusterware.

See Also: Section 9.4, "Unconfiguring Oracle Clusterware Without Removing the Software"

### A.2.1 Other Installation Issues and Errors

For additional help in resolving error messages, see My Oracle Support. For example, the note with Doc ID 1367631.1 contains some of the most common installation issues for Oracle Grid Infrastructure and Oracle Clusterware.

### A.3 Interpreting CVU "Unknown" Output Messages Using Verbose Mode

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

- The node is down
- Common operating system command binaries required by Cluster Verification Utility are missing in the `bin` directory of the Oracle Grid Infrastructure home or Oracle home directory
- The user account starting Cluster Verification Utility does not have privileges to run common operating system commands on the node
- The node is missing an operating system patch, or a required package

### A.4 Interpreting CVU Messages About Oracle Grid Infrastructure Setup

If the Cluster Verification Utility report indicates that your system fails to meet the requirements for Oracle Grid Infrastructure installation, then use the topics in this section to correct the problem or problems indicated in the report, and run Cluster Verification Utility again.

#### User Equivalence Check Failed

**Cause:** Failure to establish user equivalency across all nodes. This can be due to not creating the required users, the installation user not being the same on all nodes, or using a different password on the failed nodes.

**Action:** Cluster Verification Utility provides a list of nodes on which user equivalence failed. For each node listed as a failure node, review the Oracle Installation user configuration to ensure that the user configuration is properly completed, and that user equivalence is properly completed.

Check to ensure that:

- You are using a Domain user account that has been granted explicit membership in the Administrators group on each cluster node.
- The user account has the same password on each node.
- The domain for the user is the same on each node.
- The user account has administrative privileges on each node.
- The user can connect to the registry of each node from the local node.
- You might have to change the User Account Control settings on each node:
  - Confirm that the Administrators group is listed under 'Manage auditing and security log'.

#### Node Reachability Check or Node Connectivity Check Failed

**Cause:** One or more nodes in the cluster cannot be reached using TCP/IP protocol, through either the public or private interconnects.

**Action:** Use the command `ping address` to check each node address. When you find an address that cannot be reached, check your list of public and private addresses to ensure that you have them correctly configured. Ensure that the public and private network interfaces have the same interface names on each node of your cluster.

Do not use the names PUBLIC and PRIVATE (all capital letters) for your public and interconnect network adapters (NICs). You can use the variations of private, Private, public, and Public for the network interface names.
A.5 About the Oracle Clusterware Alert Log

The Oracle Clusterware alert log is the first place to look for serious errors. In the event of an error, it can contain path information to diagnostic logs that can provide specific information about the cause of errors.

After installation, Oracle Clusterware posts alert messages when important events occur. For example, you may see alert messages from the Cluster Ready Services daemon process (CRSD) when it starts, if it aborts, if the failover process fails, or if automatic restart of an Oracle Clusterware resource fails.

Oracle Enterprise Manager monitors the Oracle Clusterware alert log and posts an alert on the Cluster Home page if an error is detected. For example, if a voting file is not available, then a CRS-1604 error is raised, and a critical alert is posted on the Cluster Home page. You can customize the error detection and alert settings on the Metric and Policy Settings page.

The location of the Oracle Clusterware log file is Grid_home\log\hostname\alerthostname.log, where Grid_home is the directory in which Oracle Clusterware was installed and hostname is the host name of the local node.

See Also:
- Oracle Clusterware Administration and Deployment Guide
- Chapter 3, "Configuring Operating Systems for Oracle Grid Infrastructure and Oracle RAC"

A.6 Oracle Clusterware Install Actions Log Errors and Causes

During installation of the Oracle Grid Infrastructure software, a log file named installActions<Date_Timestamp>.log is written to the %TEMP%\OraInstall<Date_Timestamp> directory.

The following is a list of potential errors in the installActions.log:

- PRIF-10: failed to initialize the cluster registry
  Configuration assistant "Oracle Private Interconnect Configuration Assistant" failed
- KFOD-0311: Error scanning device device_path_name
- Step 1: checking status of Oracle Clusterware cluster
  Step 2: configuring OCR repository
  ignoring upgrade failure of ocr(-1073740972)
  failed to configure Oracle Cluster Registry with CLSCFG, ret -1073740972

Each of these error messages can be caused by one of the following issues:
A.6.1 Symbolic links for disks were not removed
When you stamp a disk with ASMTOOL, it creates symbolic links for the disks. If these links are not removed when the disk is deleted or reconfigured, then errors can occur when attempting to access the disks.

To correct the problem, you can try stamping the disks again with ASMTOOL.

A.6.2 Discovery string used by Oracle Automatic Storage Management is incorrect
When specifying Oracle Automatic Storage Management (Oracle ASM) for storage, you have the option of changing the default discovery string used to locate the disks. If the discovery string is set incorrectly, Oracle ASM will not be able to locate the disks.

A.6.3 You used a period in a node name during Oracle Clusterware install
Periods (.) are not permitted in node names. Instead, use a hyphen (-).

To resolve a failed installation, remove traces of the Oracle Grid Infrastructure installation, and reinstall with a supported node name.

A.6.4 Ignoring upgrade failure of ocr(-1073740972)
This error indicates that the user that is performing the installation does not have Administrator privileges.

A.7 Performing Cluster Diagnostics During Oracle Grid Infrastructure Installations
If the installer does not display the Node Selection page, then use the following command syntax to check the integrity of the Cluster Manager:

```
cluvfy comp clumgr -n node_list -verbose
```

In the preceding syntax example, the variable node_list is the list of nodes in your cluster, separated by commas.

**Note:** If you encounter unexplained installation errors during or after a period when scheduled tasks are run, then your scheduled task may have deleted temporary files before the installation is finished.
Oracle recommends that you complete the installation before scheduled tasks are run, or disable scheduled tasks that perform cleanup until after the installation is completed.

A.8 About Using CVU Cluster Healthchecks After Installation
Starting with Oracle Grid Infrastructure 11g Release 2 (11.2.0.3) and later, you can use the CVU healthcheck command option to check your Oracle Clusterware and Oracle Database installations for their compliance with mandatory requirements and best practices guidelines, and to check to ensure that they are functioning properly.

Use the following syntax to run the healthcheck command option:

```
cluvfy comp healthcheck [-collect {cluster|database}] [-db db_unique_name] [-bestpractice|-mandatory] [-deviations] [-html] [-save [-savedir directory_path]]
```
For example:

C:\> cd app\12.1.0\grid\cvu_home\bin
C:\..\bin> cluvfy comp healthcheck -collect cluster -bestpractice -deviations -html

The options are:

- `collect [cluster|database]`
  
  Use this flag to specify that you want to perform checks for Oracle Clusterware (cluster) or Oracle Database (database). If you do not use the collect flag with the healthcheck option, then cluvfy comp healthcheck performs checks for both Oracle Clusterware and Oracle Database.

- `db db_unique_name`
  
  Use this flag to specify checks on the database unique name that you enter after the `db` flag.
  
  CVU uses JDBC to connect to the database as the user `cvusys` to verify various database parameters. For this reason, if you want checks to be performed for the database you specify with the `-db` flag, then you must first create the `cvusys` user on that database, and grant that user the CVU-specific role, `CVUSAPP`. You must also grant members of the `CVUSAPP` role `SELECT` permissions on system tables.
  
  A SQL script, `Grid_home\cv\admin\cvusys.sql`, is provided to facilitate the creation of this user. Use this SQL script to create the `cvusys` user on all the databases that you want to verify using CVU.
  
  If you use the `db` flag but do not provide a database unique name, then CVU discovers all the Oracle Databases on the cluster. To perform best practices checks on these databases, you must create the `cvusys` user on each database, and grant that user the `CVUSAPP` role with the `SELECT` privileges needed to perform the best practice checks.

- `[-bestpractice | -mandatory] [-deviations]`
  
  Use the `bestpractice` flag to specify best practice checks, and the `mandatory` flag to specify mandatory checks. Add the `deviations` flag to specify that you want to see only the deviations from either the best practice recommendations or the mandatory requirements. You can specify either the `-bestpractice` or `-mandatory` flag, but not both flags. If you specify neither `-bestpractice` or `-mandatory`, then both best practices and mandatory requirements are displayed.

- `html`
  
  Use the `html` flag to generate a detailed report in HTML format.
  
  If you specify the `html` flag, and a browser CVU recognizes is available on the system, then the browser is started and the report is displayed on the browser when the checks are complete.
  
  If you do not specify the `html` flag, then the detailed report is generated in a text file.

- `[-save [-savedir dir_path]]`
  
  Use the `save` or `save -savedir dir_path` flags to save validation reports (`cvuchecdkreport_timestamp.txt` and `cvucheckreport_timestamp.htm`), where `timestamp` is the time and date of the validation report.
  
  If you use the `save` flag by itself, then the reports are saved in the path `CVU_home/cv/report`, where `CVU_home` is the location of the CVU binaries.
If you use the flags \-save \-savedir, and enter a path where you want the CVU reports saved, then the CVU reports are saved in the path you specify.

A.9 Interconnect Configuration Issues

If you plan to use multiple network interface cards (NICs) for the interconnect, and you do not configure them during installation or after installation with Redundant Interconnect Usage, then you should use a third party solution to bond the interfaces at the operating system level. Otherwise, the failure of a single NIC will affect the availability of the cluster node.

If you install Oracle Grid Infrastructure and Oracle RAC, then they must use the same bonded NIC cards or teamed NIC cards for the interconnect. If you use bonded or teamed NIC cards, then they must be on the same subnet.

If you encounter errors, then perform the following system checks:

- Verify with your network providers that they are using the correct cables (length, type) and software on their switches. In some cases, to avoid bugs that cause disconnects under loads, or to support additional features such as Jumbo Frames, you may need a firmware upgrade on interconnect switches, or you may need newer NIC driver or firmware at the operating system level. Running without such fixes can cause later instabilities to Oracle RAC databases, even though the initial installation seems to work.

- Review virtual local area network (VLAN) configurations, duplex settings, and auto-negotiation in accordance with vendor and Oracle recommendations.

A.10 Storage Configuration Issues

The following is a list of issues involving storage configuration:

- Recovery from Losing a Node File System or Grid Home
- Oracle ASM Storage Issues
- Oracle ASM Issues After Upgrading Oracle Grid Infrastructure

A.10.1 Recovery from Losing a Node File System or Grid Home

If you remove a file system by mistake, or encounter another storage configuration issue that results in losing the Oracle Local Registry or otherwise corrupting a node, you can recover the node in one of two ways:

1. Restore the node from an operating system level backup (preferred)
2. Remove the node from the cluster, and then add the node to the cluster, using Grid home/addnode/addnode.bat. Profile information for the cluster is copied to the node, and the node is restored.

Using addnode.bat enables cluster nodes to be removed and added again, so that they can be restored from the remaining nodes in the cluster. If you add nodes in a GNS configuration, then that is called Grid Plug and Play (GPnP). GPnP uses profiles to configure nodes, which eliminates configuration data requirements for nodes and the need for explicit add and delete nodes steps. GPnP allows a system administrator to take a template system image and run it on a new node with no further configuration. GPnP removes many manual operations, reduces the opportunity for errors, and encourages configurations that can be changed easily. Removal of individual node configuration makes the nodes easier to replace, because nodes do not need to contain individually-managed states.
Grid Plug and Play reduces the cost of installing, configuring, and managing database nodes by making their state disposable. It allows nodes to be easily replaced with regenerated state.

You initiate recovery of a node using the `addnode` command, similar to the following, where `lostnode` is the node that you are adding back to the cluster:

If you are using Grid Naming Service (GNS):

```bash
C:\Grid_home\addnode\bin> addNode.bat -silent "CLUSTER_NEW_NODES=lostnode"
```

If you are not using GNS:

```bash
C:\Grid_home\addnode\bin> addNode.bat -silent "CLUSTER_NEW_NODES={lostnode}"

"CLUSTER_NEW_VIRTUAL_HOSTNAMES={lostnode-vip}"
```

You must run the `addNode.bat` command as an Administrator user on the node that you are restoring, to recreate OCR keys and to perform other configuration tasks.

After the `addNode.bat` command finishes, run the following command on the node being added to the cluster:

```bash
C:\> Grid_home\crs\config\gridconfig.bat
```

**See Also:** Oracle Clusterware Administration and Deployment Guide for information about how to add nodes manually or with GNS

### A.10.2 Oracle ASM Storage Issues

This section describes Oracle ASM storage error messages, and how to address these errors.

**ASM-0001: could not open device \?\volume...**

O/S-Error: (OS-5) Access is denied.

**Cause:** User Account Control (UAC) can require administrators to specifically approve administrative actions or applications before they are allowed to run. If you do not supply the proper credentials, the `asmtool` and `asmtoolg` utilities report these errors.

**Action:** There are a few ways to resolve this problem:

1. Click **Continue** in the UAC dialog box if you are logged in as an administrative user, or provide the credentials for an administrator user, then click **Continue**.

2. Create a desktop shortcut to a command window. Open the command window using the **Run as Administrator** option, then right-click the context menu, and launch `asmtool`.

3. Configure the UAC implementation on your Windows Server to turn off UAC or to change the elevation prompt behavior for administrator users.


**O/S-Error: (OS-2) The system cannot find the file specified.**
Troubleshooting Windows Firewall Exceptions

Cause: If a disk is disabled at the operating system level and enabled again, some of the Oracle ASM operations such as CREATE DISKGROUP, MOUNT DISKGROUP, ADD DISK, ONLINE DISK, or querying V$ASM_DISK fail with the error:

OS Error: (OS-2) The system cannot find the file specified.

This happens when a previously mounted disk is assigned a new volume ID by the operating system. When Oracle ASM uses the old volume ID, it fails to open the disk and signals the above error.

Action: Use ASMTOOL to restamp the disk and update the volume ID used by Oracle ASM.

Unable to mount disk group; ASM discovered an insufficient number of disks for diskgroup

Cause: You performed an Oracle Grid Infrastructure software-only installation, and want to configure a disk group for storing the OCR and voting files during the postinstallation configuration of Oracle Clusterware. You used ASMTOOL to stamp the disks, and then used ASMCMD to create a disk group using the stamped disks. If you then update a crsconfig_params file with the disk device or disk partition names that constitute the Oracle ASM disk group. During the configuration of Oracle Clusterware, errors are displayed such as ORA-15017: diskgroup "DATA" cannot be mounted.

Action: Change the crsconfig_params file to use the stamped names generated by ASMTOOL instead of the disk partition names, for example:

"\\.ORCL\DISKDATA0"

A.10.3 Oracle ASM Issues After Upgrading Oracle Grid Infrastructure

The following section explains error messages that can occur when you upgrade Oracle Grid Infrastructure, and how to address them:

CRS-0219: Could not update resource 'ora.node1.asm1.installation'

Cause: After upgrading Oracle Grid Infrastructure, Oracle ASM client databases prior to Oracle Database 12c Release 1 (12.1) are unable to obtain the Oracle ASM instance aliases on the ora.asm resource through the ALIAS_NAME attribute.

Action: You must use Local ASM or set the cardinality for Flex ASM to ALL, instead of the default of 3. Use the following command to modify the Oracle ASM resource (ora.asm):

```
srvcctl modify asm -count ALL
```

This setting changes the cardinality so that Flex ASM instances run on all nodes.

See Also: Section 8.4.2, "Making Oracle ASM Available to Earlier Oracle Database Releases" for information about making Oracle ASM available to Oracle Database releases earlier than 12c Release 1 (12.1)

A.11 Troubleshooting Windows Firewall Exceptions

If you cannot establish certain connections even after granting exceptions to the executables listed in Chapter 8, "Oracle Grid Infrastructure Postinstallation Procedures," then follow these steps to troubleshoot the installation:
1. Examine Oracle configuration files (such as *.conf files), the Oracle key in the Windows registry, and network configuration files in %ORACLE_HOME%/network/admin.

2. Pay particular attention to any executable listed in %ORACLE_HOME%/network/admin/listener.ora in a PROGRAM= clause. Each of these must be granted an exception in the Windows Firewall, because a connection can be made through the TNS listener to that executable.

3. Examine Oracle trace files, log files, and other sources of diagnostic information for details on failed connection attempts. Log and trace files on the database client computer may contain useful error codes or troubleshooting information for failed connection attempts. The Windows Firewall log file on the server may contain useful information as well.

4. If the preceding troubleshooting steps do not resolve a specific configuration issue on Windows, then provide the output from the following command to Oracle Support for diagnosis and problem resolution:

   netsh firewall show state verbose=enable

See Also:

- Section 8.1.3, “Configure Exceptions for the Windows Firewall”
- http://support.microsoft.com/default.aspx?scid=kb;en-us;875357 for more information on Windows Firewall configuration

### A.12 Failed or Incomplete Installations and Upgrades

During installations or upgrades of Oracle Grid Infrastructure, the following actions take place:

1. Oracle Universal Installer (OUI) accepts inputs to configure Oracle Grid Infrastructure software on your system.
2. OUI runs the gridconfig.bat script on each node.
3. OUI runs configuration assistants. The Oracle Grid Infrastructure software installation completes successfully.

If OUI exits before the gridconfig.bat script runs, or if OUI exits before the installation or upgrade session completes successfully, then the Oracle Grid Infrastructure installation is incomplete. If your installation or upgrade does not complete, then Oracle Clusterware does not work correctly. If you are performing an upgrade, then an incomplete upgrade can result in some nodes being upgraded to the latest software and others nodes not upgraded at all. If you are performing an installation, the incomplete installation can result in some nodes not being a part of the cluster.

Additionally, with Oracle Grid Infrastructure release 11.2.0.3 or later releases, the following messages may be seen during installation or upgrade:

ACFS-9427 Failed to unload ADVM/ACFS drivers. A system reboot is recommended
ACFS-9428 Failed to load ADVM/ACFS drivers. A system reboot is recommended
CLSRSC-400: A system reboot is required to continue installing
To resolve this error, you must reboot the server, and then follow the steps for completing an incomplete installation or upgrade:

- Completing Failed or Interrupted Upgrades
- Completing Failed or Interrupted Installations

A.12.1 Completing Failed or Interrupted Upgrades

If OUI exits on the node from which you started the installation (the first node), or the node reboots before you confirm that the gridconfig.bat script was run on all cluster nodes, then the upgrade remains incomplete. In an incomplete upgrade, configuration assistants still need to run, and the new Grid home still needs to be marked as active in the central Oracle inventory. You must complete the upgrade on the affected nodes manually.

This section contains the following tasks:

- Continuing Incomplete Upgrades on First Nodes
- Continuing Upgrades on Nodes Other Than the First Node

A.12.1.1 Continuing Incomplete Upgrades on First Nodes

To continue an incomplete upgrade on the first node:

1. Complete the upgrade of all other nodes in the cluster.
2. If the OUI failure indicated a need to reboot by raising error message CLSRSC-400, then reboot the first node (the node on which you started the upgrade). Otherwise, manually fix or clear the error condition, as reported in the error output.
3. If necessary, log in as the Oracle Installation user for Oracle Grid Infrastructure. Change directory to the new Grid home on the first node and run the gridconfig.bat script with the -upgrade option on that node again. For example:

```
[C:\] cd app\12.1.0\grid
[C:\..\grid\] crs\config\gridconfig.bat -upgrade
```
4. Configure a response file, and provide passwords for the upgrade. See Section B.5, "Postinstallation Configuration Using a Response File" for information about how to create the response file.
5. To complete the upgrade, log in as the Oracle Installation user for Oracle Grid Infrastructure and run the script configToolAllCommands, located in the path Grid_home\cfgtoollogs\configToolAllCommands, specifying the response file that you created. For example, where the response file is gridinstall.rsp:

```
[C:\] cd app\12.1.0\grid\cfgtoollogs
[C:\..\cfgtoollogs\] configToolAllCommands RESPONSE_FILE=gridinstall.rsp
```

A.12.1.2 Continuing Upgrades on Nodes Other Than the First Node

For nodes other than the first node (the node on which you started the upgrade):

1. If the OUI failure indicated a need to reboot, by raising error message CLSRSC-400, then reboot the node with the error condition. Otherwise, manually fix or clear the error condition that was reported in the error output.
2. On the first node, within OUI, click Retry. This instructs OUI to retry the upgrade on the affected node.
3. Continue the upgrade from the OUI instance on the first node.

A.12.2 Completing Failed or Interrupted Installations

If OUI exits on the node from which you started the installation (the first node), or the node reboots before you confirm that gridconfig.bat script was run on all nodes, then the installation remains incomplete. In an incomplete installation, configuration assistants still need to run, and the new Grid home still needs to be marked as active in the central Oracle inventory. You must complete the installation on the affected nodes manually.

This section contains the following tasks:

- Continuing Incomplete Installations on First Nodes
- Continuing Installations on Nodes Other Than the First Node

A.12.2.1 Continuing Incomplete Installations on First Nodes

To continue an incomplete installation, the first node must finish before the rest of the clustered nodes:

1. If the OUI failure indicated a need to reboot, by raising error message CLSRSC-400, then reboot the first node (the node where the installation was started). Otherwise, manually fix or clear the error condition that was reported in the error output.

2. If necessary, log in as the Oracle Installation user for Oracle Grid Infrastructure. Change directory to the Grid home on the first node and run the gridconfig.bat script on that node again. For example:

   ```
   [C:\] cd app\12.1.0\grid\crs\config\ 
   [C:\..\config] gridconfig.bat
   ```

3. Complete the installation on all other nodes.

4. Configure a response file, and provide passwords for the installation. See Section B.5, "Postinstallation Configuration Using a Response File" for information about how to create the response file.

5. To complete the installation, log in as the Oracle Installation user for Oracle Grid Infrastructure, and run the script configToolAllCommands, located in the path Grid_home\cfgtoollogs\configToolAllCommands, specifying the response file that you created. For example, where the response file is gridinstall.rsp:

   ```
   [C:\] cd app\12.1.0\grid\cfgtoollogs 
   [C:\..\cfgtoollogs] configToolAllCommands RESPONSE_FILE=gridinstall.rsp
   ```

A.12.2.2 Continuing Installations on Nodes Other Than the First Node

For nodes other than the first node (the node on which you started the installation):

1. If the OUI failure indicated a need to reboot, by raising error message CLSRSC-400, then reboot the node with the error condition. Otherwise, manually fix or clear the error condition that was reported in the error output.

2. On the first node, within OUI, click Retry.

3. Continue the installation from the OUI instance on the first node.
This appendix describes how to install and configure Oracle Grid Infrastructure software using response files. It includes information about the following topics:

- About Response Files
- Preparing a Response File
- Running the Installer Using a Response File
- Running Net Configuration Assistant Using a Response File
- Postinstallation Configuration Using a Response File

B.1 About Response Files

When you start the installer, you can use a response file to automate the installation and configuration of Oracle software, either fully or partially. The installer uses the values contained in the response file to provide answers to some or all installation prompts.

Typically, the installer runs in interactive mode, which means that it prompts you to provide information in graphical user interface (GUI) screens. When you use response files to provide this information, you run the installer from a command prompt using either of the following modes:

- Silent mode

  If you include responses for all of the prompts in the response file and specify the -silent option when starting the installer, then it runs in silent mode. During a silent mode installation, the installer does not display any screens. Instead, it displays progress information in the terminal that you used to start it.

- Response file mode

  If you include responses for some or all of the prompts in the response file and omit the -silent option, then the installer runs in response file mode. During a response file mode installation, the installer displays all the screens, screens for which you specify information in the response file, and also screens for which you did not specify the required information in the response file.

You define the settings for a silent or response file installation by entering values for the variables listed in the response file. For example, to specify the Oracle home name, supply the appropriate value for the ORACLE_HOME variable:

```
ORACLE_HOME="OraCrs11g_home1"
```
Another way of specifying the response file variable settings is to pass them as command line arguments when you run the installer. For example:

```
-silent "ORACLE_HOME=OraCrs11g_home1" ...
```

This method is particularly useful if you do not want to embed sensitive information, such as passwords, in the response file. For example:

```
-silent "s_dlgRBOPassword=binks342" ...
```

Ensure that you enclose the variable and its setting in double-quotes.

See Also: Oracle Universal Installer and OPatch User’s Guide for Windows and UNIX for more information about response files

### B.1.1 Reasons for Using Silent Mode or Response File Mode

The following table provides use cases for running the installer in silent mode or response file mode.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silent</td>
<td>Use silent mode to do the following installations:</td>
</tr>
<tr>
<td></td>
<td>■ Complete an unattended installation, which you schedule using</td>
</tr>
<tr>
<td></td>
<td>operating system utilities such as at.</td>
</tr>
<tr>
<td></td>
<td>■ Complete several similar installations on multiple systems without</td>
</tr>
<tr>
<td></td>
<td>user interaction.</td>
</tr>
<tr>
<td></td>
<td>■ Install the software on a system that cannot display the OUI</td>
</tr>
<tr>
<td></td>
<td>graphical user interface.</td>
</tr>
<tr>
<td></td>
<td>The installer displays progress information on the terminal that you</td>
</tr>
<tr>
<td></td>
<td>used to start it, but it does not display any of the installer</td>
</tr>
<tr>
<td>Response file</td>
<td>Use response file mode to complete similar Oracle software installations on multiple systems, providing default answers to some, but not all of the installer prompts.</td>
</tr>
<tr>
<td></td>
<td>In response file mode, all the installer screens are displayed, but defaults for the fields in these screens are provided by the response file. You must provide information for the fields in screens where you have not provided values in the response file.</td>
</tr>
</tbody>
</table>

### B.1.2 General Procedure for Using Response Files

The following are the general steps to install and configure Oracle products using the installer in silent or response file mode:

**Note:** You must complete all required preinstallation tasks on a system before running the installer in silent or response file mode.

1. Prepare a response file.
2. Run the installer in silent or response file mode.
3. If you completed a software-only installation, then perform the steps necessary to configure the Oracle product.

These steps are described in the following sections.
B.2 Preparing a Response File

This section describes the following methods to prepare a response file for use during silent mode or response file mode installations:

- Editing a Response File Template
- Recording a Response File

B.2.1 Editing a Response File Template

Oracle provides response file templates for each product and installation type, and for each configuration tool. For Oracle Grid Infrastructure, the response file is located in the `staging_dir\clusterware\response` directory on the installation media and in the `Grid_home\inventory\response` directory after installation.

Table B–1 lists the response files provided with this software:

<table>
<thead>
<tr>
<th>Response File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>crs_install.rsp</td>
<td>Silent installation of Oracle Grid Infrastructure installations</td>
</tr>
</tbody>
</table>

**Caution:** When you modify a response file template and save a file for use, the response file may contain plain text passwords. Ownership of the response file should be given to the Oracle software installation owner only. Oracle strongly recommends that database administrators or other administrators delete or secure response files when they are not in use.

To copy and modify a response file:

1. Copy the response file from the response file directory to a directory on your system.
2. Open the response file in a text editor.
   - Remember that you can specify sensitive information, such as passwords, at the command line rather than within the response file. "About Response Files" on page B-1 explains this method.

**See Also:** Oracle Universal Installer and OPatch User’s Guide for Windows and UNIX for detailed information on creating response files

3. Follow the instructions in the file to edit it.

**Note:** The installer or configuration assistant fails if you do not correctly configure the response file.

B.2.2 Recording a Response File

You can use the installer in interactive mode to record a response file, which you can edit and then use to complete silent mode or response file mode installations. This method is useful for customized or software-only installations. If you use record mode during a response file mode installation, then the installer records the variable values that were specified in the original source response file into the new response file.

You can save all the installation steps into a response file during installation by clicking **Save Response File** on the Summary page. You can use the generated response file for a silent installation later.

When you record the response file, you can either complete the installation, or you can exit from the installer on the Summary page, before it starts to copy the software to the server.

To record a response file:

1. Complete preinstallation tasks as for a normal installation. When you run the installer to record a response file, it checks the system to verify that it meets the requirements to install the software. For this reason, Oracle recommends that you complete all of the required preinstallation tasks and record the response file while completing an installation.

2. Log in as the Oracle Installation User. Ensure that this user (the Oracle Grid Infrastructure software owner) has permissions to create or write to the Grid home path that you specify during installation.

3. Start the installer. On each installation screen, specify the required information.

4. When the installer displays the Summary screen, perform the following steps:
   a. Click **Save Response File**. In the pop-up window, specify a file name and location to save the values for the response file, then click **Save**.
   b. Click **Finish** to continue with the installation.

      Click **Cancel** if you do not want to continue with the installation. The installation will stop, but the settings you have entered will be recorded in the response file.

5. Before you use the saved response file on another system, edit the file and make any required changes.

   Use the instructions in the file as a guide when editing it.

---

**Note:** A fully specified response file for an Oracle Grid Infrastructure installation can contain the passwords for Oracle Automatic Storage Management (Oracle ASM) administrative accounts and for a user who is a member of the ORA_DBA group and the Administrators group. Ensure that only the Oracle software owner user can view or modify response files or consider deleting the modified response file after the installation succeeds.

**Note:** Oracle Universal Installer (OUI) does not record passwords in the response file.
B.3 Running the Installer Using a Response File

To use a response file during installation, you start OUI from the command line, specifying the response file you created. The OUI executable, `setup.exe`, provides several options. For information about the full set of these options, run the `setup.exe` command with the `-help` option, for example:

```
C:\..\bin> setup.exe -help
```

The help information appears in your session window after a short period of time.

To run the installer using a response file:

1. Complete the preinstallation tasks as for any installation
2. Log in as an Administrator user.
3. To start the installer in silent or response file mode, enter a command similar to the following:

```
C:\> directory_path\setup.exe [-silent] [-noconfig] \
    -responseFile responsefilename
```

In this example:

- `directory_path` is the path of the DVD or the path of the directory on the hard drive where you have copied the installation software.
- `-silent` runs the installer in silent mode.
- `-noconfig` suppresses running the configuration assistants during installation, and a software-only installation is performed instead.
- `responsefilename` is the full path and file name of the installation response file that you configured.

If you use record mode during a response file mode installation, then the installer records the variable values that were specified in the original source response file into the new response file.

B.4 Running Net Configuration Assistant Using a Response File

You can run Net Configuration Assistant (NETCA) in silent mode to configure and start an Oracle Net listener on the system, configure naming methods, and configure Oracle Net service names. To run NETCA in silent mode, you must copy and edit a response file template. Oracle provides a response file template named `netca.rsp` in the `database\inventory\response` directory in the Oracle home directory after installation or in the `database\response` directory on the installation media.

To run NETCA using a response file:

1. Copy the `netca.rsp` response file template from the response file directory to a directory on your system.
   
   If you have copied the software to a hard drive, then you can edit the file in the `response` directory.

2. Open the response file in a text editor.

`Note:` Do not specify a relative path to the response file. If you specify a relative path, then the installer fails.
3. Follow the instructions in the file to edit it.

---

**Note:** NETCA fails if you do not correctly configure the response file.

---

4. Log in as an Administrator user and set the `ORACLE_HOME` environment variable to specify the correct Oracle home directory.

5. Enter a command similar to the following to run NETCA in silent mode:

   ```
   C:\> \{path\}\bin\netca -silent -responsefile \{drive}\\{dir\}\netca.rsp
   ```

   In this command:
   - The `-silent` option runs NETCA in silent mode.
   - `\{drive}\\{dir\}` is the full path of the directory where you copied the `netca.rsp` response file template, where `\{drive\}` represents the drive on which the file is located, and `\{dir\}` the path on that drive.

---

**B.5 Postinstallation Configuration Using a Response File**

Use the following sections to create and run a response file configuration after installing Oracle software.

---

**B.5.1 About the Postinstallation Configuration File**

When you run a silent or response file installation, you provide information about your servers in a response file that you otherwise provide manually using a graphical user interface. However, the response file does not contain passwords for user accounts that configuration assistants require after software installation is complete. The configuration assistants are started with a script called `configToolAllCommands`. You can run this script in response file mode by creating and using a password response file. The script uses the passwords to run the configuration tools in succession to complete configuration.

If you keep the password file to use for clone installations, then Oracle strongly recommends that you store it in a secure location. In addition, if you must stop an installation to fix an error, then you can run the configuration assistants using `configToolAllCommands` and a password response file.

The `configToolAllCommands` password response file consists of the following syntax options:

- `internal_component_name` is the name of the component that the configuration assistant configures
- `variable_name` is the name of the configuration file variable
- `value` is the desired value to use for configuration.

The command syntax is as follows:

```
internal_component_name\variable_name=value
```

For example:

```
oracle.assistants.asm\S_ASMPASSWD=myPassWord
```

Oracle strongly recommends that you maintain security with a password response file.
B.5.2 Running Postinstallation Configuration Using a Response File

To run configuration assistants with the `configToolAllCommands` script:

1. Create a response file using the format `filename.properties` for the file name.
2. Open the file with a text editor, and cut and paste the password template, modifying as needed.

**Example B–1 Password response file for Oracle Grid Infrastructure Installation**

Oracle Grid Infrastructure requires passwords for Oracle Automatic Storage Management Configuration Assistant (ASMCA), and for Intelligent Platform Management Interface Configuration Assistant (IPMICA) if you have a baseboard management controller (BMC) card and you want to enable this feature. Provide the following response file:

```plaintext
oracle.assistants.asm|S_ASMPASSWORD=password
oracle.assistants.asm|S_ASMMONITORPASSWORD=password
oracle.crs|S_BMCPASSWORD=password
```

If you do not have a BMC card, or you do not want to enable Intelligent Platform Management Interface (IPMI), then leave the `S_BMCPASSWORD` input field blank.

If you are upgrading Oracle ASM 11g Release 1 or earlier, then you only need to provide the input field for `oracle.assistants.asm|S_ASMMONITORPASSWORD`.

**Note:** If you are upgrading Oracle ASM 11g Release 1 or earlier releases, then you only need to provide the input field for `oracle.assistants.asm|S_ASMMONITORPASSWORD`.

**Example B–2 Password response file for Oracle Real Application Clusters**

Oracle Database configuration requires the SYS, SYSTEM, and DBSNMP passwords for use with Database Configuration Assistant (DBCA). The `S_ASMSNMPPASSWORD` response is necessary only if the database is using Oracle ASM for storage. Similarly, the `S_PDBADMINPASSWORD` password is necessary only if you create a multitenant container database (CDB) with one or more pluggable databases (PDBs). Also, if you selected to configure Oracle Enterprise Manager Cloud Control, then you must provide the password for the Oracle software installation owner for `S_EMADMINPASSWORD`, similar to the following example, where the phrase `password` represents the password string:

```plaintext
oracle.assistants.server|S_SYSPASSWORD=password
oracle.assistants.server|S_SYSTEMPASSWORD=password
oracle.assistants.server|S_DBSNMPPASSWORD=password
oracle.assistants.server|S_PDBADMINPASSWORD=password
oracle.assistants.server|S_EMADMINPASSWORD=password
oracle.assistants.server|S_ASMSNMPPASSWORD=password
```

If you do not want to enable Oracle Enterprise Manager for Oracle ASM, then leave those password fields blank.

3. Change directory to `Oracle_home\cfgtoollogs`, and run the configuration script using the following syntax:

   `configToolAllCommands RESPONSE_FILE=\path\filename.properties`

For example:

   `C:\..\cfgtoollogs> configToolAllCommands RESPONSE_FILE=C:\users\oracle`
\grid\cfgrsp.properties
This appendix provides an overview of concepts and terms that may be necessary to complete your installation.

This appendix contains the following sections:

- Understanding Preinstallation Configuration
- Understanding Network Addresses
- Understanding Network Time Requirements
- Understanding Storage Configuration
- Understanding Server Pools
- Understanding Out-of-Place Upgrade

## C.1 Understanding Preinstallation Configuration

This section reviews concepts about Oracle Grid Infrastructure for a cluster preinstallation tasks. It contains the following sections:

- Optimal Flexible Architecture Guidelines for Oracle Grid Infrastructure
- Oracle Grid Infrastructure for a Cluster and Oracle Restart Differences
- Understanding the Oracle Inventory Directory
- Understanding the Oracle Base Directory
- Understanding Operating System Groups and User Privileges
- Understanding Network Addresses
- Understanding Network Time Requirements

### C.1.1 Optimal Flexible Architecture Guidelines for Oracle Grid Infrastructure

For installations with Oracle Grid Infrastructure only, Oracle recommends that you create an Oracle base and Grid home path compliant with Oracle Optimal Flexible Architecture (OFA) guidelines, so that Oracle Universal Installer (OUI) can select that directory during installation.

The OFA path for an Oracle base is `X:\app\user`, where `user` is the name of the Oracle Installation user account.

The OFA path for an Oracle Grid Infrastructure Oracle home is `X:\app\release\grid` where `release` is the three-digit Oracle Grid Infrastructure release (for example, 12.1.0).
When OUI finds an OFA-compliant software path, it creates the Oracle Grid Infrastructure Grid home and Oracle Inventory (oraInventory) directories for you. For example, the path `C:\app` and `G:\app` are OFA-compliant paths.

The Oracle Grid Infrastructure home must be in a path that is different from the Grid home for the Oracle Installation user for Oracle Grid Infrastructure. If you create an Oracle Grid Infrastructure base path manually, then ensure that it is in a separate path specific for this release, and not under an existing Oracle base path.

---

**Note:** If you choose to create an Oracle Grid Infrastructure home manually, then do not create the Oracle Grid Infrastructure home for a cluster under either the Oracle base directory for the Oracle Installation user for Oracle Grid Infrastructure (for example, `grid`) or the Oracle base directory for the Oracle Installation user for Oracle Database (for example, `oracle`). Creating an Oracle Clusterware installation in an Oracle base directory will cause succeeding Oracle installations to fail.

Oracle Grid Infrastructure homes can be placed in a local home on servers, even if your existing Oracle Clusterware home from a prior release is in a shared location.

---

### C.1.2 Oracle Grid Infrastructure for a Cluster and Oracle Restart Differences

Requirements for Oracle Grid Infrastructure for a cluster are different from Oracle Grid Infrastructure on a single instance in an Oracle Restart configuration.

**See Also:** *Oracle Database Installation Guide* for information about Oracle Restart requirements

### C.1.3 Understanding the Oracle Inventory Directory

The Oracle Inventory directory is the central inventory location for all Oracle software installed on a server. The location of the Oracle Inventory directory is `\Program Files\Oracle\Inventory`.

The first time you install Oracle software on a system, the installer checks to see if an Oracle Inventory directory exists. The location of the Oracle Inventory directory is determined by the Windows Registry key `HKEY_LOCAL_MACHINE\SOFTWARE\Oracle\inst_loc`. If an Oracle Inventory directory does not exist, then the installer creates one in the default location of `C:\Program Files\Oracle\Inventory`.

---

**Note:** Changing the value for `inst_loc` in the Windows registry is not supported.

---

By default, the Oracle Inventory directory is not installed under the Oracle base directory for the Oracle Installation user. This is because all Oracle software installations share a common Oracle Inventory, so there is only one Oracle Inventory for all users, whereas there is a separate Oracle Base directory for each user.

The Oracle Inventory directory contains the following:

- A registry of the Oracle home directories (Oracle Grid Infrastructure and Oracle Database) on the system
■ Installation logs and trace files from installations of Oracle software. These files are also copied to the respective Oracle homes for future reference.

■ Other metadata inventory information regarding Oracle installations are stored in the individual Oracle home inventory directories, and are separate from the central inventory.

The central inventory is created on all cluster nodes. On core nodes, the inventory does not include processing nodes in the Oracle home’s nodelist. For processing nodes, the nodelist in the central inventory includes only the local node. The list of core nodes is updated only in the central inventory on core nodes.

C.1.4 Understanding the Oracle Base Directory

During installation, you are prompted to specify an Oracle base location, which is based on the Oracle Installation user. You can choose a location with an existing Oracle home, or choose another directory location that does not have the structure for an Oracle base directory. The default location for the Oracle base directory is <SYSTEM_DRIVE>\app\user_name\.

Using the Oracle base directory path helps to facilitate the organization of Oracle installations, and helps to ensure that installations of multiple databases maintain an Optimal Flexible Architecture (OFA) configuration.

Multiple Oracle Database installations can use the same Oracle base directory. The Oracle Grid Infrastructure installation uses a different directory path, one outside of Oracle base. If you use different operating system users to perform the Oracle software installations, then each user will have a different default Oracle base location.

However, Oracle Restart can be in the same location as other Oracle software.

Because you can have only one Oracle Grid Infrastructure installation on a cluster, and all upgrades are out-of-place upgrades, Oracle recommends that you have an Oracle base for the Oracle Installation user for Oracle Grid Infrastructure (for example, C:\app\grid), and use an Oracle home for the Oracle Grid Infrastructure binaries using the release number of that installation (for example, C:\app\12.1.0\grid).

C.1.5 Understanding Operating System Groups and User Privileges

This section contains the following topics:

■ Understanding the Oracle Inventory Group
■ Understanding Operating System Groups for Oracle Database
■ Understanding Operating System Groups for Oracle ASM
■ Understanding Administrative Operating System Groups

C.1.5.1 Understanding the Oracle Inventory Group

You must have a group whose members are given access to write to the Oracle Inventory directory, which is the central inventory record of all Oracle software installations on a server. Members of this group have write privileges to the Oracle central inventory directory, and are also granted permissions for various Oracle Clusterware resources, OCR keys, directories in the Oracle Clusterware home to which DBAs need write access, and other necessary privileges. By default, this group is called ORA_INSTALL. All Oracle software install users must be members of the Oracle Inventory group. Members of this group can talk to Cluster Synchronization Service (CSS).
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C.1.5.2 Understanding Operating System Groups for Oracle Database

When you install Oracle Database, a special Windows local group called ORA_DBA is created (if it does not already exist from an earlier Oracle Database installation), and the Oracle Installation user is automatically added to this group. Members of the ORA_DBA group automatically receive the SYSDBA privilege. Membership in the ORA_DBA group allows a user to:

- Connect to Oracle Database instances without a password
- Perform database administration procedures such as starting and shutting down local databases
- Add additional Windows users to ORA_DBA, enabling them to have the SYSDBA privilege

Membership in the ORA_DBA group grants full access to all databases on the server. Membership in the ORA_HOMENAME_DBA group grants full access to all databases that run from the specific Oracle home. Belonging to either group does not grant any special privileges for the user with respect to the Oracle ASM instance. Members of these groups will not be able to connect to the Oracle ASM instance.

The ORA_OPER and ORA_HOMENAME OPER groups are also created during installation. However, these are optional groups. You assign users to these groups if you want a separate group of users that have a limited set of database administrative privileges (the SYSOPER privilege) for either all databases or databases that run from one Oracle home.

C.1.5.3 Understanding Operating System Groups for Oracle ASM

SYSASM is a system privilege that enables the separation of the Oracle ASM storage administration privilege from SYSDBA. By default, members of the database ORA_DBA group are not granted SYSASM privileges. Table C–1 lists the groups you can create or specify during installation for managing Oracle ASM privileges:

Table C–1 Oracle ASM Operating System Groups and Privileges for Windows

<table>
<thead>
<tr>
<th>Role</th>
<th>Operating System Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSASM</td>
<td>ORA_ASMADMIN</td>
<td>Members of this group can connect to the Oracle ASM instance with the SYSASM privilege using operating system authentication. Initially, only the user that installs Oracle ASM is a member of this group. Other users can be added after installation.</td>
</tr>
<tr>
<td>OSDBA for ASM</td>
<td>ORA_ASMDBA</td>
<td>Members of this group can connect to the Oracle ASM instance with the SYSDBA privilege using operating system authentication. Any client of ASM that needs to access storage managed by ASM needs to be in this group.</td>
</tr>
</tbody>
</table>

Note: If Oracle software is already installed on the system, then the existing Oracle Inventory group is used instead of creating a new Inventory group.
Select separate operating system groups as the operating system authentication groups for privileges on Oracle ASM. Before you start OUI, create the following groups and users for Oracle ASM:

- **The Oracle Automatic Storage Management Group (ORA_ASMADMIN)**
  
  This is a required group. Create this group as a separate group to have separate administration privilege groups for Oracle ASM and Oracle Database administrators. In Oracle documentation, the operating system group whose members are granted privileges is called the OSASM group, and in code examples, where there is a group specifically created to grant this privilege, ORA_ASMADMIN.

  If you have multiple databases on your system, and use multiple OSDBA groups to provide separate SYSDBA privileges for each database, then you should create a separate OSASM group, and use a separate user from the database users to own the Oracle Grid Infrastructure installation (Oracle Clusterware and Oracle ASM). Oracle ASM can support multiple databases.

  Members of the OSASM group can use SQL to connect to an Oracle ASM instance as SYSASM using operating system authentication. The SYSASM privileges permit mounting and dismounting disk groups, and other storage administration tasks. SYSASM privileges provide no access privileges on an Oracle Database instance.

- **The Oracle ASM Database Administrator group (ORA_ASMDBA)**

  Members of the Oracle ASM Database Administrator group (OSDBA for ASM) are granted read and write access to files managed by Oracle ASM. The Oracle Grid Infrastructure installation owner and all Oracle Database software owners must be a member of this group, and all users with OSDBA membership on databases that have access to the files managed by Oracle ASM must be members of the OSDBA group for ASM.

- **Members of the ASM Operator Group (ORA_ASMOPER)**

  This is an optional group. Create this group if you want a separate group of operating system users to have a limited set of Oracle ASM instance administrative privileges (the SYSOPER for ASM privilege), including starting up and stopping the Oracle ASM instance. By default, members of the OSASM group also have all privileges granted by the SYSOPER for ASM privilege.

  To use the Oracle ASM Operator (OSOPER for ASM) group to create an Oracle ASM administrator group with fewer privileges than the default ORA_ASMADMIN group, then you must choose the Advanced installation type to install the software and specify the name of this group when prompted by OUI. In code examples, this group is ORA_ASMOPER.
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C.1.5.4 Understanding Administrative Operating System Groups

Oracle Database and Oracle RAC provide two special administrative privileges, SYSDBA and SYSOPER, which allow grantees to perform critical database administration tasks, such as creating databases and starting up or shutting down database instances. In Windows, the operating system groups for the SYSDBA and SYSOPER database administrative privileges are fixed to ORA_DBA and ORA_OPER groups and these group names cannot be changed. However, while the SYSDBA privilege is convenient to use, the authority provided by SYSDBA privilege provides more access than what is necessary for the assigned tasks of administrators.

Oracle Database 12c introduces new administrative privileges that are more task-specific and least privileged to support those tasks. Four new administrative privileges are created to satisfy the needs of common database tasks. These new privileges and their related operating systems groups are described in Table C–2:

<table>
<thead>
<tr>
<th>Privilege</th>
<th>Operating System Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSBACKUP</td>
<td>ORA_HOMENAME_SYSBACKUP</td>
<td>Administrative privilege for backup and recovery tasks</td>
</tr>
<tr>
<td>SYSDG</td>
<td>ORA_HOMENAME_SYSDG</td>
<td>Administrative privilege for Data Guard administrative tasks</td>
</tr>
<tr>
<td>SYSKM</td>
<td>ORA_HOMENAME_SYSKM</td>
<td>Administrative privilege for encryption key management tasks</td>
</tr>
</tbody>
</table>

You cannot change the name of these operating system groups. These groups do not have any members after database creation, but an Administrator user can assign users to these groups after installation. Each operating system group identifies a group of operating system users that are granted the associated set of database privileges.

C.1.6 Understanding Network Addresses

During installation, you are asked to identify the planned use for each network interface that Oracle Universal Installer (OUI) detects on your cluster node. Identify each interface as a public or private interface, or as an interface that you do not want Oracle Clusterware to use. Public and virtual internet protocol (VIP) addresses are configured on public interfaces. Private addresses are configured on private interfaces.

Refer to the following sections for detailed information about each address type:

- About the Public IP Address
- About the Private IP Address
- About the Virtual IP Address
- About the Grid Naming Service Virtual IP Address
- About the SCAN

C.1.6.1 About the Public IP Address

The public IP address is assigned dynamically using dynamic host configuration protocol (DHCP), or defined statically in a domain name system (DNS) or hosts file. It uses the public interface (the interface with access available to clients).
C.1.6.2 About the Private IP Address

Oracle Clusterware uses interfaces marked as private for internode communication. Each cluster node must have an interface that you identify during installation as a private interface. Private interfaces must have addresses configured for the interface itself, but no additional configuration is required. Oracle Clusterware uses the interfaces you identify as private for the cluster interconnect. Any interface that you identify as private must be on a subnet that connects to every node of the cluster. Oracle Clusterware uses all the interfaces you identify for use as private interfaces.

For the private interconnects, because of Cache Fusion and other traffic between nodes, Oracle strongly recommends using a physically separate, private network. If you configure addresses using a DNS, then you should ensure that the private IP addresses are reachable only by the cluster nodes.

After installation, if you modify the interconnect for Oracle Real Application Clusters (Oracle RAC) with the `CLUSTER_INTERCONNECTS` initialization parameter, then you must change the interconnect to a private IP address, on a subnet that is not used with a public IP address, nor marked as a public subnet by `oifcfg`. Oracle does not support changing the interconnect to an interface using a subnet that you have designated as a public subnet.

You should not use a firewall on the network with the private network IP addresses, because this can block interconnect traffic.

C.1.6.3 About the Virtual IP Address

The virtual IP (VIP) address is registered in the grid naming service (GNS), or the DNS. Select an address for your VIP that meets the following requirements:

- The IP address and host name are currently unused (it can be registered in a DNS, but should not be accessible by a `ping` command)
- The VIP is on the same subnet as your public interface

C.1.6.4 About the Grid Naming Service Virtual IP Address

The GNS VIP address is a static IP address configured in the DNS. The DNS delegates queries to the GNS VIP address, and the GNS daemon responds to incoming name resolution requests at that address.

Within the subdomain, the GNS uses multicast Domain Name Service (mDNS), included with Oracle Clusterware, to enable the cluster to map host names and IP addresses dynamically as nodes are added and removed from the cluster, without requiring additional host configuration in the DNS.

To enable GNS, you must have your network administrator provide a set of IP addresses for a subdomain assigned to the cluster (for example, `grid.example.com`), and delegate DNS requests for that subdomain to the GNS VIP address for the cluster, which GNS will serve. The set of IP addresses is provided to the cluster through DHCP, which must be available on the public network for the cluster.

See Also: Oracle Clusterware Administration and Deployment Guide for more information about GNS

C.1.6.5 About the SCAN

Oracle Database 12c Release 1 (12.1) clients connect to the database using a single client access name (SCAN). The SCAN and its associated IP addresses provide a stable name for clients to use for connections, independent of the nodes that make up the
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cluster. SCAN addresses, virtual IP addresses, and public IP addresses must all be on the same subnet.

The SCAN is a VIP name, similar to the names used for VIP addresses, such as node1-vip. However, unlike a VIP, the SCAN is associated with the entire cluster, rather than an individual node, and associated with multiple IP addresses, not just one address.

The SCAN resolves to multiple IP addresses reflecting multiple listeners in the cluster that handle public client connections. When a client submits a request, the SCAN listener listening on a SCAN IP address and the SCAN port is made available to a client. Because all services on the cluster are registered with the SCAN listener, the SCAN listener replies with the address of the local listener on the least-loaded node where the service is currently being offered. Finally, the client establishes connection to the service through the listener on the node where service is offered. All of these actions take place transparently to the client without any explicit configuration required in the client.

During installation, listeners are created. These SCAN listeners listen on the SCAN IP addresses. The SCAN listeners are started on nodes determined by Oracle Clusterware. Oracle Net Services routes application requests to the least loaded instance providing the service. Because the SCAN addresses resolve to the cluster, rather than to a node address in the cluster, nodes can be added to or removed from the cluster without affecting the SCAN address configuration.

The SCAN should be configured so that it is resolvable either by using GNS within the cluster, or by using DNS. For high availability and scalability, Oracle recommends that you configure the SCAN name so that it resolves to three IP addresses. At a minimum, the SCAN must resolve to at least one address.

If you specify a GNS domain, then the SCAN name defaults to $clustername$-scan.$GNS$_.
domain. Otherwise, it defaults to $clustername$-scan.$current$_.domain. For example, if you start Oracle Grid Infrastructure installation from the server node1, the cluster name is mycluster, and the GNS domain is grid.example.com, then the SCAN Name is mycluster-scan.grid.example.com.

Clients configured to use IP addresses for Oracle Database releases prior to Oracle Database 11g Release 2 can continue to use their existing connection addresses; using SCANs is not required. When you upgrade to Oracle Clusterware 12c Release 1 (12.1), the SCAN becomes available, and you should use the SCAN for connections to Oracle Database 11g Release 2 or later databases. When an earlier release of Oracle Database is upgraded, it registers with the SCAN listeners, and clients can start using the SCAN to connect to that database. The database registers with the SCAN listener through the remote listener parameter in the init.ora file. The REMOTE_LISTENER parameter must be set to SCAN:PORT. Do not set it to a TNSNAMES alias with a single address with the SCAN, for example, using HOST= SCAN_name.

The SCAN is optional for most deployments. However, clients using Oracle Database 11g Release 2 and later policy-managed databases using server pools must access the database using the SCAN. This is required because policy-managed databases can run on different servers at different times, so connecting to a particular node by using the virtual IP address for a policy-managed database is not possible.

C.1.7 Understanding Network Time Requirements

Oracle Clusterware 12c Release 1 (12.1) is automatically configured with Cluster Time Synchronization Service (CTSS). This service provides automatic synchronization of the time settings on all cluster nodes using the optimal synchronization strategy for the type of cluster you deploy. If you have an existing cluster synchronization service,
such as network time protocol (NTP) or Windows Time Service, then it will start in an observer mode. Otherwise, it will start in an active mode to ensure that time is synchronized between cluster nodes. CTSS will not cause compatibility issues.

The CTSS module is installed as a part of Oracle Grid Infrastructure installation. CTSS daemons are started by the Oracle High Availability Services daemon (ohasd), and do not require a command-line interface.

C.2 Understanding Network Addresses

During installation, you are asked to identify the planned use for each network interface that OUI detects on your cluster node. Identify each interface as a public or private interface, or as an interface that you do not want Oracle Grid Infrastructure or Oracle ASM to use. Public and virtual IP addresses are configured on public interfaces. Private addresses are configured on private interfaces.

See the following sections for detailed information about each address type:

- About the Public IP Address
- About the Private IP Address
- About the Virtual IP Address
- About the Grid Naming Service (GNS) Virtual IP Address
- About the SCAN for Oracle Grid Infrastructure Installations

C.2.1 About the Public IP Address

The public IP address is assigned dynamically using DHCP, or defined statically in a DNS or in a hosts file. It uses the public interface (the interface with access available to clients). The public IP address is the primary address for a cluster member node, and should be the address that resolves to the name returned when you enter the command hostname.

If you configure IP addresses manually, then avoid changing host names after you complete the Oracle Grid Infrastructure installation, including adding or deleting domain qualifications. A node with a new host name is considered a new host, and must be added to the cluster. A node under the old name will appear to be down until it is removed from the cluster.

C.2.2 About the Private IP Address

Oracle Clusterware uses interfaces marked as private for internode communication. Each cluster node needs to have an interface that you identify during installation as a private interface. Private interfaces need to have addresses configured for the interface itself, but no additional configuration is required. Oracle Clusterware uses interfaces you identify as private for the cluster interconnect. If you identify multiple interfaces during information for the private network, then Oracle Clusterware configures them with Redundant Interconnect Usage. Any interface that you identify as private must be on a subnet that connects to every node of the cluster. Oracle Clusterware uses all the interfaces you identify for use as private interfaces.

For the private interconnects, because of Cache Fusion and other traffic between nodes, Oracle strongly recommends using a physically separate, private network. If you configure addresses using a DNS, then you should ensure that the private IP addresses are reachable only by the cluster nodes.
After installation, if you modify interconnects on Oracle RAC with the `CLUSTER_INTERCONNECTS` initialization parameter, then you must change it to a private IP address, on a subnet that is not used with a public IP address. Oracle does not support changing the interconnect to an interface using a subnet that you have designated as a public subnet.

You should not use a firewall on the network with the private network IP addresses, as this can block interconnect traffic.

### C.2.3 About the Virtual IP Address

If you are not using Grid Naming Service (GNS), then determine a virtual host name for each node. A virtual host name is a public node name that reroutes client requests sent to the node if the node is down. Oracle Database uses VIPs for client-to-database connections, so the VIP address must be publicly accessible. Oracle recommends that you provide a name in the format `hostname-vip`. For example: `myclstr2-vip`.

The virtual IP (VIP) address is registered in the GNS, or the DNS. Select an address for your VIP that meets the following requirements:

- The IP address and host name are currently unused (it can be registered in a DNS, but should not be accessible by a `ping` command)
- The VIP is on the same subnet as your public interface

### C.2.4 About the Grid Naming Service (GNS) Virtual IP Address

The GNS virtual IP address is a static IP address configured in the DNS. The DNS delegates queries to the GNS virtual IP address, and the GNS daemon responds to incoming name resolution requests at that address.

Within the subdomain, the GNS uses multicast Domain Name Service (mDNS), included with Oracle Clusterware, to enable the cluster to map host names and IP addresses dynamically as nodes are added and removed from the cluster, without requiring additional host configuration in the DNS.

To enable GNS, you must have your network administrator provide a set of IP addresses for a subdomain assigned to the cluster (for example, `grid.example.com`), and delegate DNS requests for that subdomain to the GNS virtual IP address for the cluster, which GNS will serve. The set of IP addresses is provided to the cluster through DHCP, which must be available on the public network for the cluster.

**See Also:** [Oracle Clusterware Administration and Deployment Guide](#) for more information about Grid Naming Service

### C.2.5 About the SCAN for Oracle Grid Infrastructure Installations

Oracle Database clients connect to Oracle Real Application Clusters database using SCANs. The SCAN and its associated IP addresses provide a stable name for clients to use for connections, independent of the nodes that make up the cluster. SCAN addresses, virtual IP addresses, and public IP addresses must all be on the same subnet.

The SCAN is a virtual IP name, similar to the names used for virtual IP addresses, such as `node1-vip`. However, unlike a virtual IP, the SCAN is associated with the entire cluster, rather than an individual node, and associated with multiple IP addresses, not just one address.

The SCAN works by being able to resolve to multiple IP addresses in the cluster handling public client connections. When a client submits a request, the SCAN listener
listening on a SCAN IP address and the SCAN port is made available to a client. Because all services on the cluster are registered with the SCAN listener, the SCAN listener replies with the address of the local listener on the least-loaded node where the service is currently being offered. Finally, the client establishes connection to the service through the listener on the node where service is offered. All of these actions take place transparently to the client without any explicit configuration required in the client.

During installation listeners are created. They listen on the SCAN IP addresses provided on nodes for the SCAN IP addresses. Oracle Net Services routes application requests to the least loaded instance providing the service. Because the SCAN addresses resolve to the cluster, rather than to a node address in the cluster, nodes can be added to or removed from the cluster without affecting the SCAN address configuration.

The SCAN should be configured so that it is resolvable either by using Grid Naming Service (GNS) within the cluster, or by using Domain Name Service (DNS) resolution. For high availability and scalability, Oracle recommends that you configure the SCAN name so that it resolves to three IP addresses. At a minimum, the SCAN must resolve to at least one address.

If you specify a GNS domain, then the SCAN name defaults to \textit{clusternamem-scan.GNS\_domain}. Otherwise, it defaults to \textit{clusternamem-scan.current\_domain}. For example, if you start Oracle Grid Infrastructure installation from the server node1, the cluster name is mycluster, and the GNS domain is grid.example.com, then the SCAN Name is mycluster-scan.grid.example.com.

Clients configured to use IP addresses for Oracle Database releases prior to Oracle Database 11g Release 2 can continue to use their existing connection addresses; using SCANs is not required. When you upgrade to Oracle Clusterware 12c Release 1 (12.1), the SCAN becomes available, and you should use the SCAN for connections to Oracle Database 11g Release 2 or later databases. When an earlier release of Oracle Database is upgraded, it registers with the SCAN listeners, and clients can start using the SCAN to connect to that database. The database registers with the SCAN listener through the remote listener parameter in the init.ora file. The REMOTE\_LISTENER parameter must be set to SCAN:PORT. Do not set it to a TNSNAMES alias with a single address with the SCAN as HOST=SCAN.

The SCAN is optional for most deployments. However, clients using Oracle Database 11g Release 2 and later policy-managed databases using server pools should access the database using the SCAN. This is because policy-managed databases can run on different servers at different times, so connecting to a particular node virtual IP address for a policy-managed database is not possible.

Provide SCAN addresses for client access to the cluster. These addresses should be configured as round robin addresses on the domain name service (DNS). Oracle recommends that you supply three SCAN addresses.
C.3 Understanding Network Time Requirements

Oracle Clusterware 12c Release 1 (12.1) is automatically configured with Cluster Time Synchronization Service (CTSS). This service provides automatic synchronization of all cluster nodes using the optimal synchronization strategy for the type of cluster you deploy. If you have existing cluster time synchronization service, such as NTP, then it starts in an observer mode. Otherwise, it starts in an active mode to ensure that time is synchronized between cluster nodes. CTSS will not cause compatibility issues.

The CTSS module is installed as a part of Oracle Grid Infrastructure installation. CTSS daemons are started up by the OHAS daemon (ohasd), and do not require a command-line interface.

C.4 Understanding Storage Configuration

The following sections describe concepts related to Oracle Automatic Storage Management (Oracle ASM) storage:

- Understanding Oracle Automatic Storage Management Cluster File System
- About Migrating Existing Oracle ASM Instances
- About Converting Standalone Oracle ASM Installations to Clustered Installations

C.4.1 Understanding Oracle Automatic Storage Management Cluster File System

Oracle ASM has been extended to include a general purpose file system, called Oracle Automatic Storage Management Cluster File System (Oracle ACFS). Oracle ACFS is a new multi-platform, scalable file system, and storage management technology that extends Oracle ASM functionality to support customer files maintained outside of the Oracle Database. Files supported by Oracle ACFS include application executable files, data files, and application reports. Other supported files are video, audio, text, images, engineering drawings, and other general-purpose application file data.
Oracle ACFS can provide optimized storage for all Oracle files, including Oracle Database binaries. It can also store other application files. However, it cannot be used for Oracle Clusterware binaries or Oracle Clusterware files.

See Also: Oracle Automatic Storage Management Administrator’s Guide for more information about Oracle ACFS

C.4.2 About Migrating Existing Oracle ASM Instances

If you have an Oracle ASM installation from a prior release installed on your server, or in an existing Oracle Clusterware installation, then you can use Oracle Automatic Storage Management Configuration Assistant (ASMCA), located in the path `Grid_home\bin`, to upgrade the existing Oracle ASM instance to Oracle ASM 12c Release 1 (12.1). You can also use ASMCA to configure failure groups, Oracle ASM volumes, and Oracle ACFS.

Note: You must first shut down all database instances and applications on the node with the existing Oracle ASM instance before upgrading it.

During installation, if you chose to use Oracle ASM and ASMCA detects that there is a prior Oracle ASM release installed in another Oracle ASM home, then after installing the Oracle ASM 12c Release 1 (12.1) software, you can start ASMCA to upgrade the existing Oracle ASM instance. You can then configure an Oracle ACFS deployment by creating Oracle ASM volumes and using the upgraded Oracle ASM to create the Oracle ACFS.

On an existing Oracle Clusterware or Oracle RAC installation, if the prior release of Oracle ASM instances on all nodes is Oracle ASM 11g Release 1 or higher, then you are provided with the option to perform a rolling upgrade of Oracle ASM instances. If the prior release of Oracle ASM instances on an Oracle RAC installation are from an Oracle ASM release prior to Oracle ASM 11g Release 1, then rolling upgrades cannot be performed. Oracle ASM is then upgraded on all nodes to 12c Release 1 (12.1).

C.4.3 About Converting Standalone Oracle ASM Installations to Clustered Installations

If you have an existing standalone Oracle ASM installation on one or more nodes that are member nodes of the cluster, then OUI proceeds to install Oracle Grid Infrastructure for a cluster. If you place Oracle Clusterware files (OCR and voting files) on Oracle ASM, then ASMCA is started at the end of the clusterware installation, and provides prompts for you to migrate and upgrade the Oracle ASM instance on the local node, so that you have an Oracle ASM 12c Release 1 (12.1) installation.

On remote nodes, ASMCA identifies any running standalone Oracle ASM instances, and prompts you to shut down those Oracle ASM instances, and any database instances that use them. ASMCA then extends clustered Oracle ASM instances to all nodes in the cluster. However, disk group names on the cluster-enabled Oracle ASM instances must be different from existing standalone disk group names.

See Also: Oracle Automatic Storage Management Administrator’s Guide
C.5 Understanding Server Pools

The following topics provide a short overview of server pools:

- Overview of Server Pools and Policy-based Management
- How Server Pools Work
- The Free Server Pool
- The Generic Server Pool

See Also: Oracle Clusterware Administration and Deployment Guide for information about how to configure and administer server pools

C.5.1 Overview of Server Pools and Policy-based Management

With Oracle Clusterware 11g Release 2 (11.2) and later, resources managed by Oracle Clusterware are contained in logical groups of servers called server pools. Resources are hosted on a shared infrastructure and are contained within server pools. The resources are restricted with respect to their hardware resource (such as CPU and memory) consumption by policies, behaving as if they were deployed in a single-system environment.

You can choose to manage resources dynamically using server pools to provide policy-based management of resources in the cluster, or you can choose to manage resources using the traditional method of physically assigning resources to run on particular nodes.

The Oracle Grid Infrastructure installation owner has privileges to create and configure server pools, using the Server Control utility (SRVCTL), Oracle Enterprise Manager, or Oracle Database Configuration Assistant (DBCA).

Policy-based management provides the following functionality:

- Enables dynamic capacity assignment when needed to provide server capacity in accordance with the priorities you set with policies
- Enables allocation of resources by importance, so that applications obtain the required minimum resources, whenever possible, and so that lower priority applications do not take resources from more important applications
- Ensures isolation where necessary, so that you can provide dedicated servers in a cluster for applications and databases

Applications and databases running in server pools do not share resources. Because of this, server pools isolate resources where necessary, but enable dynamic capacity assignments as required. Together with role-separated management, this capability addresses the needs of organizations that have a standardized cluster environment, but allow multiple administrator groups to share the common cluster infrastructure.

C.5.2 How Server Pools Work

Server pools divide the cluster into groups of servers hosting the same or similar resources. They distribute a uniform workload (a set of Oracle Clusterware resources) over several servers in the cluster. For example, you can restrict Oracle databases to run only in a particular server pool. When you enable role-separated management, you can explicitly grant permission to operating system users to change attributes of certain server pools.

Top-level server pools:
Understanding Server Pools

- Logically divide the cluster
- Are always exclusive, meaning that one server can only reside in one particular server pool at a certain point in time

Each server pool has three attributes that are assigned when the server pool is created:

- MIN_SIZE: The minimum number of servers the server pool should contain. If the number of servers in a server pool is below the value of this attribute, then Oracle Clusterware automatically moves servers from elsewhere into the server pool until the number of servers reaches the attribute value, or until there are no free servers available from less important pools.
- MAX_SIZE: The maximum number of servers the server pool may contain.
- IMPORTANCE: A number from 0 to 1000 (0 being least important) that ranks a server pool among all other server pools in a cluster.

When Oracle Clusterware is installed, two server pools are created automatically: Generic and Free. All servers in a new installation are assigned to the Free server pool, initially. Servers move from the Free server pool to newly defined server pools automatically. When you upgrade Oracle Clusterware, all nodes are assigned to the Generic server pool to ensure compatibility with database releases before Oracle Database 11g Release 2 (11.2).

C.5.3 The Free Server Pool

The Free server pool contains servers that are not assigned to any other server pools. The attributes of the Free server pool are restricted, as follows:

- SERVER_NAMES, MIN_SIZE, and MAX_SIZE cannot be edited by the user
- IMPORTANCE and ACL can be edited by the user

See Also: Oracle Clusterware Administration and Deployment Guide

C.5.4 The Generic Server Pool

The Generic server pool stores Oracle Database 11g Release 1 (11.1) databases and earlier releases, and administrator-managed databases that have fixed configurations. Additionally, the Generic server pool contains servers that match either of the following:

- Servers that you specified in the HOSTING_MEMBERS attribute of all resources of the application resource type
- Servers with names you specified in the SERVER_NAMES attribute of the server pools that list the Generic server pool as a parent server pool

The attributes of the Generic server pool are restricted, as follows:

- The configuration attributes of the Generic server pool cannot be modified (all attributes are read-only).
- When you specify a server name in the HOSTING_MEMBERS attribute, Oracle Clusterware only allows it if the server is:
  - Online and exists in the Generic server pool
  - Online and exists in the Free server pool, in which case Oracle Clusterware moves the server into the Generic server pool
– Online and exists in any other server pool and the client is either a cluster administrator or is allowed to use the server pool’s servers, in which case, the server is moved into the Generic server pool
– Offline and the client is a cluster administrator

When you register a child server pool with the Generic server pool, Oracle Clusterware only allows it if the server names pass the same requirements as previously specified for the resources.

Servers are initially considered for assignment into the Generic server pool at cluster startup time or when a server is added to the cluster, and only after that to other server pools.

C.6 Understanding Out-of-Place Upgrade

During an out-of-place upgrade of Oracle Grid Infrastructure, the installer installs the newer release of the software in a separate Grid home. Both releases of Oracle Clusterware are on each cluster member node, but only one release is active.

Rolling upgrade avoids downtime and ensure continuous availability while the software is upgraded to a new release.

If you have separate Oracle Clusterware homes on each node, then you can perform an out-of-place upgrade on all nodes, or perform an out-of-place rolling upgrade, so that some nodes run Oracle Clusterware from the earlier release Oracle Clusterware home, and other nodes run Oracle Clusterware from the new Oracle Clusterware home.

An in-place upgrade of Oracle Clusterware 11g Release 2 or later is not supported.

See Also:  Appendix D, "How to Upgrade to Oracle Grid Infrastructure 12c Release 1" for instructions on completing rolling upgrades
This appendix describes how to perform Oracle Clusterware and Oracle Automatic Storage Management (Oracle ASM) upgrades.

This appendix contains the following topics:

- Back Up the Oracle Software Before Upgrades
- About Oracle ASM and Oracle Grid Infrastructure Installation and Upgrade
- Options for Clusterware and Oracle ASM Upgrades and Downgrades
- Restrictions for Oracle Clusterware and Oracle ASM Upgrades
- Understanding Out-of-Place and Rolling Upgrades
- Preparing to Upgrade an Existing Oracle Clusterware Installation
- Using CVU to Validate Readiness for Oracle Clusterware Upgrades
- Understanding Rolling Upgrades Using Batches
- Performing Rolling Upgrades of Oracle Grid Infrastructure
- Performing Rolling Upgrades of Oracle ASM
- Applying Patches to Oracle ASM
- Checking Cluster Health Monitor Repository Size After Upgrading
- Downgrading Oracle Clusterware After an Upgrade
- Updating Oracle Enterprise Manager Cloud Control Target Parameters

D.1 Back Up the Oracle Software Before Upgrades

Before you make any changes to the Oracle software, Oracle recommends that you create a backup of the Oracle software and databases. For Oracle software running on Windows operating systems, you must also take a backup of the Windows registry. Without a registry backup, you will not be able to restore the Oracle software to a working state if the upgrade of Oracle Grid Infrastructure or Oracle Database fails and you want to revert to the previous software installation.
D.2 About Oracle ASM and Oracle Grid Infrastructure Installation and Upgrade

You can upgrade Oracle Grid Infrastructure either by bringing the cluster down and upgrading the complete cluster, or upgrading individual nodes without stopping Oracle Grid Infrastructure on other nodes in the cluster, which is called performing a rolling upgrade. An upgrade is always a temporary option, because some services are disabled when one or more nodes are in the process of being upgraded. All upgrades are out-of-place upgrades, meaning that the software executable files are placed in a different Grid home from the Grid home used for the prior release.

You can downgrade from Oracle Grid Infrastructure 12c Release 1 (12.1) to prior releases of Oracle Grid Infrastructure. Be aware that if you downgrade to a prior release, then your cluster must conform with the configuration requirements for that prior release, and the features available for the cluster consist only of the features available for that prior release of Oracle Clusterware and Oracle ASM.

If you have an existing Oracle ASM instance, then you can either upgrade it at the time that you install Oracle Grid Infrastructure, or you can upgrade it after the installation, using Oracle ASM Configuration Assistant (ASMCA). Note that a number of Oracle ASM features are disabled until you upgrade Oracle ASM. Also, Oracle Clusterware management of Oracle ASM does not function correctly until Oracle ASM is upgraded, because Oracle Clusterware only manages Oracle ASM when it is running in the Oracle Grid Infrastructure home. For this reason, Oracle recommends that if you do not upgrade Oracle ASM at the same time as you upgrade Oracle Clusterware, then you should upgrade Oracle ASM immediately afterward.

You can perform out-of-place upgrades to an Oracle ASM instance using ASMCA. In addition to running ASMCA using the graphical user interface (GUI), you can run ASMCA in non-interactive (silent) mode.

---

**Note:** If you are currently using OCFS for Windows as your shared storage, then you must migrate to using Oracle ASM during the upgrade of Oracle Database and Oracle Grid Infrastructure.

---

**Note:** You must complete an upgrade before attempting to use cluster backup files. You cannot use backups for a cluster that has not completed upgrade.

---

**See Also:** *Oracle Database Upgrade Guide* and *Oracle Automatic Storage Management Administrator’s Guide* for additional information about upgrading existing Oracle ASM installations.

D.3 Options for Clusterware and Oracle ASM Upgrades and Downgrades

Upgrade options from Oracle Grid Infrastructure 11g to Oracle Grid Infrastructure 12c include the following:

- Oracle Grid Infrastructure rolling upgrades, with OCR and voting files on Oracle ASM
- Oracle Grid Infrastructure complete cluster (downtime, non-rolling), with OCR and voting files on Oracle ASM
Oracle Grid Infrastructure rolling upgrades with OCR and voting files on storage other than Oracle ASM

Oracle Grid Infrastructure complete cluster (downtime, non-rolling), with OCR and voting files on storage other than Oracle ASM

Upgrade options from releases before Oracle Grid Infrastructure 11g Release 2 (11.2) to Oracle Grid Infrastructure 12c include the following:

Oracle Grid Infrastructure rolling upgrades, with OCR and voting files on storage other than Oracle ASM

Oracle Grid Infrastructure complete cluster (downtime, non-rolling), with OCR and voting files on storage other than Oracle ASM

Downgrade options from Oracle Grid Infrastructure 12c to earlier releases include the following:

Oracle Grid Infrastructure downgrade to Oracle Grid Infrastructure 11g Release 2 (11.2)

D.4 Restrictions for Oracle Clusterware and Oracle ASM Upgrades

Oracle recommends that you use CVU to check if there are any patches required for upgrading your existing Oracle Grid Infrastructure 11g Release 2 or Oracle RAC 11g Release 2 installations.

See Also: Section D.7, "Using CVU to Validate Readiness for Oracle Clusterware Upgrades"

Be aware of the following restrictions and changes for upgrades to Oracle Grid Infrastructure installations, which consists of Oracle Clusterware and Oracle ASM:

If the OCR and Voting File locations for your current installation are on raw devices, then you must migrate them to Oracle ASM disk groups or shared file systems before upgrading to Oracle Grid Infrastructure 12c Release 1 (12.1).

To upgrade existing Oracle Clusterware installations to Oracle Grid Infrastructure 12c Release 1 (12.1), your current release must be Oracle Grid Infrastructure 11g Release 2.

On the Windows platform, to upgrade Oracle Clusterware from releases 10.2.0.5 and 11.1.0.7 to Oracle Grid Infrastructure release 12.1, you must perform an interim upgrade to Oracle Grid Infrastructure 11g Release 2 for Oracle Clusterware. After upgrading Oracle Clusterware to Oracle Grid Infrastructure 11g Release 2, you must move the Oracle Cluster Registry (OCR) and voting files to Oracle ASM. You can then upgrade Oracle Grid Infrastructure 11g Release 2 to Oracle Grid Infrastructure release 12.1.

If you are upgrading an Oracle Database release 10.2.0.5 or Oracle Database release 11.1.0.7 environment that stores Oracle Clusterware files on OCFS for Windows or RAW devices, then you cannot directly upgrade to Oracle Database 12c. See Oracle Database Upgrade Guide.

To upgrade existing Oracle ASM installations to Oracle Grid Infrastructure 12c Release 1 (12.1), in a Standard configuration, your release must be greater than or equal to 10.1.0.5, 10.2.0.3, 11.1.0.6, or 11.2.

To upgrade existing Oracle Grid Infrastructure installations to Oracle Grid Infrastructure, you must first verify if you need to apply any mandatory patches for upgrade to succeed. To upgrade Oracle Grid Infrastructure installations from
11.2.0.2 to a later release, you must install the latest bundle for the cumulative patches for Oracle Grid Infrastructure (Patch 11 bundle or higher). See Section D.7, "Using CVU to Validate Readiness for Oracle Clusterware Upgrades" for steps to check readiness.

**See Also:** Oracle 12c Upgrade Companion (My Oracle Support Note 1462240.1):

[https://support.oracle.com/oip/faces/secure/km/DocumentDisplay.jspx?id=1462240.1](https://support.oracle.com/oip/faces/secure/km/DocumentDisplay.jspx?id=1462240.1)

- If you have Oracle ACFS file systems on Oracle Grid Infrastructure 11g Release 2 (11.2.0.1), you upgrade Oracle Grid Infrastructure to any later release, and you take advantage of Redundant Interconnect Usage and add one or more additional private interfaces to the private network, then you must restart the Oracle ASM instance on each upgraded cluster member node.
- Do not delete directories in the Grid home. For example, do not delete Grid_home\Opatch. If you delete the directory, then the Oracle Installation User for Oracle Grid Infrastructure cannot use Opatch to patch the Grid home, and Opatch displays the error "checkdir error: cannot create Grid_home\Opatch"
- Oracle Clusterware and Oracle ASM upgrades are always out-of-place upgrades. With Oracle Grid Infrastructure 12c Release 1 (12.1), you cannot perform an in-place upgrade of Oracle Clusterware and Oracle ASM to existing homes.
- With Oracle Clusterware 11g Release 2 (11.2) and later, you can perform upgrades on a shared Oracle Clusterware home.
- You must use an Administrator user to perform the Oracle Grid Infrastructure 12c Release 1 (12.1) upgrade.
- Oracle ASM and Oracle Clusterware both run in the Oracle Grid Infrastructure home.
- During a major release upgrade to Oracle Clusterware 12c Release 1 (12.1), the software in the Grid home for Oracle Grid Infrastructure 12c Release 1 (12.1) is not fully functional until the upgrade is completed. Running the Server Control Utility (SRVCTL), crsctl, and other commands from the 12c Release 1 (12.1) Grid home is not supported until the upgrade is complete across all nodes.

To manage databases using earlier releases (release 10.x, 11.1, or 11.2) of Oracle Database software during the Oracle Grid Infrastructure upgrade, use SRVCTL in the existing database homes.

- During Oracle Clusterware installation, if there is a single instance Oracle ASM release on the local node, then it is converted to a clustered Oracle ASM 12c Release 1 (12.1) installation, and Oracle ASM runs in the Oracle Grid Infrastructure home on all nodes.
- If a single instance (non-clustered) Oracle ASM installation is on a remote node, which is a node other than the local node (the node on which the Oracle Grid Infrastructure installation is being performed), then it will remain a single instance Oracle ASM installation. However, during installation, if you select to place the Oracle Cluster Registry (OCR) and voting files on Oracle ASM, then a clustered Oracle ASM installation is created on all nodes in the cluster, and the single instance Oracle ASM installation on the remote node will become nonfunctional.

**See Also:** Oracle Database Upgrade Guide
D.5 Understanding Out-of-Place and Rolling Upgrades

Rolling Upgrades
You can upgrade Oracle Grid Infrastructure either by bringing the cluster down and upgrading the complete cluster, or upgrading individual nodes without stopping Oracle Grid Infrastructure on other nodes in the cluster, which is called performing a rolling upgrade. If you upgrade a subset of nodes, then a software-only installation is performed on the existing cluster nodes that you do not select for upgrade. Rolling upgrades avoid downtime and ensure continuous availability while the software is upgraded to a new release.

Note: In contrast with releases prior to Oracle Clusterware 11g Release 2, Oracle Universal Installer (OUI) always performs rolling upgrades, even if you select all nodes for the upgrade.

Out-of-Place Upgrades
During an out-of-place upgrade, the installer installs the newer release in a separate Oracle Clusterware home. Both releases of Oracle Clusterware are on each cluster member node, but only one release is active. By contrast, an in-place upgrade overwrites the software in the current Oracle Clusterware home.

To perform an out-of-place upgrade, you must create new Oracle Grid Infrastructure homes on each node. Then you can perform an out-of-place rolling upgrade, so that some nodes run Oracle Clusterware from the original Oracle Clusterware home, and other nodes run Oracle Clusterware from the new Oracle Grid Infrastructure home.

If you have an existing Oracle Clusterware installation, then you upgrade your existing cluster by performing an out-of-place upgrade. An in-place upgrade of Oracle Clusterware is not supported.

See Also: "Performing Rolling Upgrades of Oracle Grid Infrastructure" on page D-9 for instructions on completing rolling upgrades

D.6 Preparing to Upgrade an Existing Oracle Clusterware Installation

If you have an existing Oracle Clusterware installation, then you upgrade your existing cluster by performing an out-of-place upgrade. You cannot perform an in-place upgrade.

The following sections describe the tasks you should complete before starting an upgrade:

- Verify System Readiness for Patches and Upgrades
- Gather the Necessary System Information
- Upgrade to the Minimum Required Oracle Clusterware Release
- Unset Environment Variables Used By Oracle Software

D.6.1 Verify System Readiness for Patches and Upgrades
If you are completing a patch update of Oracle Clusterware or Oracle ASM, then after you download the patch software and before you start to patch or upgrade your software installation, review the Patch Set Release Notes that accompany the patch to
determine if your system meets the system requirements for the operating system and
the hardware.

Use the Cluster Verification Utility (CVU) to assist you with system checks in
preparation for patching or upgrading. You can run CVU before starting the upgrade,
however, the installer runs the appropriate CVU checks automatically, and prompts
you to fix problems before proceeding with the upgrade.

**See Also:** *Oracle Database Upgrade Guide*

### D.6.2 Gather the Necessary System Information

Ensure that you have the information you will need when installing Oracle Grid
Infrastructure into a new home directory, including the following:

- The Oracle base location for Oracle Clusterware
- An Oracle Grid Infrastructure home location that is different from your existing
  Oracle Clusterware home (or Grid home) location
- SCAN name and addresses, and other network addresses, as described in
  Chapter 4
- Privileged user operating system groups, as described in Section 5.1, "Creating
  Groups and Users for Oracle Grid Infrastructure and Oracle RAC"
- Local Administrator user access, or access as the user who performed the previous
  Oracle Clusterware installation

### D.6.3 Upgrade to the Minimum Required Oracle Clusterware Release

To upgrade existing Oracle Clusterware installations to a standard configuration
Oracle Grid Infrastructure 12c cluster, your release must be greater than or equal to
Oracle Clusterware 10g Release 1 (10.1.0.5), Oracle Clusterware 10g Release 2 (10.2.0.3),
Oracle Grid Infrastructure 11g Release 1 (11.1.0.6), or Oracle Grid Infrastructure 11g
Release 2 (11.2.0.2). If your current Oracle Clusterware installation is not currently
running at least the minimum supported release, then a prerequisite check failure is
reported.

You must upgrade your current Oracle Clusterware installation to at least the
minimum supported release before upgrading. For example, if you plan to upgrade
your Oracle Clusterware 11g Release 1 installation to Oracle Clusterware 12c Release 1
(12.1) and your current Oracle Clusterware installation is release 11.1.0.2, then you
must upgrade your current Oracle Clusterware installation to release 11.1.0.6 or higher
before starting the upgrade.

### D.6.4 Unset Environment Variables Used By Oracle Software

If you have had an existing installation on your system, and you are using the same
user account to install Oracle Grid Infrastructure 12c Release 1 (12.1), then unset the
following environment variables, and any other environment variable set for the
Oracle installation user that is connected with Oracle software homes.

- ORACLE_BASE
- ORACLE_HOME
- ORACLE_SID
- ORA_NLS10
- TNS_ADMIN
Using CVU to Validate Readiness for Oracle Clusterware Upgrades

If you have set ORA_CRS_HOME as an environment variable, following instructions from Oracle Support, then unset it before starting an installation or upgrade. You should never use ORA_CRS_HOME as an environment variable except under explicit direction from Oracle Support.

To remove the environment variable settings for all sessions, from the Start menu, right click My Computer and select Properties. In the System Properties window, select Advanced, then click the Environment Variables button.

Also, check to ensure that the user profile for the Oracle Installation User does not set any of these environment variables.

D.7 Using CVU to Validate Readiness for Oracle Clusterware Upgrades

You can use Cluster Verification Utility (CVU) to assist you with system checks in preparation for starting an upgrade. CVU runs the appropriate system checks automatically, and prompts you to fix problems before proceeding with the upgrade.

This section contains the following topics:

- About the CVU Grid Upgrade Validation Command Options
- Example of Verifying System Upgrade Readiness for Grid Infrastructure

See Also: Oracle Database Upgrade Guide

D.7.1 About the CVU Grid Upgrade Validation Command Options

You can run upgrade validations in one of two ways:

- Run OUI, and allow the CVU validation built into OUI to perform system checks
- Run the CVU manual script cluvfy.bat script to perform system checks

To use OUI to perform pre-install checks, run the installation as you normally would. OUI starts CVU, and performs system checks as part of the installation process. Selecting OUI to perform these checks is particularly appropriate if you think you have completed preinstallation checks, and you want to confirm that your system configuration meets minimum requirements for installation.

To use the cluvfy.bat command-line script for CVU, navigate to the staging area for the upgrade, where the runcluvfy.bat command is located, and run the following command to check the readiness of your Oracle Clusterware installation for upgrades:

```
runcluvfy.bat stage -pre crsinst -upgrade
```

Running runcluvfy.bat with the -pre crsinst -upgrade options performs system checks to confirm if the cluster is in a correct state for upgrading from an existing clusterware installation.

The runcluvfy command uses the following syntax, where variable content is indicated by italics:

```
```
The options are:

- `-n nodelist`
  The `-n` flag indicates cluster member nodes, and `nodelist` is the comma-delimited list of non-domain qualified node names on which to run a preupgrade verification. If you do not add the `-n` flag to the verification command, then all the nodes in the cluster are verified.

- `-rolling`
  Use this flag to verify readiness for rolling upgrades.

- `-src_crshome src_Gridhome`
  Use this flag to indicate the location of the source Oracle Clusterware or Grid home that you are upgrading, where `src_Gridhome` is the path to the home to upgrade.

- `-dest_crshome dest_Gridhome`
  Use this flag to indicate the location of the upgrade Grid home, where `dest_Gridhome` is the path to the Grid home.

- `-dest_version dest_version`
  Use the `dest_version` flag to indicate the release number of the upgrade, including any patchset. The release number must include the five digits designating the release to the level of the platform-specific patch. For example: 12.1.0.1.0.

- `-verbose`
  Use the `-verbose` flag to produce detailed output of individual checks.

### D.7.2 Example of Verifying System Upgrade Readiness for Grid Infrastructure

You can verify that the permissions required for installing Oracle Clusterware have been configured on the nodes `node1` and `node2` by running the following command:

```
C:\> runcluvfy.bat stage -pre crsinst -upgrade -n node1,node2 -rolling
   -src_crshome C:\app\11.2.0.3\grid -dest_crshome C:\app\12.1.0\grid
   -dest_version 12.1.0.0.0 -verbose
```

### D.8 Understanding Rolling Upgrades Using Batches

Upgrades from earlier releases require that you upgrade the entire cluster. You cannot select or de-select individual nodes for upgrade. Oracle does not support attempting to add additional nodes to a cluster during a rolling upgrade.

Oracle recommends that you leave Oracle RAC instances running when upgrading Oracle Clusterware. When you start the upgrade process on each node, the upgrade scripts shut down the database instances and then start the instances again. If you upgrade from Oracle Grid Infrastructure 11g Release 11.2.0.1 and later to any later release of Oracle Grid Infrastructure, then all nodes are selected for upgrade by default.

When performing the upgrade, you can divide the nodes into groups, or batches, and start upgrades of these node batches. Between batches, you can move services from nodes running the previous release to the upgraded nodes, so that services are not affected by the upgrade.
Performing Rolling Upgrades of Oracle Grid Infrastructure

This section contains the following topics:

- Performing a Standard Upgrade from an Earlier Release
- Completing an Oracle Clusterware Upgrade when Nodes Become Unreachable
- Upgrading Inaccessible Nodes After Forcing an Upgrade

D.9.1 Performing a Standard Upgrade from an Earlier Release

Use the following procedure to upgrade Oracle Clusterware or Oracle Automatic Storage Management (Oracle ASM) from an earlier release to a later release.

1. If there are non-clustered, or single-instance, Oracle databases that use Oracle ASM running on any of the nodes in the cluster, they must be shut down before you start the upgrade. Listeners associated with those databases do not have to be shut down.

2. Start the installer, and select the option to upgrade an existing Oracle Clusterware and Oracle ASM installation.

3. On the node selection page, select all nodes.

4. Select installation options as prompted.

5. Confirm your selections, and then the upgrade scripts are run automatically.

Note: When you upgrade to Oracle Clusterware 12c Release 1 (12.1), Oracle Automatic Storage Management (Oracle ASM) is installed in the same home as Oracle Clusterware. In Oracle documentation, this home is called the Oracle Grid Infrastructure home, or Grid home. Also note that Oracle does not support attempting to add additional nodes to a cluster during a rolling upgrade.

Note: Oracle recommends that you leave Oracle Real Application Clusters (Oracle RAC) instances running during the Oracle Clusterware upgrade. During the upgrade process, the database instances on the node being upgraded are stopped and started automatically during the upgrade process.

Note: In contrast with releases prior to Oracle Clusterware 11g Release 2, all upgrades are rolling upgrades, even if you select all nodes for the upgrade. If you are upgrading from Oracle Clusterware 11g, then all nodes are selected by default. You cannot select or de-select the nodes.

Note: If you receive an error indicating the server must be restarted before the installation completes, see Section A.12.1, "Completing Failed or Interrupted Upgrades;"
6. After the Oracle Clusterware upgrade completes, if you are upgrading from a release earlier than Oracle ASM 11g Release 2 (11.2.0.1), and you left the check box for ASM Configuration Assistant (ASMCA) selected, as is the default, then the installer starts ASMCA to upgrade Oracle ASM. If you unchecked the box on the interview stage of the upgrade, then ASMCA is not run automatically.

If an earlier release of Oracle ASM is installed, then the installer starts ASMCA to upgrade Oracle ASM to 12c Release 1 (12.1). You can upgrade Oracle ASM at this time, or upgrade it later.

Oracle recommends that you upgrade Oracle ASM at the same time that you upgrade Oracle Clusterware. Until Oracle ASM is upgraded, Oracle databases that use Oracle ASM cannot be created and the Oracle ASM management tools in the Oracle Grid Infrastructure 12c Release 1 (12.1) home (for example, srvctl) do not work.

---

**Note:** After the upgrade, if you set the Oracle Cluster Registry (OCR) backup location manually to the earlier release Oracle Clusterware home (CRS home), then you must change the OCR backup location to the Oracle Grid Infrastructure home (Grid home). If you did not set the OCR backup location manually, then this issue does not concern you.

Because upgrades of Oracle Clusterware are out-of-place upgrades, the Oracle Clusterware home for the earlier release cannot be the location of the OCR backups. Backups in the old Oracle Clusterware home could be deleted.

---

7. Because the Oracle Grid Infrastructure home is in a different location than the former Oracle Clusterware and Oracle ASM homes, update any scripts or applications that use utilities or other files that reside in the Oracle Clusterware and Oracle ASM homes.

---

**See Also:** Section A.12, "Failed or Incomplete Installations and Upgrades" for information about completing interrupted upgrades

---

**D.9.2 Completing an Oracle Clusterware Upgrade when Nodes Become Unreachable**

If some nodes become unreachable in the middle of an upgrade, then you cannot complete the upgrade, because the upgrade did not complete successfully on the unreachable nodes. Because the upgrade is incomplete, Oracle Clusterware remains in the previous release. You can confirm that the upgrade is incomplete by entering the command `crsctl query crs activeversion`.

To resolve this problem, run the `rootupgrade.bat` command with the `-force` flag using the following syntax:

```
Grid_home/rootupgrade -force
```

For example, as the Oracle Installation User for Oracle Grid Infrastructure, run the following command:

```
C:/> C:\app\12.1.0\grid\rootupgrade -force
```

This command forces the upgrade to complete. Verify that the upgrade has completed by using the command `crsctl query crs activeversion`. The active release should be the upgrade release.

The force cluster upgrade has the following limitations:
■ All active nodes must be upgraded to the newer release
■ All inactive nodes (accessible or inaccessible) may be either upgraded or not upgraded
■ For inaccessible nodes, after patch set upgrades, you can delete the node from the cluster. If the node becomes accessible later, and the patch version upgrade path is supported, then you can upgrade it to the new patch version.

D.9.3 Upgrading Inaccessible Nodes After Forcing an Upgrade

Starting with Oracle Grid Infrastructure 12c, after you complete a force cluster upgrade command, you can join inaccessible nodes to the cluster as an alternative to deleting the nodes, which was required in earlier releases. To use this option, Oracle Grid Infrastructure 12c Release 1 (12.1) software must already be installed on the nodes.

To complete the upgrade of inaccessible or unreachable nodes:

1. Log in as the Oracle Installation User for Oracle Grid Infrastructure on one of the nodes that is a member of the cluster.
2. Change directory to the crs\install directory in the Oracle Grid Infrastructure 12c Release 1 (12.1) Grid home. For example:
   ```
   C:\> cd app\12.1.0\grid\crs\install
   ```
3. Run the following PERL command, where existing_node is the node in the cluster on which you run the command, and upgraded_node is the inaccessible or unreachable node that you want to join to the cluster:
   ```
   C:\..\install> rootcrs.pl -join -existingNode upgraded_node
   ```

D.10 Performing Rolling Upgrades of Oracle ASM

After you have completed the Oracle Clusterware portion of Oracle Grid Infrastructure 12c Release 1 (12.1) upgrade, you may need to upgrade Oracle ASM separately if the Oracle ASM portion of the Oracle Grid Infrastructure upgrade failed, or for some other reason Automatic Storage Management Configuration assistant (asmca) did not run.

You can use asmca to complete the upgrade separately, but you should do it soon after you upgrade Oracle Clusterware, as Oracle ASM management tools such as srvctl do not work until Oracle ASM is upgraded.

---

**Note:** ASMCA performs a rolling upgrade only if the earlier release of Oracle ASM is either 11.1.0.6 or 11.1.0.7. Otherwise, ASMCA performs a rolling upgrade, during which ASMCA shuts down all Oracle ASM instances on all nodes of the cluster, and then starts an Oracle ASM instance on each node from the new Oracle Grid Infrastructure home.

---

After you have upgraded Oracle ASM to Oracle Grid Infrastructure 12c Release 1, you can install individual patches for Oracle ASM by downloading them from the Oracle Automated Release Update site. See Section D.10.1, "Preparing to Complete a Separate Upgrade of Oracle ASM” for steps to upgrade Oracle ASM separately from Oracle Grid Infrastructure.
D.10.1 Preparing to Complete a Separate Upgrade of Oracle ASM

If you must complete upgrade of Oracle ASM separately, then note the following requirements:

- The active release of Oracle Clusterware must be 12c Release 1 (12.1). To determine the active release, enter the following command from the Grid home:
  
  C:\..\bin> crsctl query crs activeversion

- You can upgrade a single instance Oracle ASM installation to a clustered Oracle ASM installation. However, you can only upgrade an existing single instance Oracle ASM installation if you run the installation from the node on which Oracle ASM is installed. You cannot upgrade a single instance Oracle ASM installation on a remote node.

- You must ensure that any rebalance operations on your existing Oracle ASM installation are completed before starting the upgrade process.

- During the upgrade process, you alter the state of the Oracle ASM instances to an upgrade state. Because this upgrade state limits Oracle ASM operations, you should complete the upgrade process soon after you begin. The following operations are allowed when an Oracle ASM instance is in the upgrade state:
  - Diskgroup mounts and dismounts
  - Opening, closing, resizing, or deleting database files
  - Recovering instances
  - Queries of fixed views and packages: Users are allowed to query fixed views and run anonymous PL/SQL blocks using fixed packages, such as \texttt{DBMS\_DISKGROUP}

- You do not need to shut down database clients unless they are on Oracle ACFS.

D.10.2 Upgrading Oracle ASM Separately from an Oracle Grid Infrastructure Upgrade

Complete the following tasks if you must upgrade from an Oracle ASM release where Oracle ASM was installed in a separate Oracle home, or if the Oracle ASM portion of Oracle Grid Infrastructure upgrade failed to complete:

1. On the node you plan to start the upgrade, set the environment variable \texttt{ASMCA\_ROLLING\_UPGRADE} to true. For example:

   C:\> set ASMCA\_ROLLING\_UPGRADE=true

2. From the Oracle Grid Infrastructure 12c Release 1 (12.1) home, start ASMCA. For example:

   C:\> cd app\12.1\grid\bin
   C:\..\bin> asmca.bat

3. Select Upgrade.

   Oracle ASM Configuration Assistant (ASMCA) upgrades Oracle ASM in succession for all nodes in the cluster.

4. After you complete the upgrade, run the command to unset the \texttt{ASMCA\_ROLLING\_UPGRADE} environment variable.

   C:\> set ASMCA\_ROLLING\_UPGRADE=
Applying Patches to Oracle ASM

After you have upgraded Oracle ASM with Oracle Grid Infrastructure 12c Release 1, you can install individual patches for Oracle ASM by downloading them from My Oracle Support.

Starting with Oracle Grid Infrastructure 12c Release 1 (12.1), a new cluster state called "Rolling Patch" is available. This mode is similar to the existing "Rolling Upgrade" mode in terms of the Oracle ASM operations allowed in this quiesce state.

- About Individual (One-Off) Oracle ASM Patches
- About Oracle Grid Infrastructure Software Patch Levels
- Patching Oracle ASM to a Software Patch Level

D.11.1 About Individual (One-Off) Oracle ASM Patches

Individual patches are called one-off patches. An Oracle ASM one-off patch is available for a specific release of Oracle ASM. If a patch you want is available, then you can download the patch and apply it to Oracle ASM using the OPatch Utility. The OPatch inventory keeps track of the patches you have installed for your release of Oracle ASM. If there is a conflict between the patches you have installed and patches you want to apply, then the OPatch Utility advises you of these conflicts. See Section D.11.3, "Patching Oracle ASM to a Software Patch Level" for information about applying patches to Oracle ASM using the OPatch Utility.

D.11.2 About Oracle Grid Infrastructure Software Patch Levels

The software patch level for Oracle Grid Infrastructure represents the set of all one-off patches applied to the Oracle Grid Infrastructure software release, including Oracle ASM. The release is the release number, in the format of major, minor, and patch set release number. For example, with the release number 12.1.0.1, the major release is 12, the minor release is 1, and 0.0 is the patch set number. With one-off patches, the major and minor release numbers remain the same, though the patch levels change each time you apply or roll back an interim patch.

As with standard upgrades to Oracle Grid Infrastructure, at any given point in time for normal operation of the cluster, all the nodes in the cluster must have the same software release and patch level. Because one-off patches can be applied as rolling upgrades, all possible patch levels on a particular software release are compatible with each other.

See Also:
- Section D.9.1, "Performing a Standard Upgrade from an Earlier Release" for information about upgrading Oracle Grid Infrastructure
- Section D.11.3, "Patching Oracle ASM to a Software Patch Level" for information about applying patches to Oracle ASM using the OPatch utility
D.11.3 Patching Oracle ASM to a Software Patch Level

1. Download the patch you want to apply from My Oracle Support:

https://support.oracle.com

Select the Patches and Updates tab to locate the patch. To locate patch bundles, you can perform a Product or Family (Advanced) search for your platform and software release.

Oracle recommends that you select Recommended Patch Advisor, and enter the product group, release, and platform for your software. My Oracle Support provides you with a list of the most recent patches and critical patch updates (CPUs).

Place the patch in an accessible directory, such as C:\downloads.

2. Change directory to the opatch directory in the Grid home. For example:

C:\> cd app\12.1.0\grid\opatch

3. Review the patch documentation for the patch you want to apply, and complete all required steps before starting the patch upgrade. Follow the instructions in the patch documentation to apply the patch.

D.12 Checking Cluster Health Monitor Repository Size After Upgrading

If you are upgrading from a prior release using IPD/OS to Oracle Grid Infrastructure 11g Release 2 (11.2.0.2 and later), then you should review the Cluster Health Monitor repository size (the CHM repository). Oracle recommends that you review your CHM repository needs, and enlarge the repository size to maintain a larger CHM repository.

Note: Your previous IPD/OS repository is deleted when you install Oracle Grid Infrastructure.

By default, the CHM repository size is a minimum of either 1GB or 3600 seconds (1 hour), regardless of the size of the cluster.

To enlarge the CHM repository, use the following command syntax, where RETENTION_TIME is the size of CHM repository in number of seconds:

oclumon manage -repos changeretentiontime RETENTION_TIME

The value for RETENTION_TIME must be more than 3600 (one hour) and less than 259200 (three days). If you enlarge the CHM repository size, then you must ensure that there is local space available for the repository size you select on each node of the cluster. If there is not sufficient space available, then you can move the repository to shared storage.

For example, to set the repository size to four hours:

C:\> oclumon manage -repos changeretentiontime 14400

D.13 Downgrading Oracle Clusterware After an Upgrade

After a successful or a failed upgrade to Oracle Clusterware 12c Release 1 (12.1), you can restore Oracle Clusterware to the previous release. This section contains the following topics:
D.13.1 About Downgrading Oracle Clusterware After an Upgrade

Downgrading Oracle Clusterware restores the Oracle Clusterware configuration to the state it was in before the Oracle Clusterware 12c Release 1 (12.1) upgrade. Any configuration changes you performed during or after the Oracle Grid Infrastructure 12c Release 1 (12.1) upgrade are removed and cannot be recovered.

In the downgrade procedures, the following variables are used:

- **local node** is the first node on which you started the upgrade process.
- **remote nodes** are all other nodes where you started the upgrade process.

To restore Oracle Clusterware to the previous release, use the downgrade procedure for the release to which you want to downgrade.

D.13.2 Downgrading to Oracle Clusterware 11g Releases Prior to Release 11.2.0.1

To restore Oracle Clusterware to the previous release:

1. On all remote nodes, as an Administrator user, use the command syntax `Grid_home\crs\install\rootcrs.pl -downgrade [-force]` to stop the Oracle Clusterware 12c Release 1 (12.1) resources, and shut down the Oracle Grid Infrastructure 12c Release 1 (12.1) stack.

2. After the `rootcrs.pl -downgrade` script has completed on all remote nodes, on the local node use the following command syntax:

   `Grid_home\crs\install\rootcrs.pl -downgrade -lastnode [-force]
   For example:
   C:\app\12.1.0\grid\crs\install> rootcrs.pl -downgrade -lastnode`

   **Note:** With Oracle Grid Infrastructure 12c, you no longer need to provide the location of the previous release Grid home or release number.

This script downgrades the OCR. To stop a partial or failed Oracle Grid Infrastructure 12c Release 1 (12.1) installation and restore the previous release Oracle Clusterware, use the `-force` flag with this command.

3. On each cluster member node where the upgrade completed successfully:

   a. Log in as the Oracle Grid Infrastructure installation owner.

   b. Use the following command to start the installer, where `C:\app\12.1.0\grid` represents the location of the new (upgraded) Grid home:

   ```
   setup.exe -updateNodeList -silent CRS=false ORACLE_HOME=C:\app\12.1.0\grid
   Add the flag `-cfs` if the Grid home is a shared home.
   ```

4. On each cluster member node where the upgrade completed successfully:

   a. Log in as the Oracle Grid Infrastructure installation owner.
b. Use the following command to start the installer, where the path you provide for the flag ORACLE_HOME is the location of the home directory from the earlier Oracle Clusterware installation.

For example, if the location of the earlier Oracle Clusterware installation is C:\app\crs, you would use a command similar to the following:

C:\> cd C:\app\12.1.0\grid\oui\bin
C:\..bin> setup.exe -updateNodeList -silent CRS=true ORACLE_HOME=C:\app\crs

c. For downgrades to 11.1 and earlier releases

If you are downgrading to Oracle Clusterware 11g Release 1 (11.1) or an earlier release, then you must run root.bat manually from the earlier release Oracle Clusterware home to complete the downgrade after you complete step b.

OUI prompts you to run root.bat manually from the earlier release Oracle Clusterware installation home in sequence on each member node of the cluster to complete the downgrade. After you complete this task, downgrade is completed.

Running root.bat from the earlier release Oracle Clusterware installation home restarts the Oracle Clusterware stack, starts all the resources previously registered with Oracle Clusterware in the older release, and configures the old initialization scripts to run the earlier release Oracle Clusterware stack.

5. The installer stops the Oracle Grid Infrastructure 12c software stack. The Windows services used by Oracle Grid Infrastructure are recreated to refer to the Grid home for the older software release by one of the scripts during the downgrade process.

D.13.3 Downgrading to Oracle Clusterware 11g Release 2 (11.2.0.1) or Later Release

To restore Oracle Clusterware to the previous release:

1. On all remote nodes, as an Administrator user, use the command syntax Grid_home\crs\install\rootcrs.pl -downgrade [-force] to stop the Oracle Clusterware 12c Release 1 (12.1) resources, and shut down the Oracle Grid Infrastructure 12c Release 1 (12.1) stack.

For example:

C:\app\12.1.0\grid\crs\install> rootcrs.pl -downgrade

To stop a partial or failed Oracle Grid Infrastructure 12c Release 1 (12.1) installation and restore the previous release of Oracle Clusterware, use the -force flag with this command.

2. After the rootcrs.pl -downgrade script has completed on all remote nodes, on the local node use the following command syntax:

Grid_home\crs\install\rootcrs.pl -downgrade -lastnode [-force]

For example:

C:\app\12.1.0\grid\crs\install> rootcrs.pl -downgrade -lastnode

**Note:** With Oracle Grid Infrastructure 12c, you no longer need to provide the location of the previous release Grid home or release number.
This script downgrades the OCR. To stop a partial or failed Oracle Grid Infrastructure 12c Release 1 (12.1) installation and restore the previous release Oracle Clusterware, use the -force flag with this command.

3. On each cluster member node where the upgrade to Oracle Grid Infrastructure 12c has completed successfully, log in as an Administrator user, and use the following command to start the installer, where C:\app\12.1.0\grid is the location of the new (upgraded) Grid home (12.1):

```bash
setup.exe -updateNodeList -silent CRS=false ORACLE_HOME=C:\app\12.1.0\grid
```

Add the flag -cfs if the Grid home is a shared home.

4. Run the following command, where C:\app\11.2.0.2\grid represents the home directory of the earlier Oracle Clusterware installation:

```bash
setup.exe -updateNodeList -silent CRS=true ORACLE_HOME=C:\app\11.2.0.2\grid
```

5. On each node, start Oracle Clusterware from the earlier release Oracle Clusterware home using the command crsctl start crs. For example, where the earlier release home is C:\app\11.2.0.2\grid, use the following command on each node:

```bash
C:\app\11.2.0.2\grid\bin> crsctl start crs
```

D.14 Updating Oracle Enterprise Manager Cloud Control Target Parameters

Because the Oracle Clusterware upgrade is an out-of-place upgrade, the upgraded software has a new location for the Grid home. The path for the Oracle Clusterware home in some Oracle Enterprise Manager parameter files must be changed. If you do not change the CRS_HOME parameter, then you can encounter errors such as "cluster target broken" on Oracle Enterprise Manager Cloud Control.

To resolve the issue, upgrade the Enterprise Manager Cloud Control target, and then update the Enterprise Manager Agent Base Directory on each cluster member node running an agent, as described in the following sections:

- Updating the Enterprise Manager Cloud Control Target After Upgrades
- Updating the Enterprise Manager Agent Base Directory After Upgrades

D.14.1 Updating the Enterprise Manager Cloud Control Target After Upgrades

1. Log in to Enterprise Manager Cloud Control
2. Navigate to the Targets menu, and then to the Cluster page.
3. Click a cluster target that was upgraded.
4. Click Cluster, then Target Setup, and then Monitoring Configuration from the menu.
5. Update the value for Oracle Home with the new Grid home path.
6. Save the updates.

D.14.2 Updating the Enterprise Manager Agent Base Directory After Upgrades

1. Navigate to the bin directory in the Agent Base Directory.
The Agent Base Directory is a directory where the Management Agent home is created. It is in the path `EMAgent_home\core\EMAgent_Version\bin`. For example, if the Agent Base Directory is `C:\app\grid`, then the Management Agent home is created as `C:\app\emagent\core\12.1.0.1.0\bin`.

2. In the bin directory, open the file `emctl` with a text editor.

3. Locate the parameter `CRS_HOME`, and update the parameter to the new Grid home path.

4. Repeat steps 1-3 on each node of the cluster with an Enterprise Manager agent.
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