Oracle® Database

Database Installation Guide



19c for Linux

E96432-52

September 2026



Oracle Database Database Installation Guide, 19c for Linux

E96432-52

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Preface

This guide explains how to install and configure single-instance Oracle Database.

This guide also provides information about Optimal Flexible Architecture, cloning an Oracle home, and how to remove the database software.

- Audience
  This guide is intended for anyone responsible for installing Oracle Database 19c.
- Set Up Java Access Bridge to Implement Java Accessibility
  Install Java Access Bridge so that assistive technologies on Microsoft Windows systems can use the Java Accessibility API.
- Command Syntax
  Refer to these command syntax conventions to understand command examples in this guide.
- Conventions

Audience

This guide is intended for anyone responsible for installing Oracle Database 19c.

Additional installation guides for Oracle Database, Oracle Real Application Clusters, Oracle Clusterware, Oracle Database Examples, and Oracle Enterprise Manager Cloud Control are available at the following URL:

http://docs.oracle.com

Set Up Java Access Bridge to Implement Java Accessibility

Install Java Access Bridge so that assistive technologies on Microsoft Windows systems can use the Java Accessibility API.

Java Access Bridge is a technology that enables Java applications and applets that implement the Java Accessibility API to be visible to assistive technologies on Microsoft Windows systems.

Refer to *Java Platform, Standard Edition Accessibility Guide* for information about the minimum supported versions of assistive technologies required to use Java Access Bridge. Also refer to this guide to obtain installation and testing instructions, and instructions for how to use Java Access Bridge.

Related Topics

- *Java Platform, Standard Edition Java Accessibility Guide*

Command Syntax

Refer to these command syntax conventions to understand command examples in this guide.

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Convention	Description
$	Bourne or BASH shell prompt in a command example. Do not enter the prompt as part of the command.
%	C Shell prompt in a command example. Do not enter the prompt as part of the command.
#	Superuser (root) prompt in a command example. Do not enter the prompt as part of the command.
`monospace`	UNIX command syntax
backslash \	A backslash is the UNIX and Linux command continuation character. It is used in command examples that are too long to fit on a single line. Enter the command as displayed (with a backslash) or enter it on a single line without a backslash: `dd if=/dev/rdsk/c0t1d0s6 of=/dev/rst0 bs=10b \  count=10000`
braces { }	Braces indicate required items: `.DEFINE {macro1}`
brackets [ ]	Brackets indicate optional items: `cvtcrt termname [outfile]`
ellipses ...	Ellipses indicate an arbitrary number of similar items: `CHKVAL fieldname value1 value2 ... valueN`
italic	Italic type indicates a variable. Substitute a value for the variable: *`library_name`*
vertical line |	A vertical line indicates a choice within braces or brackets: `FILE filesize [K|M]`

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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Changes in this Release for Oracle Database

Learn about the new features and changes in Oracle Database Installation Guide for Oracle Database 19c.

- New Features
  Review new features available with Oracle Database installation in Oracle Database 19c.
- Deprecated Features
  Review features that are deprecated starting with Oracle Database 19c.
- Other Changes
  Review other changes for Oracle Database 19c.

Related Topics

- *Oracle Database New Features Guide*

New Features

Review new features available with Oracle Database installation in Oracle Database 19c.

- Oracle Memory Speed Support for PMEM Devices
- Root Scripts Automation Support for Oracle Database Installation
- Simplified Image-Based Oracle Database Client Installation

Oracle Memory Speed Support for PMEM Devices

Oracle recommends that you use Oracle Database with the Oracle Memory Speed (OMS) file system to fully utilize the potential of persistent memory (PMEM) devices safely in data centers.

With PMEM as the backing device, OMS utilizes a memory-mapped file hosted on an XFS-based, DAX-enabled file system to perform I/O operations. You must export the PMEM device as a file using a DAX-enabled file system, such as XFS.

Related Topics

- Deploying the Oracle Memory Speed File System
  Learn how to deploy the Oracle Memory Speed (OMS) file system on your persistent memory (PMEM) storage devices with a single-instance Oracle Database.

Root Scripts Automation Support for Oracle Database Installation

Starting with Oracle Database 19c, the database installer, or setup wizard, provides options to set up permissions to run the root configuration scripts automatically, as required, during a database installation. You continue to have the option to run the root configuration scripts manually.

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Setting up permissions for root configuration scripts to run without user intervention can simplify database installation and help avoid inadvertent permission errors.

Related Topics

- Running Oracle Database Setup Wizard to Install Oracle Database
  Extract the database image files and use the `runInstaller` command to start the installation.

Simplified Image-Based Oracle Database Client Installation

Starting with Oracle Database 19c, the Oracle Database client software is available as an image file for download and installation. You must extract the image software into a directory where you want your Oracle home to be located, and then run the `runInstaller` script to start the Oracle Database client installation. Oracle Database client installation binaries continue to be available in the traditional format as non-image zip files.

As with Oracle Database and Oracle Grid Infrastructure image file installations, Oracle Database client image installations simplify Oracle Database client installations and ensure best practice deployments.

Related Topics

- Installing Oracle Database Client Using Image File

Deprecated Features

Review features that are deprecated starting with Oracle Database 19c.

The following feature is deprecated in this release, and may be desupported in another release. For more information about deprecated and desupported features, parameters and views, refer to *Oracle Database Upgrade Guide*.

- Deprecation of Oracle ASMFDOracle ASM Filter Driver (ASMFD) is deprecated on both Linux and Oracle Solaris beginning with Oracle Database 19c. It will be desupported in a future release.
  On Linux systems running kernel 5.14 or higher (including Oracle Linux, RedHat Enterprise Linux, and SUSE Linux Enterprise Server), ASMFD filtering is already disabled and will not be supported going forward. Oracle recommends moving to ASMlib v3 for those environments, as it provides equivalent functionality. For details, see My Oracle Support Document 2806979.1. Migration steps are available for Oracle Restart and Oracle Grid Infrastructure. On Oracle Solaris, ASMFD is deprecated, but remains fully supported. No immediate action is required until a formal desupport notice is issued.
- Deprecation of clone.pl

  The `clone.pl` script is deprecated in Oracle Database 19c. The functionality of performing a software-only installation, using the gold image, is available in the installer wizard. The `clone.pl` script can be removed in a future release. Instead of using the `clone.pl` script, Oracle recommends that you install the extracted gold image as a home, using the installer wizard.
- Deprecation of the SERVICE_NAMES parameter

  The use of the `SERVICE_NAMES` parameter is no longer actively supported. It must not be used for high availability (HA) deployments. It is not supported to use service names parameter for any HA operations. This restriction includes FAN, load balancing, `FAILOVER_TYPE`, `FAILOVER_RESTORE`, `SESSION_STATE_CONSISTENCY`, and any other uses.
- Deprecation of Oracle ACFS on IBM AIX

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The ACFS storage option on IBM AIX is deprecated in Oracle Database 19c.
To align the support for the IBM AIX platform, Oracle Automatic Storage Management Cluster File System (ACFS) on IBM AIX (called Oracle Advanced Cluster File System starting with Oracle Database 21c) is deprecated in Oracle Database 19c. For data or files currently stored on an ACFS file system that cannot be stored in the Oracle database, the IBM General Parallel File System (GPFS) can be used.

Related Topics

- *Oracle Database Upgrade Guide*

Other Changes

Review other changes for Oracle Database 19c.

- Rapid Home Provisioning Name Change

  Starting with Oracle Database 19c and Oracle Grid Infrastructure 19c, Rapid Home Provisioning is renamed to Fleet Patching and Provisioning (FPP).

- Operating System Package Names

  To simplify the installation of operating system packages required for an Oracle Database and Oracle Grid Infrastructure installation on Linux, starting with 19c, only the operating system package names will be listed and not the exact package version. Install or update to the latest version of these packages from the minimum supported Linux distribution.Only packages that are officially released by Oracle or your operating system vendor are supported.

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1

Oracle Database Installation Checklist

Use checklists to review system requirements, and to plan and carry out Oracle Database installation.

Oracle recommends that you use checklists as part of your installation planning process. Using checklists can help you to confirm that your server hardware and configuration meet minimum requirements for this release, and can help you to ensure you carry out a successful installation.

- Server Hardware Checklist for Oracle Database Installation
  Use this checklist to check hardware requirements for Oracle Database.
- Operating System Checklist for Oracle Database Installation on Linux
  Use this checklist to check minimum operating system requirements for Oracle Database.
- Server Configuration Checklist for Oracle Database Installation
  Use this checklist to check minimum server configuration requirements for Oracle Database installations.
- Oracle User Environment Configuration Checklist for Oracle Database Installation
  Use this checklist to plan operating system users, groups, and environments for Oracle Database management.
- Storage Checklist for Oracle Database Installation
  Use this checklist to review storage minimum requirements and assist with configuration planning.
- Installer Planning Checklist for Oracle Database
  Use this checklist to assist you to be prepared before starting Oracle Universal Installer.
- Deployment Checklist for Oracle Database
  Use this checklist to decide the deployment method for a single-instance Oracle Database.

Server Hardware Checklist for Oracle Database Installation

Use this checklist to check hardware requirements for Oracle Database.

Table 1-1 Server Hardware Checklist for Oracle Database Installation

Check	Task
Runlevel	3 or 5
Server Display Cards	At least 1024 x 768 display resolution, which Oracle Universal Installer requires.
Minimum network connectivity	Server is connected to a network
Minimum RAM	• At least 1 GB RAM for Oracle Database installations. 2 GB RAM recommended. • At least 8 GB RAM for Oracle Grid Infrastructure installations.
Linux for Arm (aarch64) processor	Oracle Database 19c Linux for Arm (aarch64) requires a CPU capable of Neoverse N1. Oracle recommends using a server with an Ampere Altra or Ampere Altra Max CPU.

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Operating System Checklist for Oracle Database Installation on Linux

Use this checklist to check minimum operating system requirements for Oracle Database.

Table 1-2 Operating System General Checklist for Oracle Database on Linux

Item	Task
Operating system general requirements	OpenSSH installed manually, if you do not have it installed already as part of a default Linux installation. A Linux kernel in the list of supported kernels and releases listed in this guide.
Linux x86-64 operating system requirements	The following Linux x86-64 kernels are supported: • Oracle Linux 10 with the Unbreakable Enterprise Kernel 8: 6.12.0-104.43.4.2.el10uek.x86_64 or later Oracle Linux 10 with the Red Hat Compatible Kernel: 6.12.0-55.40.1.0.1.el10_0.x86_64 or later • Oracle Linux 9 with the Unbreakable Enterprise Kernel 7: 5.15.0-1.43.4.2.el9uek.x86_64 or later Oracle Linux 9 with the Red Hat Compatible Kernel: 5.14.0-70.22.1.0.2.el9_0.x86_64 or later • Oracle Linux 8.8 with the Unbreakable Enterprise Kernel 7: 5.15.0-202.135.2.el8uek.x86_64 or later Oracle Linux 8.1 with the Unbreakable Enterprise Kernel 6: 5.4.17-2011.0.7.el8uek.x86_64 or later Oracle Linux 8 with the Red Hat Compatible kernel: 4.18.0-80.el8.x86_64 or later • Oracle Linux 7.4 with the Unbreakable Enterprise Kernel 4: 4.1.12-124.19.2.el7uek.x86_64 or later Oracle Linux 7.4 with the Unbreakable Enterprise Kernel 5: 4.14.35-1818.1.6.el7uek.x86_64 or later Oracle Linux 7.7 with the Unbreakable Enterprise Kernel 6: 5.4.17-2011.4.4.el7uek.x86_64 or later Oracle Linux 7.5 with the Red Hat Compatible Kernel: 3.10.0-862.11.6.el7.x86_64 or later • Red Hat Enterprise Linux 10: 6.12.0-55.40.1.0.1.el10_0.x86_64 or later • Red Hat Enterprise Linux 9: 5.14.0-70.22.1.el9_0.x86_64 or later • Red Hat Enterprise Linux 8: 4.18.0-80.el8.x86_64 or later • Red Hat Enterprise Linux 7.5: 3.10.0-862.11.6.el7.x86_64 or later **Note:** Oracle Database 19c continues to be supported on Oracle Linux 7 and Red Hat Enterprise Linux 7, however, Oracle strongly recommends that you upgrade your operating system to Oracle Linux 8 or Red Hat Enterprise Linux 8 or later. • SUSE Linux Enterprise Server 15: 4.12.14-23-default or later • SUSE Linux Enterprise Server 12 SP3: 4.4.162-94.72-default or later Review the system requirements section for a list of minimum package requirements.

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Table 1-2 (Cont.) Operating System General Checklist for Oracle Database on Linux

Item	Task
IBM: Linux on System z operating system requirements	The following IBM: Linux on System z kernels are supported: • Red Hat Enterprise Linux 9.2: 5.14.0-284.30.1.el9_2.s390x or later • Red Hat Enterprise Linux 8.3: 4.18.0-240.el8.s390x or later • Red Hat Enterprise Linux 7.4: 3.10.0-693.el7.s390x or later • SUSE Linux Enterprise Server 15: 5.3.18-57-default s390x or later • SUSE Linux Enterprise Server 12: 4.4.73-5-default s390x or later Review the system requirements section for a list of minimum package requirements.
Linux for Arm (aarch64) operating system requirements	Starting with Oracle Database 19c Release 19.19, the Linux for Arm (aarch64) operating system is supported with the following minimum supported version: Oracle Linux 8.6 with Unbreakable Enterprise Kernel 7: 5.15.0-6.80.3.1.el8uek.aarch64 or later **Note:** Oracle recommends that you update Oracle Linux 8 to the latest available release level.
Oracle Database Preinstallation RPM for Oracle Linux	If you use Oracle Linux, then Oracle recommends that you run the Oracle Database Preinstallation RPM for your Linux release to configure your operating system for Oracle Database and Oracle Grid Infrastructure installations.
Oracle RPM Checker utility for IBM: Linux on System z	Oracle recommends that you use the Oracle RPM Checker utility to verify that you have the required Red Hat Enterprise Linux or SUSE packages installed on your IBM: Linux on System z operating system before you start the Oracle Database or Oracle Grid Infrastructure installation.
Disable Transparent HugePages	Oracle recommends that you disable Transparent HugePages and use standard HugePages for enhanced performance.

Related Topics

- Automatically Configuring Oracle Linux with Oracle Database Preinstallation RPM
  Use Oracle Database Preinstallation RPM to simplify operating system configuration in preparation for Oracle software installations.
- Operating System Requirements for x86-64 Linux Platforms
  The Linux distributions and packages listed in this section are supported for this release on x86-64.
- Setting Transparent HugePages to madvise
  Transparent HugePages memory is enabled by default with Oracle Linux. However, for optimal performance, Oracle recommends that you set Transparent HugePages to `madvise` on all Oracle Database servers running UEK7 and later kernels before you start the installation.

Server Configuration Checklist for Oracle Database Installation

Use this checklist to check minimum server configuration requirements for Oracle Database installations.

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Table 1-3 Server Configuration Checklist for Oracle Database

Check	Task
Disk space allocated to the `/tmp` directory	At least 1 GB of space in the `/tmp` directory.
Swap space allocation relative to RAM (Oracle Database)	Between 1 GB and 2 GB: 1.5 times the size of the RAM Between 2 GB and 16 GB: Equal to the size of the RAM More than 16 GB: 16 GB **Note:** If you enable HugePages for your Linux servers, then you should deduct the memory allocated to HugePages from the available RAM before calculating swap space.
Swap space allocation relative to RAM (Oracle Restart)	Between 8 GB and 16 GB: Equal to the size of the RAM More than 16 GB: 16 GB **Note:** If you enable HugePages for your Linux servers, then you should deduct the memory allocated to HugePages from the available RAM before calculating swap space.
Oracle Inventory (oraInventory) and OINSTALL Group Requirements	• For upgrades, the installer detects an existing oraInventory directory from the `/etc/oraInst.loc` file, and uses the existing oraInventory. • For new installs, if you have not configured an oraInventory directory, then you can specify the oraInventory directory during the software installation and Oracle Universal Installer will set up the software directories for you. The Oracle inventory is one directory level up from the Oracle base for the Oracle software installation and designates the installation owner's primary group as the Oracle inventory group. Ensure that the oraInventory path that you specify is in compliance with the Oracle Optimal Flexible Architecture recommendations. The Oracle Inventory directory is the central inventory of Oracle software installed on your system. Users who have the Oracle Inventory group as their primary group are granted the OINSTALL privilege to write to the central inventory. The OINSTALL group must be the primary group of all Oracle software installation owners on the server. It should be writable by any Oracle installation owner.
Groups and users	Oracle recommends that you create groups and user accounts required for your security plans before starting installation. Installation owners have resource limits settings and other requirements. Group and user names must use only ASCII characters.
Mount point paths for the software binaries	Oracle recommends that you create an Optimal Flexible Architecture configuration as described in the appendix "Optimal Flexible Architecture" in *Oracle Database Installation Guide* for your platform.
Ensure that the Oracle home (the Oracle home path you select for Oracle Database) uses only ASCII characters	The ASCII character restriction includes installation owner user names, which are used as a default for some home paths, as well as other directory names you may select for paths.

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Table 1-3 (Cont.) Server Configuration Checklist for Oracle Database

Check	Task
Unset Oracle software environment variables	If you have an existing Oracle software installation, and you are using the same user to install this installation, then unset the following environment variables: `$ORACLE_HOME`,`$ORA_NLS10`, and `$TNS_ADMIN`. If you have set `$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, except as directed by Oracle Support.
Set locale (if needed)	Specify the language and the territory, or locale, in which you want to use Oracle components. A locale is a linguistic and cultural environment in which a system or program is running. NLS (National Language Support) parameters determine the locale-specific behavior on both servers and clients. The locale setting of a component determines the language of the user interface of the component, and the globalization behavior, such as date and number formatting.
Check Shared Memory File System Mount	By default, your operating system includes an entry in `/etc/fstab` to mount `/dev/shm`. However, if your Cluster Verification Utility (CVU) or installer checks fail, ensure that the `/dev/shm` mount area is of type `tmpfs` and is mounted with the following options: • `rw` and `exec` permissions set on it • Without `noexec` or `nosuid` set on it **Note** These options may not be listed as they are usually set as the default permissions by your operating system.
Symlinks	Oracle home or Oracle base cannot be `symlinks`, nor can any of their parent directories, all the way to up to the `root` directory.

Related Topics

- Checking and Configuring the Server for Oracle Database
  Verify that servers where you install Oracle Database meet the minimum requirements for installation.
- Configuring Users, Groups and Environments for Oracle Grid Infrastructure and Oracle Database
  Before installation, create operating system groups and users, and configure user environments.
- *Oracle Database Globalization Support Guide*

Oracle User Environment Configuration Checklist for Oracle Database Installation

Use this checklist to plan operating system users, groups, and environments for Oracle Database management.

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Table 1-4 User Environment Configuration for Oracle Database

Check	Task
Review Oracle Inventory (oraInventory) and OINSTALL Group Requirements	The physical group you designate as the Oracle Inventory directory is the central inventory of Oracle software installed on your system. It should be the primary group for all Oracle software installation owners. Users who have the Oracle Inventory group as their primary group are granted the OINSTALL privilege to read and write to the central inventory. • If you have an existing installation, then OUI detects the existing oraInventory directory from the `/etc/oraInst.loc` file, and uses this location. • If you are installing Oracle software for the first time, then you can specify the Oracle inventory directory and the Oracle base directory during the Oracle software installation, and Oracle Universal Installer will set up the software directories for you. Ensure that the directory paths that you specify are in compliance with the Oracle Optimal Flexible Architecture recommendations. Ensure that the group designated as the OINSTALL group is available as the primary group for all planned Oracle software installation owners.
Create operating system groups and users for standard or role-allocated system privileges	The Preinstallation RPM automatically creates the `oracle` user and the oraInventory (`oinstall`) and OSDBA (`dba`) groups for you. Create additional operating system groups and users depending on your security requirements as described in this installation guide. Set resource limits settings and other requirements for Oracle software installation owners. Group and user names must use only ASCII characters.
Unset Oracle Software Environment Variables	If you have had an existing installation on your system, and you are using the same user account for this installation, then unset the ORACLE_HOME, ORACLE_BASE, ORACLE_SID, TNS_ADMIN environment variables and any other environment variable set for the Oracle installation user that is connected with Oracle software homes.
Configure the Oracle Software Owner Environment	Configure the environment of the `oracle` or `grid` user by performing the following tasks: • Set the default file mode creation mask (`umask`) to 022 in the shell startup file. • Set the `DISPLAY` environment variable.

Related Topics

- Optimal Flexible Architecture
  Oracle Optimal Flexible Architecture (OFA) rules are a set of configuration guidelines created to ensure well-organized Oracle installations, which simplifies administration, support and maintenance.

Related Topics

- Configuring Users, Groups and Environments for Oracle Grid Infrastructure and Oracle Database
  Before installation, create operating system groups and users, and configure user environments.

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Storage Checklist for Oracle Database Installation

Use this checklist to review storage minimum requirements and assist with configuration planning.

Table 1-5 Storage Checklist for Oracle Database

Check	Task
Minimum local disk storage space for Oracle software	For Linux x86-64 and Linux for Arm (aarch64): At least 6.5 GB for an Oracle Grid Infrastructure for a standalone server installation. At least 7.2 GB for Oracle Database Enterprise Edition. At least 7.2 GB for Oracle Database Standard Edition 2. For IBM: Linux on System z: At least 5.5 GB for an Oracle Grid Infrastructure for a standalone server installation. At least 5.9 GB for Oracle Database Enterprise Edition. At least 5.9 GB for Oracle Database Standard Edition 2. **Note** Oracle recommends that you allocate approximately 100 GB to allow additional space for applying any future patches on top of the existing Oracle home. For specific patch-related disk space requirements, please refer to your patch documentation.
Select Database File Storage Option	Ensure that you have one of the following storage options available: • File system mounted on the server. Oracle recommends that the file system you select is separate from the file system used by the operating system or the Oracle software. Options include the following: – A file system on a logical volume manager (LVM) volume or a RAID device – A network file system (NFS) mounted on a network-attached storage (NAS) device • Oracle Automatic Storage Management (Oracle ASM). Oracle ASM is installed as part of an Oracle Grid Infrastructure installation. If you plan to use Oracle ASM for storage, then you should install Oracle Grid Infrastructure before you install and create the database.
Determine your recovery plan	If you want to enable recovery during installation, then be prepared to select one of the following options: • **File system**: Configure a fast recovery area on a file system during installation • **Oracle Automatic Storage Management**: Configure a fast recovery area disk group using Oracle ASMCA. Review the storage configuration sections of this document for more information about configuring recovery.

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Related Topics

- Configuring File System Storage for Oracle Database
  Complete these procedures to use file system storage for Oracle Database.

Installer Planning Checklist for Oracle Database

Use this checklist to assist you to be prepared before starting Oracle Universal Installer.

Table 1-6 Oracle Universal Installer Planning Checklist for Oracle Database Installation

Check	Task
Read the Release Notes	Review release notes for your platform, which are available for your release at the following URL: http://docs.oracle.com/en/database/database.html
Review Oracle Support Certification Matrix	New platforms and operating system software versions may 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: https://support.oracle.com/ You must register online before using My Oracle Support. After logging in, from the menu options, select the **Certifications** tab. On the Certifications page, use the **Certification Search** options to search by Product, Release, and Platform. You can also search using the **Certification Quick Link** options such as Product Delivery, and Lifetime Support.
Review the Licensing Information	You are permitted to use only those components in the Oracle Database media pack for which you have purchased licenses. For more information about licenses, refer to the following URL: *Oracle Database Licensing Information*
Run OUI with CVU and use fixup scripts	Oracle Universal Installer is fully integrated with Cluster Verification Utility (CVU), automating many CVU prerequisite checks. Oracle Universal Installer runs all prerequisite checks and creates fixup scripts when you run the installer. You can run OUI up to the Summary screen without starting the installation. You can also run CVU commands manually to check system readiness. For more information, see: *Oracle Clusterware Administration and Deployment Guide*

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Table 1-6 (Cont.) Oracle Universal Installer Planning Checklist for Oracle Database Installation

Check	Task

Update and run Oracle ORAchk for runtime and upgrade checks, or runtime health checks	Oracle recommends that you update to the latest version of Oracle ORAchk by installing the latest version of Autonomous Health Framework (AHF).
	The Oracle ORAchk utility provides system checks that can help to prevent issues before and after installation. These checks include kernel requirements, operating system resource allocations, and other system requirements.
	Use the Oracle ORAchk Upgrade Readiness Assessment to obtain an automated upgrade-specific system health check for upgrades to 19c. For example:
	• Before you perform a fresh database installation:
	`./orachk -profile preinstall`
	• To upgrade your existing database to a higher version or release:
	`./orachk -pregupgrade -targetversion 19.0.0.0.0`
	The Oracle ORAchk Upgrade Readiness Assessment automates many of the manual pre- and post-upgrade checks described in Oracle upgrade documentation. Check My Oracle Support Note 2550798.1 for more information about Oracle ORAchk support.
	https://support.oracle.com/epmos/faces/DocContentDisplay?id=2550798.1&parent=DOCUMENTATION&sourceId=USERGUIDE

Verify if Oracle Grid Infrastructure is installed	If you want to use Oracle ASM or Oracle Restart, then install Oracle Grid Infrastructure for a standalone server before you install and create the database. Otherwise, to use Oracle ASM, you must complete an Oracle Grid Infrastructure installation, and then manually register the database with Oracle Restart. For Oracle Real Application Clusters (Oracle RAC) installations, ensure that you have installed and configured Oracle Grid Infrastructure for a cluster.
Check running Oracle processes, and shut down if necessary	• On a standalone database not using Oracle ASM: You do not need to shut down the database while you install Oracle Grid Infrastructure. • On a standalone database using Oracle ASM: The Oracle ASM instances are restarted during installation. • 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 `cron` jobs do not run during installation	If the installer is running when daily `cron` jobs start, then you may encounter unexplained installation problems if your `cron` job is performing cleanup, and temporary files are deleted before the installation is finished. Oracle recommends that you complete installation before daily `cron` jobs are run, or disable daily `cron` jobs that perform cleanup until after the installation is completed.

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Table 1-6 (Cont.) Oracle Universal Installer Planning Checklist for Oracle Database Installation

Check	Task
Obtain your My Oracle Support account information.	During installation, you may require a My Oracle Support user name and password to configure updates, download software updates, and other installation tasks. You can register for My Oracle Support at the following URL: https://support.oracle.com/
Decide Oracle Database management tool	By default, Oracle Database is managed by Oracle Enterprise Manager Database Express. If you have an existing Oracle Management Agent, and decide to use Oracle Enterprise Manager Cloud Control to centrally manage your database, then obtain the following information to enter during the database installation: • OMS host • OMS port • EM admin username • EM admin password • Specify password of ASMSNMP user For more information, see: • *Oracle Database 2 Day DBA* • *Oracle Enterprise Manager Cloud Control Administrator's Guide*
Review memory allocation and Automatic Memory Management feature	You can enable automatic memory management either during, or after Oracle Database installation. If you enable automatic memory management after installation, then you must shut down and restart the database. If the total physical memory of your database instance is greater than 4 GB, then you cannot select the Oracle Automatic Memory Management option during database installation and creation. Instead, use automatic shared memory management. Automatic shared memory management automatically distributes the available memory among the various components as required, allowing the system to maximize the use of all available SGA memory. For more information, see: *Oracle Database Administrator's Guide*

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Table 1-6 (Cont.) Oracle Universal Installer Planning Checklist for Oracle Database Installation

Check	Task
Determine superuser (`root`) privilege delegation option for installation	During a database or grid infrastructure installation, you are asked to run configuration scripts as the `root` user. You can either run these scripts manually as `root` when prompted, or you can provide configuration information and passwords using a root privilege delegation option. To run `root` scripts automatically, select **Automatically run configuration scripts** during installation. • **Use root user credentials** Provide the superuser password for cluster member node servers. • **Use Sudo** Sudo is a UNIX and Linux utility that allows members of the sudoers list privileges to run individual commands as `root`. Provide the username and password of an operating system user that is a member of sudoers, and is authorized to run Sudo on each cluster member node. To enable Sudo, have a system administrator with the appropriate privileges configure a user that is a member of the sudoers list, and provide the username and password when prompted during installation.
Oracle Database Client and Oracle Database interoperability	For information about interoperability between Oracle Database Client and Oracle Database releases, see My Oracle Support Note 207303.1: https://support.oracle.com/rs?type=doc&id=207303.1

Related Topics

- Installing Oracle Database
  Oracle Database and Oracle Grid Infrastructure installation software is available as image-based zip files and can be installed using several options.
- Installing and Configuring Oracle Grid Infrastructure for a Standalone Server
  Oracle Grid Infrastructure for a standalone server includes Oracle Restart and Oracle Automatic Storage Management.

Deployment Checklist for Oracle Database

Use this checklist to decide the deployment method for a single-instance Oracle Database.

Table 1-7 Deployment Checklist for Oracle Database (single-instance)

Item	Task
To deploy single-instance Oracle Database software	Use one of the following deployment methods: • Install Oracle Database software using Oracle Universal Installer (OUI). • Provision Oracle Database software using Oracle Fleet Patching and Provisioning. • Clone Oracle Database.

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Table 1-7 (Cont.) Deployment Checklist for Oracle Database (single-instance)

Item	Task
To deploy single-instance Oracle Database software and create databases	Use one of the following deployment methods: • Install Oracle Database software using Oracle Universal Installer (OUI). • Provision Oracle Database software using Oracle Fleet Patching and Provisioning. • Clone Oracle Database.
To create single-instance Oracle Database in an already-installed Oracle home	• Use Oracle Database Configuration Assistant (Oracle DBCA). • Use Oracle Fleet Patching and Provisioning

Related Topics

- Installing Oracle Database
  Oracle Database and Oracle Grid Infrastructure installation software is available as image-based zip files and can be installed using several options.
- About Deploying Oracle Database Using Oracle Fleet Patching and Provisioning
  You can use Oracle Fleet Patching and Provisioning (Oracle FPP) to provision Oracle Database software.
- *Oracle Database Administrator's Guide*
- *Oracle Fleet Patching and Provisioning Administrator's Guide*

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2

Checking and Configuring the Server for Oracle Database

Verify that servers where you install Oracle Database meet the minimum requirements for installation.

This section provides minimum server requirements to complete installation of Oracle Database. It does not provide system resource guidelines, or other tuning guidelines for particular workloads.

- Logging In to a Remote System Using X Window System
  Use this procedure to run Oracle Universal Installer (OUI) by logging on to a remote system where the runtime setting prohibits logging in directly to a graphical user interface (GUI).
- Checking Server Hardware and Memory Configuration
  Use this procedure to gather information about your server configuration.

Logging In to a Remote System Using X Window System

Use this procedure to run Oracle Universal Installer (OUI) by logging on to a remote system where the runtime setting prohibits logging in directly to a graphical user interface (GUI).

OUI is a graphical user interface (GUI) application. On servers where the runtime settings prevent GUI applications from running, you can redirect the GUI display to a client system connecting to the server.

> **Note**
>
> If you log in as another user (for example, `oracle` or `grid`), then repeat this procedure for that user as well.

1. Start an X Window System session. If you are using an X Window System terminal emulator from a PC or similar system, then you may need to configure security settings to permit remote hosts to display X applications on your local system.
2. Enter a command using the following syntax to enable remote hosts to display X applications on the local X server:

   ```
   # xhost + RemoteHost
   ```

   RemoteHost is the fully qualified remote host name. For example:

   ```
   # xhost + somehost.example.com
   somehost.example.com being added to the access control list
   ```


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

   ```
   # ssh -Y  RemoteHost
   ```

   RemoteHost is the fully qualified remote host name. The `-Y` flag ("yes") enables remote clients to have full access to the original server display. For example:

   ```
   # ssh -Y somehost.example.com
   ```

4. If you are not logged in as the `root` user, and you are performing configuration steps that require `root` user privileges, then switch the user to `root`.

> **Note**
>
> For more information about remote login using X Window System, refer to your X server documentation, or contact your X server vendor or system administrator. Depending on the X server software that you are using, you may have to complete the tasks in a different order.

Checking Server Hardware and Memory Configuration

Use this procedure to gather information about your server configuration.

1. Use the following command to determine physical RAM size on the server:

   ```
   # grep MemTotal /proc/meminfo
   ```

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

2. Determine the size of the configured swap space:

   ```
   # grep SwapTotal /proc/meminfo
   ```

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

3. Determine the amount of space available in the `/tmp` directory:

   ```
   # df -h /tmp
   ```

   If the free space available in the `/tmp` directory is less than what is required, then complete one of the following steps:

   - Delete unused files from the `/tmp` directory to meet the disk space requirement.

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> **Note**
>
> If you perform this step after installing Oracle software, then do not remove `/tmp/.oracle` or `/var/tmp/.oracle` directories or their files.

- When you set the Oracle user's environment, also set the `TMP` and `TMPDIR` environment variables to the directory you want to use instead of `/tmp`.

4. Determine the amount of free RAM and disk swap space on the system:

   ```
   # free
   ```

5. Determine if the system architecture can run the software:

   ```
   # uname -m
   ```

   Verify that the processor architecture matches the Oracle software release to install. For example, you should see the following for a x86-64 bit system:

   ```
   x86_64
   ```

   If you do not see the expected output, then you cannot install the software on this system.

6. Verify that shared memory (`/dev/shm`) is mounted properly with sufficient size:

   ```
   df -h /dev/shm
   ```

   The `df-h` command displays the filesystem on which `/dev/shm` is mounted, and also displays in GB the total size and free size of shared memory.

Related Topics

- Server Hardware Checklist for Oracle Database Installation
  Use this checklist to check hardware requirements for Oracle Database.

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3

Automatically Configuring Oracle Linux with Oracle Database Preinstallation RPM

Use Oracle Database Preinstallation RPM to simplify operating system configuration in preparation for Oracle software installations.

Oracle recommends that you install Oracle Linux and use Oracle Database Preinstallation RPM to configure your operating systems for Oracle Database and Oracle Grid Infrastructure installations.

- About the Oracle Database Preinstallation RPM
  If your Linux distribution is Oracle Linux or Red Hat Enterprise Linux, and you are an Oracle Linux support customer, then you can complete most preinstallation configuration tasks by using the Oracle Database Preinstallation RPM for your release.
- Overview of Oracle Linux Configuration with Oracle Database Preinstallation RPM
  Use Oracle Database Preinstallation RPM to simplify operating system configuration, and to ensure that you have required kernel packages.
- Installing the Oracle Database Preinstallation RPM Using ULN
  Use this procedure to subscribe to Unbreakable Linux Network (ULN) Oracle Linux channels for your Oracle software.
- Installing Oracle Database Preinstallation RPM During an Oracle Linux Installation
  Use this procedure to install a new Oracle Linux installation and to perform system configuration with the Oracle Database Preinstallation RPM:
- Installing Oracle Oracle Database Preinstallation RPM Using the Oracle Linux yum Server
  Install Oracle Linux and configure your Oracle Linux installation for security errata or bug fix updates using the Oracle Linux yum server.
- Configure Additional Operating System Features
  Oracle recommends that you configure your operating system before starting installation with additional features, such as IPMI or additional programming environments.

About the Oracle Database Preinstallation RPM

If your Linux distribution is Oracle Linux or Red Hat Enterprise Linux, and you are an Oracle Linux support customer, then you can complete most preinstallation configuration tasks by using the Oracle Database Preinstallation RPM for your release.

Oracle Database Preinstallation RPMs are available from the Oracle Linux Network. While not mandatory, Oracle recommends using the Oracle Database Preinstallation RPM to expedite cluster server setup.

When installed, the Oracle Database Preinstallation RPM performs the following actions:

- Automatically downloads and installs any additional RPM packages needed for installing Oracle Grid Infrastructure and Oracle Database, and resolves any dependencies
- Creates an `oracle` user, and creates the oraInventory (`oinstall`) and OSDBA (`dba`) groups for that user

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- As needed, sets `sysctl.conf` settings, system startup parameters, and driver parameters to values based on recommendations from the Oracle Database Preinstallation RPM program
- Sets hard and soft resource limits
- Sets other recommended parameters, depending on your kernel version
- Sets `numa=off` in the kernel for Linux x86_64 and Linux aarch64 machines.

Configure the Oracle Database Preinstallation RPM once during the initial installation of Oracle Database or Oracle Grid Infrastructure on your system. For subsequent installations on the same system, do not install Oracle Database Preinstallation RPM again.

Do not install the Oracle Database Preinstallation RPM on Oracle Engineered Systems, such as Oracle Exadata Database Machine. Oracle Engineered Systems include integrated system software that contain the required version of the operating system kernel and all software packages.

Note

- The Oracle Database Preinstallation RPM designated for each Oracle Database release sets kernel parameters and resource limits exclusively for the `oracle` user account. To use multiple software account owners, manually configure system settings for each additional account.
- The Oracle Database Preinstallation RPM installs X11 client libraries, but it does not install the X Window System server packages. To use graphical user interfaces such as OUI, configuration assistants, and Oracle Enterprise Manager, set the display to a system with X Window System server packages.

Overview of Oracle Linux Configuration with Oracle Database Preinstallation RPM

Use Oracle Database Preinstallation RPM to simplify operating system configuration, and to ensure that you have required kernel packages.

Oracle recommends that you install Oracle Linux and use Oracle Database Preinstallation RPM to configure your operating systems for Oracle Database and Oracle Grid Infrastructure installations.

Configure Oracle Database Preinstallation RPM only once on your operating system when you install Oracle Database or Oracle Grid Infrastructure for the first time on your system. For subsequent installations on the same system, do not install Oracle Database Preinstallation RPM again.

Do not install Oracle Database Preinstallation RPM on Oracle Engineered Systems, such as Oracle Exadata Database Machine. Oracle Engineered Systems include integrated system software that contain the required version of the operating system kernel and all software packages.

The Oracle Database Preinstallation RPM for your Oracle Linux distributions and database release automatically installs any additional packages needed for installing Oracle Grid Infrastructure and Oracle Database, and configures your server operating system automatically, including setting kernel parameters and other basic operating system

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requirements for installation. For more information about Oracle Linux and Oracle Database Preinstallation RPM, refer to:

https://docs.oracle.com/en/operating-systems/oracle-linux/

Configuring a server using Oracle Linux and the Oracle Database Preinstallation RPM consists of the following steps:

1. Install Oracle Linux.
2. Register your Linux distribution with Oracle Unbreakable Linux Network (ULN) or download and configure the yum repository for your system using the Oracle Linux yum server for your Oracle Linux release.
3. Install the Oracle Database Preinstallation RPM with the RPM for your Oracle Grid Infrastructure and Oracle Database releases, and update your Linux release.
4. Create role-allocated groups and users with identical names and ID numbers.
5. Complete network interface configuration for each cluster node candidate.
6. Complete system configuration for shared storage access as required for each standard or core node cluster candidate.

After these steps are complete, you can proceed to install Oracle Grid Infrastructure and Oracle Database.

Installing the Oracle Database Preinstallation RPM Using ULN

Use this procedure to subscribe to Unbreakable Linux Network (ULN) Oracle Linux channels for your Oracle software.

To obtain Unbreakable Linux Network (ULN) support, subscribe to Oracle Linux channels, and to add the Oracle Linux channel that distributes the Oracle Database Preinstallation RPM:

1. Download the Oracle Linux ISO from one of the following websites:
   - Oracle yum

     https://yum.oracle.com/oracle-linux-isos.html

   - Oracle Software Delivery Cloud website:

     https://edelivery.oracle.com/linux

   > **Note**
   >
   > Ensure that you use the latest available update release for Oracle Linux.

2. Register your server with Unbreakable Linux Network (ULN). By default, you are registered for the Oracle Linux Latest channel for your operating system and hardware.
   - Unbreakable Linux Network User's Guide
   - Managing Software in Oracle Linux
3. Log in to Unbreakable Linux Network:

   https://linux.oracle.com

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4. Start a terminal session and enter the following command as `root`, depending on your platform. For example:
   - Oracle Linux 7

     ```
     # yum install oracle-database-preinstall-19c
     ```

     > **Note**
     >
     > Use the `-y` option if you want `yum` to skip the package confirmation prompt.

   - Oracle Linux 8 and later

     ```
     # dnf install oracle-database-preinstall-19c
     ```

   You should see output indicating that you have subscribed to the Oracle Linux channel, and that packages are being installed.

   The Oracle Database Preinstallation RPM automatically creates a standard (not role-allocated) Oracle installation owner and groups, and sets up other kernel configuration settings as required for Oracle installations.
5. Check the RPM log file to review the system configuration changes. For example:

   ```
   /var/log/oracle-database-preinstall-19c/backup/timestamp/orakernel.log
   ```

6. Repeat steps 1 through 4 on all other servers in your cluster.

If you have a premier support subscription, you can enable Ksplice to provide zero downtime patching. Refer to the Ksplice User's Guide for installation instructions:

https://docs.oracle.com/en/operating-systems/oracle-linux/ksplice-user/

Installing Oracle Database Preinstallation RPM During an Oracle Linux Installation

Use this procedure to install a new Oracle Linux installation and to perform system configuration with the Oracle Database Preinstallation RPM:

1. Obtain Oracle Linux by downloading disk images
   - Oracle yum

     https://yum.oracle.com/oracle-linux-isos.html

   - Oracle Software Delivery Cloud website:

     https://edelivery.oracle.com/linux

   > **Note**
   >
   > Ensure that you use the latest available update release for Oracle Linux.

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2. Start the Oracle Linux installation and respond to installation screens with values appropriate for your environment.
3. Review the first software selection screen, which lists task-specific software options. At the bottom of the screen, there is an option to customize now or customize later. Select **Customize now**, and click **Next**.
4. On Oracle Linux, select **Servers** on the left of the screen and **System administration tools** on the right of the screen (options may vary between releases).

   The Packages in System Tools window opens.
5. Select the Oracle Database Preinstallation RPM package box from the package list. For example, select a package similar to the following:

   For Oracle Linux 7:

   ```
   oracle-database-preinstall-19c-1.0-1.el7.x86_64.rpm
   ```

   For Oracle Linux 8:

   ```
   oracle-database-preinstall-19c-1.0-1.el8.x86_64.rpm
   ```

   (or)

   ```
   oracle-database-preinstall-19c-1.0-1.el8.aarch64.rpm
   ```

   For Oracle Linux 9:

   ```
   oracle-database-preinstall-19c-1.0-1.el9.x86_64.rpm
   ```

   For Oracle Linux 10:

   ```
   oracle-database-preinstall-19c-1.0-1.el10.x86_64.rpm
   ```

   If you do not have an Oracle Database Preinstallation RPM package option that is current for your Oracle Database release, because you are using an Oracle Linux installation that is previous to your Oracle Database and Oracle Grid Infrastructure release, then install the RPM for your release manually after completing the operating system installation.
6. Close the optional package window and click **Next**.
7. Complete the other screens to finish the Oracle Linux installation.

   Oracle Linux automatically creates a standard (not role-allocated) Oracle installation owner and groups, and sets up other kernel configuration settings as required for Oracle installations.
8. Repeat steps 2 through 6 on all other cluster member nodes.

Installing Oracle Oracle Database Preinstallation RPM Using the Oracle Linux yum Server

Install Oracle Linux and configure your Oracle Linux installation for security errata or bug fix updates using the Oracle Linux yum server.

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1. Refer to the official Oracle Linux documentation to install Oracle Linux:

   Oracle Linux Documentation

2. After you have completed your Oracle Linux installation, run the command `yum update` as needed to obtain the most current security errata and bug fixes for your Oracle Linux installation.
3. Restart your system.
4. Start a terminal session and enter the following command as `root`:
   - Oracle Linux 7:

     ```
     # yum install oracle-database-preinstall-19c
     ```

     > **Note**
     >
     > Use the `-y` option if you want `yum` to skip the package confirmation prompt.

   - Oracle Linux 8 and later:

     ```
     # dnf install oracle-database-preinstall-19c
     ```

     > **Note**
     >
     > Use the `-y` option if you want `yum` to skip the package confirmation prompt.

   You should see output indicating that you have subscribed to the Oracle Linux channel, and that packages are being installed.

   The Oracle Database Preinstallation RPM automatically creates a standard (not role-allocated) Oracle installation owner and groups and sets up other kernel configuration settings as required for Oracle installations. If you plan to use job-role separation, then create the extended set of database users and groups depending on your requirements.

Configure Additional Operating System Features

Oracle recommends that you configure your operating system before starting installation with additional features, such as IPMI or additional programming environments.

Review the preinstallation chapters to ensure that you have completed configuration as needed for the features you want.

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4

Configuring Operating Systems for Oracle Database on Linux

Complete operating system configuration requirements and checks for Linux operating systems before you start installation.

You must meet the minimum requirements such as the operating system distribution, packages, and other software requirements for this release before you start an Oracle Database or Oracle Grid Infrastructure installation.

- Guidelines for Linux Operating System Installation
  Operating system guidelines to be aware of before proceeding with an Oracle installation.
- Reviewing Operating System and Software Upgrade Best Practices
  These topics provide general planning guidelines and platform-specific information about upgrades and migration.
- Reviewing Operating System Security Common Practices
  Secure operating systems are an important basis for general system security.
- About Installation Fixup Scripts
  Oracle Universal Installer detects when the minimum requirements for an installation are not met, and creates shell scripts, called fixup scripts, to finish incomplete system configuration steps.
- About Operating System Requirements
  Depending on the products that you intend to install, verify that you have the required operating system kernel and packages installed.
- Using Oracle RPM Checker on IBM: Linux on System z
  Use the Oracle RPM Checker utility to verify that you have the required Red Hat Enterprise Linux or SUSE packages installed on the operating system before you start the Oracle Database or Oracle Grid Infrastructure installation.
- Operating System Requirements for x86-64 Linux Platforms
  The Linux distributions and packages listed in this section are supported for this release on x86-64.
- Operating System Requirements for IBM: Linux on System z
  The Linux distributions and packages listed in this section are supported for this release on IBM: Linux on System z.
- Operating System Requirements for Linux for Arm (aarch64)
  The Linux distribution and packages listed in this section are supported for this release on Linux for Arm (aarch64).
- Additional Drivers and Software Packages for Linux
  Information about optional drivers and software packages.
- Checking Kernel and Package Requirements for Linux
  Verify your kernel and packages to see if they meet minimum requirements for installation.
- Setting Clock Source for VMs on Linux x86-64
  Oracle recommends that you set the clock source to `tsc` for better performance in virtual environments (VM) on Linux x86-64.

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- Confirming Host Name Resolution
  Check to ensure that the host name for your server is resolvable.
- Setting and Disabling Transparent HugePages on UEK Kernels
  Learn when to set Transparent HugePages and when to disable Transparent HugePages depending on your UEK kernel version.
- Using Automatic SSH Configuration During Installation
  To install Oracle software, configure secure shell (SSH) connectivity between all cluster member nodes.
- Verifying the Disk I/O Scheduler on Linux 8 and Later Systems
  Disk I/O schedulers reorder, delay, or merge requests for disk I/O to achieve better throughput and lower latency.
- Verifying the Disk I/O Scheduler on Linux 7 Systems
  Disk I/O schedulers reorder, delay, or merge requests for disk I/O to achieve better throughput and lower latency.

Guidelines for Linux Operating System Installation

Operating system guidelines to be aware of before proceeding with an Oracle installation.

This section provides information about installing a supported Linux distribution. Complete the minimum hardware configuration before you install the operating system.

- Completing a Minimal or Default Linux Installation
  You must perform either a minimal or default Linux installation.
- About Oracle Linux with the Unbreakable Enterprise Kernel
  The Unbreakable Enterprise Kernel for Oracle Linux provides the latest innovations from upstream development to customers who run Oracle Linux in the data center.
- About the Oracle Database Preinstallation RPM
- Configuring HugePages on Linux
  HugePages is a feature integrated into the Linux kernel. For Oracle Database, using HugePages reduces the operating system maintenance of page states and increases Translation Lookaside Buffer (TLB) hit ratio.
- Restrictions for HugePages and Transparent HugePages Configurations
  Review the HugePages and Transparent HugePages guidelines discussed in this section.

Related Topics

- Oracle Linux Operating System Documentation
- About the Oracle Database Preinstallation RPM

Completing a Minimal or Default Linux Installation

You must perform either a minimal or default Linux installation.

To complete a minimal Linux installation, select one of the minimal installation options.

A minimal Linux installation option is either a custom installation where you select the **Minimal** option from Package Group Selection, or where you deselect all packages except for the Base pack. A minimal Linux installation lacks many RPMs required for database installation, so you must use an RPM package for your Oracle Linux release to install the required packages. The package you use depends on your Linux release, and your support status with Unbreakable Linux Network (ULN).

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If you do not install the Oracle Database Preinstallation RPM, then Oracle recommends that you install your Linux operating system with the default software packages (RPMs).

A default Linux installation includes most of the required packages and helps you limit manual verification of package dependencies. Oracle recommends that you do not customize the RPMs during installation.

Refer to the official Oracle Linux documentation for more information about installing Oracle Linux:

https://docs.oracle.com/en/operating-systems/oracle-linux/

About Oracle Linux with the Unbreakable Enterprise Kernel

The Unbreakable Enterprise Kernel for Oracle Linux provides the latest innovations from upstream development to customers who run Oracle Linux in the data center.

The Unbreakable Enterprise Kernel is included and enabled by default in Oracle Linux kernels. It is based on a recent stable mainline development Linux kernel, and also includes optimizations developed in collaboration with Oracle Database, Oracle middleware, and Oracle hardware engineering teams to ensure stability and optimal performance for the most demanding enterprise workloads.

Oracle highly recommends deploying the Unbreakable Enterprise Kernel in your Oracle Linux environment, especially if you run enterprise applications. However, using Unbreakable Enterprise Kernel is optional. If you require strict Red Hat Enterprise Linux (RHEL) kernel compatibility, then Oracle Linux also includes a kernel compatible with the RHEL Linux kernel, compiled directly from the RHEL source code.

You can obtain more information about the Unbreakable Enterprise Kernel for Oracle Linux at the following URL:

https://www.oracle.com/linux/

The Unbreakable Enterprise Kernel for Oracle Linux is the standard kernel used with Oracle products. The build and QA systems for Oracle Database and other Oracle products use the Unbreakable Enterprise Kernel for Oracle Linux exclusively. The Unbreakable Enterprise Kernel for Oracle Linux is also the kernel used in Oracle Exadata and Oracle Exalogic systems. Unbreakable Enterprise Kernel for Oracle Linux is used in all benchmark tests on Linux in which Oracle participates, as well as in the Oracle Database Preinstallation RPM program for x86-64.

Oracle Ksplice, which is part of Oracle Linux, updates the Linux operating system (OS) kernel, while it is running, without requiring restarts or any interruption. Ksplice is available only with Oracle Linux.

About the Oracle Database Preinstallation RPM

If your Linux distribution is Oracle Linux or Red Hat Enterprise Linux, and you are an Oracle Linux support customer, then you can complete most preinstallation configuration tasks by using the Oracle Database Preinstallation RPM for your release.

Oracle Database Preinstallation RPMs are available from the Oracle Linux Network. While not mandatory, Oracle recommends using the Oracle Database Preinstallation RPM to expedite cluster server setup.

When installed, the Oracle Database Preinstallation RPM performs the following actions:

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- Automatically downloads and installs any additional RPM packages needed for installing Oracle Grid Infrastructure and Oracle Database, and resolves any dependencies
- Creates an `oracle` user, and creates the oraInventory (`oinstall`) and OSDBA (`dba`) groups for that user
- As needed, sets `sysctl.conf` settings, system startup parameters, and driver parameters to values based on recommendations from the Oracle Database Preinstallation RPM program
- Sets hard and soft resource limits
- Sets other recommended parameters, depending on your kernel version
- Sets `numa=off` in the kernel for Linux x86_64 and Linux aarch64 machines.

Configure the Oracle Database Preinstallation RPM once during the initial installation of Oracle Database or Oracle Grid Infrastructure on your system. For subsequent installations on the same system, do not install Oracle Database Preinstallation RPM again.

Do not install the Oracle Database Preinstallation RPM on Oracle Engineered Systems, such as Oracle Exadata Database Machine. Oracle Engineered Systems include integrated system software that contain the required version of the operating system kernel and all software packages.

> **Note**
>
> - The Oracle Database Preinstallation RPM designated for each Oracle Database release sets kernel parameters and resource limits exclusively for the `oracle` user account. To use multiple software account owners, manually configure system settings for each additional account.
> - The Oracle Database Preinstallation RPM installs X11 client libraries, but it does not install the X Window System server packages. To use graphical user interfaces such as OUI, configuration assistants, and Oracle Enterprise Manager, set the display to a system with X Window System server packages.

Configuring HugePages on Linux

HugePages is a feature integrated into the Linux kernel. For Oracle Database, using HugePages reduces the operating system maintenance of page states and increases Translation Lookaside Buffer (TLB) hit ratio.

> **Note**
>
> HugePages support is available in kernels built with the `CONFIG_HUGETLBFS` and `CONFIG_HUGETLB_PAGE` configuration options.

Oracle recommends that you reserve a minimum of 30 percent of the total memory for standard pages and not more than 70 percent of the total memory for HugePages.

Ensure that you have created the Oracle Database software owner (oracle) user accounts and all its groups. For more information see, Automatically Configuring Oracle Linux with Oracle Database Preinstallation RPM or Creating an Oracle Software Owner User.

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Enabling Using HugePages

Perform these steps to enable HugePages on Linux:

1. Check if the kernel supports HugePages:

   ```
   $ grep Huge /proc/meminfo
   ```

2. Edit the `memlock` setting in the `/etc/security/limits.conf` file.

   Specify the `memlock` setting in KB. Set the maximum locked memory limit to at least 90 percent of the current RAM when you enable HugePages memory and at least to 3145728 KB (3 GB) if you disable HugePages. For example, if you have 64 GB RAM, then add the following entries to increase the maximum locked-in-memory address space:

   ```
   oracle   soft   memlock    60397977
   oracle   hard   memlock    60397977
   ```

   You can also set the `memlock` value higher than your SGA requirements.

   > **Note**
   >
   > On Exadata systems, specify the `memlock` setting as `unlimited`.

3. Log in as the `oracle` user again and run the `ulimit -l` command to verify the new `memlock` setting:

   ```
   $ ulimit -l
   60397977
   ```

4. Run the following command to display the value of the `Hugepagesize` variable:

   ```
   $ grep Hugepagesize /proc/meminfo
   ```

5. Determine the `gid` or `oracle` user group ID value:

   ```
   # id oracle
   ```

   The output is similar to the following:

   ```
   uid=54321(oracle) gid=54321(oinstall) groups=54321(oinstall),54322(dba),
   54323(oper),54324(backupdba),54325(dgdba),54326(kmdba),54327(asmdba),54330(
   racdba)
   ```

   Note the value of `gid`.

6. Set the `vm.hugetlb_shm_group` kernel parameter value to the `gid` value:

   ```
   # sysctl -w vm.hugetlb_shm_group=gid
   ```

   where `gid` is the `oracle` user group ID. For example, value of `gid=54321`.

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To ensure that this value is available even after the system restarts, add the following entry to the `/etc/sysctl.d/99-hugetlb-shm-group.conf` file that contains this setting.

```
vm.hugetlb_shm_group=gid
```

Configuring the Capacity for HugePages

To configure the required number of HugePages for your databases, perform this step after you complete the Oracle Database installation and create your databases.

1. Complete the following procedure to create a script that computes recommended values for HugePages configuration for the current shared memory segments:
   a. Create a text file `hugepages_settings.sh`

      See My Oracle Support note 401749.1 to create the `hugepages_settings.sh` script.
   b. Change the permission of the `hugepages_settings.sh` file:

      ```
      $ chmod +x hugepages_settings.sh
      ```
2. Run the `hugepages_settings.sh` script to compute values for the HugePages configuration.

   ```
   $ ./hugepages_settings.sh
   ```

   > **Note**
   >
   > Before you run this script, ensure that all the databases that use hugepages run.
3. Set the following kernel parameter, where `value` is the HugePages value that you determined in Step 2:

   ```
   # sysctl -w vm.nr_hugepages=value
   ```
4. To ensure that HugePages is allocated after the system restarts, add the following entry to the `/etc/sysctl.d/99-nr_hugepages.conf` file, where `value` is the HugePages value that you determined in Step 2:

   ```
   vm.nr_hugepages=value
   ```

   > **Note**
   >
   > If you cannot set your HugePages allocation using `nr_hugepages`, then your available memory may be fragmented. Restart your server for the Hugepages allocation to take effect.
5. Run the following command to check the available HugePages:

   ```
   $ grep Huge /proc/meminfo
   ```
6. Restart the instances.

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7. Run the following command to check the available HugePages (1 or 2 pages free):

```
$ grep Huge /proc/meminfo
```

Restrictions for HugePages and Transparent HugePages Configurations

Review the HugePages and Transparent HugePages guidelines discussed in this section.

Oracle recommends that you disable Transparent HugePages, because they may cause delays in accessing memory that can result in node restarts in Oracle RAC environments, or performance issues or delays for Oracle Database single instances. Oracle continues to recommend using standard HugePages for Linux.

Transparent HugePages memory is enabled by default with Oracle Linux 6 and later, Red Hat Enterprise Linux 6 and later, SUSE 11 and later, kernels.

If you install Oracle Database Preinstallation RPM, then it disables Transparent HugePages.

Transparent Hugepages are similar to standard HugePages. However, while standard HugePages allocate memory at startup, Transparent Hugepages memory uses the `khugepaged` thread in the kernel to allocate memory dynamically during runtime, using swappable HugePages.

HugePages allocates non-swappable memory for large page tables using memory-mapped files. HugePages are not enabled by default. If you enable HugePages, then you should deduct the memory allocated to HugePages from the available RAM before calculating swap space. Refer to your distribution documentation and to Oracle Technology Network and My Oracle Support for more information.

During Oracle Grid Infrastructure installation, the Grid Infrastructure Management Repository (GIMR) is configured to use HugePages. Because the Grid Infrastructure Management Repository database starts before all other databases installed on the cluster, if the space allocated to HugePages is insufficient, then the System Global Area (SGA) of one or more databases may be mapped to regular pages, instead of Hugepages, which can adversely affect performance. Configure the HugePages memory allocation to a size large enough to accommodate the sum of the SGA sizes of all the databases you intend to install on the cluster, as well as the Grid Infrastructure Management Repository.

Reviewing Operating System and Software Upgrade Best Practices

These topics provide general planning guidelines and platform-specific information about upgrades and migration.

- General Upgrade Best Practices
  Be aware of these guidelines as a best practice before you perform an upgrade.
- New Server Operating System Upgrade Option
  You can upgrade your operating system by installing a new operating system on a server, and then migrating your database either manually, or by using Export/Import method.
- Oracle ASM Upgrade Notifications
  Understand Oracle ASM upgrade options and restrictions.

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General Upgrade Best Practices

Be aware of these guidelines as a best practice before you perform an upgrade.

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

- Record the version numbers, patches, and other configuration information
- Review upgrade procedures for your existing installation
- Review Oracle Database 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.

Refer to *Oracle Database Upgrade Guide* for more information about required software updates, pre-upgrade tasks, post-upgrade tasks, compatibility, and interoperability between different releases.

Related Topics

- *Oracle Database Upgrade Guide*

New Server Operating System Upgrade Option

You can upgrade your operating system by installing a new operating system on a server, and then migrating your database either manually, or by using Export/Import method.

> **Note**
>
> Confirm that the server operating system is supported, and that kernel and package requirements for the operating system meet or exceed the minimum requirements for the Oracle Database release to which you want to migrate.

Manual, Command-Line Copy for Migrating Data and Upgrading Oracle Database

You can copy files to the new server and upgrade it manually. If you use this procedure, then you cannot use Oracle Database Upgrade Assistant. However, you can revert to your existing database if you encounter upgrade issues.

1. Copy the database files from the computer running the previous operating system to the one running the new operating system.
2. Re-create the control files on the computer running the new operating system.
3. Manually upgrade the database using command-line scripts and utilities.

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> **See Also**
>
> *Oracle Database Upgrade Guide* to review the procedure for upgrading the database manually, and to evaluate the risks and benefits of this option

Export/Import Method for Migrating Data and Upgrading Oracle Database

You can install the operating system on the new server, install the new Oracle Database release on the new server, and then use Oracle Data Pump Export and Import utilities to migrate a copy of data from your current database to a new database in the new release. Data Pump Export and Import are recommended for higher performance and to ensure support for new data types.

> **See Also**
>
> *Oracle Database Upgrade Guide* to review the Export/Import method for migrating data and upgrading Oracle Database

Oracle ASM Upgrade Notifications

Understand Oracle ASM upgrade options and restrictions.

- You can upgrade Oracle Automatic Storage Management (Oracle ASM) 11g release 2 (11.2) 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.
- 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).
- Two nodes of different releases cannot run in the cluster. When upgrading from Oracle Grid Infrastructure 11g release 2 (11.2) or Oracle Grid Infrastructure 12c release 1 (12.1) to a later release, if there is an outage during the rolling upgrade, then when you restart the upgrade, ensure that you start the earlier release of Oracle Grid Infrastructure and bring the Oracle ASM cluster back in the rolling migration mode.

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.

About Installation Fixup Scripts

Oracle Universal Installer detects when the minimum requirements for an installation are not met, and creates shell scripts, called fixup scripts, to finish incomplete system configuration steps.

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If Oracle Universal Installer detects an incomplete task, then it generates fixup scripts (`runfixup.sh`). You can run the fixup script and click **Fix and Check Again**. The fixup script modifies both persistent parameter settings and parameters in memory, so you do not have to restart the system.

The Fixup script does the following tasks:

- Sets kernel parameters, if necessary, to values required for successful installation, including:
  - Shared memory parameters.
  - Open file descriptor and UDP send/receive parameters.
- Creates and sets permissions on the Oracle Inventory (central inventory) directory.
- Creates or reconfigures primary and secondary group memberships for the installation owner, if necessary, for the Oracle Inventory directory and the operating system privileges groups.
- Sets shell limits, if necessary, to required values.

> **Note**
>
> Using fixup scripts does not ensure that all the prerequisites for installing Oracle Database are met. You must still verify that all the preinstallation requirements are met to ensure a successful installation.

Oracle Universal Installer is fully integrated with Cluster Verification Utility (CVU) automating many prerequisite checks for your Oracle Grid Infrastructure or Oracle Real Application Clusters (Oracle RAC) installation. You can also manually perform various CVU verifications by running the `cluvfy` command.

Related Topics

- Completing Preinstallation Tasks Manually
  You can complete the preinstallation configuration tasks manually.
- Minimum Parameter Settings for Installation
  Use this table to set parameters manually if you cannot use the fixup scripts.
- *Oracle Clusterware Administration and Deployment Guide*

About Operating System Requirements

Depending on the products that you intend to install, verify that you have the required operating system kernel and packages installed.

Requirements listed in this document are current as of the date listed on the title page.

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

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> **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.

Using Oracle RPM Checker on IBM: Linux on System z

Use the Oracle RPM Checker utility to verify that you have the required Red Hat Enterprise Linux or SUSE packages installed on the operating system before you start the Oracle Database or Oracle Grid Infrastructure installation.

1. Download the Oracle RPM Checker utility for your IBM: Linux on System z distribution from the link in My Oracle Support Note 2553465.1.
2. Unzip the RPM, and install the RPM as `root`.
3. Run the utility as `root` to check your operating system packages. For example:

   Download the Oracle RPM Checker utility for your IBM: Linux on System z distribution. Then,

   On Red Hat Enterprise Linux 9:

   ```
   # rpm -ivh ora-val-rpm-RH9-DB-19c-19.0.1-1.s390x.rpm
   ```

   On Red Hat Enterprise Linux 8:

   ```
   # rpm -ivh ora-val-rpm-RH8-DB-19c.s390x.rpm
   ```

   On Red Hat Enterprise Linux 7:

   ```
   # rpm -ivh ora-val-rpm-RH7-DB-19c.s390x.rpm
   ```

   On SUSE Linux Enterprise Server 12:

   ```
   # rpm -ivh ora-val-rpm-S12-DB-19c.s390x.rpm
   ```

   On SUSE Linux Enterprise Server 15:

   ```
   # rpm -ivh ora-val-rpm-S15-DB-19c.s390x.rpm
   ```

   On Red Hat Enterprise Linux, the utility checks and also installs all required RPMs. For example:

   On Red Hat Enterprise Linux 9:

   ```
   # yum install ora-val-rpm-RH9-DB-19c-19.0.1-1.s390x.rpm
   ```


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On Red Hat Enterprise Linux 8:

```
# yum install ora-val-rpm-RH8-DB-19c.s390x.rpm
```

On Red Hat Enterprise Linux 7:

```
# yum install ora-val-rpm-RH7-DB-19c.s390x.rpm
```

To remove the Oracle RPM Checker utility:

On Red Hat Enterprise Linux 9:

```
# rpm -e ora-val-rpm-RH9-DB-19c-19.0.1-1.s390x
```

On Red Hat Enterprise Linux 8:

```
# rpm -e ora-val-rpm-RH8-DB-19c.s390x
```

On Red Hat Enterprise Linux 7:

```
# rpm -e ora-val-rpm-RH7-DB-19c.s390x
```

On SUSE Linux Enterprise Server 12:

```
# rpm -e ora-val-rpm-S12-DB-19c.s390x
```

On SUSE Linux Enterprise Server 15:

```
# rpm -e ora-val-rpm-S15-DB-19c.s390x
```

Operating System Requirements for x86-64 Linux Platforms

The Linux distributions and packages listed in this section are supported for this release on x86-64.

Identify the requirements for your Linux distribution, and ensure that you have a supported kernel and required packages installed before starting installation.

The platform-specific hardware and software requirements included in this guide were current when this guide was published. However, because new platforms and operating system software versions may 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:

https://support.oracle.com/

- General Guidelines for Operating System Packages
  Review these guidelines before you proceed with installing operating system packages.
- Supported Oracle Linux 10 Distributions for x86-64
  Use this information to check supported Oracle Linux 10 distributions.
- Supported Oracle Linux 9 Distributions for x86-64
  Use the following information to check supported Oracle Linux 9 distributions:

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- Supported Oracle Linux 8 Distributions for x86-64
  Use this information to check supported Oracle Linux 8 distributions.
- Supported Oracle Linux 7 Distributions for x86-64
  Use the following information to check supported Oracle Linux 7 distributions:
- Supported Red Hat Enterprise Linux 10 Distributions for x86-64
  Use this information to check supported Red Hat Enterprise Linux 10 distributions.
- Supported Red Hat Enterprise Linux 9 Distributions for x86-64
  Use the following information to check supported Red Hat Enterprise Linux 9 distributions:
- Supported Red Hat Enterprise Linux 8 Distributions for x86-64
  Use this information to check supported Red Hat Enterprise Linux 8 distributions.
- Supported Red Hat Enterprise Linux 7 Distributions for x86-64
  Use the following information to check supported Red Hat Enterprise Linux 7 distributions:
- Supported SUSE Linux Enterprise Server 12 Distributions for x86-64
  Use the following information to check supported SUSE Linux Enterprise Server 12 distributions:
- Supported SUSE Linux Enterprise Server 15 Distributions for x86-64
  Use this information to check supported SUSE Linux Enterprise Server 15 distributions.
- Installing Operating System Packages
  Learn how to install the latest version of your Oracle Linux and SUSE Linux Enterprise Server operating system packages listed earlier.

General Guidelines for Operating System Packages

Review these guidelines before you proceed with installing operating system packages.

- Oracle recommends that you install Oracle Linux and use Oracle Database Preinstallation RPM to configure your operating systems for Oracle Database and Oracle Grid Infrastructure installations.
- The Oracle Database installation requires an X Window System (for example, `libX`). The `libX` packages are not part of a default Linux installation. If you perform an installation on a system with a reduced set of packages, then you must ensure that `libX` or a similar X Window System package is installed.
- The Unbreakable Enterprise Kernel for Oracle Linux can be installed on x86-64 servers running either Oracle Linux or Red Hat Enterprise Linux. As of Oracle Linux 5 Update 6, the Unbreakable Enterprise Kernel is the default system kernel. An x86 (32-bit) release of Oracle Linux including the Unbreakable Enterprise Kernel is available with Oracle Linux 5 update 7 and later.
- 32-bit packages in these requirements lists are needed only if you intend to use 32-bit client applications to access 64-bit servers that have the same operating system.
- Oracle Database 12c Release 2 (12.2) and later does not require the compiler packages `gcc` and `gcc-c++` on for Oracle Database or Oracle Grid Infrastructure installations.
- These operating system requirements do not apply to Oracle Engineered Systems, such as Oracle Exadata Database Machine. Oracle Engineered Systems include integrated system software that contain the required version of the operating system kernel and all software packages. Please verify that you have the minimum required Exadata image. Refer My Oracle Support note 888828.1 for more information.

Related Topics

- My Oracle Support Note 888828.1

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Supported Oracle Linux 10 Distributions for x86-64

Use this information to check supported Oracle Linux 10 distributions.

Table 4-1 x86-64 Oracle Linux 10 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Oracle Linux 10	Starting with Oracle Database 19c (19.32), the Linux x86-64 operating system is supported with the following minimum supported versions: • Oracle Linux 10 with the Unbreakable Enterprise Kernel 8: 6.12.0-104.43.4.2.el10uek.x86_64 or later • Oracle Linux 10 with the Red Hat Compatible Kernel: 6.12.0-55.40.1.0.1.el10_0.x86_64 or later **Note:** Oracle recommends that you update Oracle Linux 10 to the latest available release level.

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Table 4-1 (Cont.) x86-64 Oracle Linux 10 Minimum Operating System Requirements

Item	Requirements
Packages for Oracle Linux 10	Subscribe to the Oracle Linux 10 channel on the Unbreakable Linux Network, or configure a yum repository from the Oracle Linux yum server website, and then install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`. The Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, automatically installs all required packages listed in the table below, their dependencies for Oracle Grid Infrastructure and Oracle Database installations, and also performs other system configuration. If you install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, then you do not have to install these packages, as the Oracle Database Preinstallation RPM automatically installs them. Install the latest released versions of the following packages: bc binutils elfutils-libelf fontconfig glibc glibc-devel ksh libaio libgcc libibverbs libstdc++ libvirt-libs libxcb libX11 libXau libXi libXrender libXtst libxcrypt-compat make policycoreutils policycoreutils-python-utils smartmontools sysstat xz-devel
Optional Packages for Oracle Linux 10	ipmiutil (for Intelligent Platform Management Interface) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS) libnsl (for Oracle Database Client) libnsl2 (for Oracle Database Client) libnsl2-devel (for Oracle Database Client)
Patches and Known Issues	• Installing Oracle Database 19c on Oracle Linux 10 and Red Hat Enterprise Linux 10 • Known Issues and Bugs for Oracle Linux 10 and Red Hat Enterprise Linux 10 • Open Bugs Affecting Linux

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Supported Oracle Linux 9 Distributions for x86-64

Use the following information to check supported Oracle Linux 9 distributions:

Table 4-2 x86-64 Oracle Linux 9 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Oracle Linux 9	Starting with Oracle Database 19c Release 19.19, the following minimum versions are supported: • Oracle Linux 9 with the Unbreakable Enterprise Kernel 7: 5.15.0-1.43.4.2.el9uek.x86_64 or later • Oracle Linux 9 with the Red Hat Compatible Kernel: 5.14.0-70.22.1.0.2.el9_0.x86_64 or later **Note:** Oracle recommends that you update Oracle Linux to the latest available version and release level.

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Table 4-2 (Cont.) x86-64 Oracle Linux 9 Minimum Operating System Requirements

Item	Requirements
Packages for Oracle Linux 9	Subscribe to the Oracle Linux 9 channel on the Unbreakable Linux Network, or configure a yum repository from the Oracle Linux yum server website, and then install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`. The Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, automatically installs all required packages listed in the table below, their dependencies for Oracle Grid Infrastructure and Oracle Database installations, and also performs other system configuration. If you install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, then you do not have to install these packages, as the Oracle Database Preinstallation RPM automatically installs them. Install the latest released versions of the following packages: bc binutils compat-openssl11 elfutils-libelf fontconfig glibc glibc-devel ksh libasan liblsan librdmacm libaio libX11 libXau libXi libXrender libXtst libxcrypt-compat libgcc libibverbs libnsl libstdc++ libxcb libvirt-libs make policycoreutils policycoreutils-python-utils smartmontools sysstat xz-devel **Note:** If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

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Table 4-2 (Cont.) x86-64 Oracle Linux 9 Minimum Operating System Requirements

Item	Requirements
Optional Packages for Oracle Linux 9	Based on your requirement, install the latest released versions of the following packages: glibc-headers (for application development only) ipmiutil (for Intelligent Platform Management Interface) libnsl2 (for Oracle Database Client only) libnsl2-devel (for Oracle Database Client only) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS)
Patches and Known Issues	• Installing Oracle Database 19c on Oracle Linux 9 • Known Issues and Bugs for OL9 and RHEL9 for Client • Open Bugs Affecting Linux

Related Topics

- Installing Oracle Database 19c (19.19) on Oracle Linux 9
- Installing Oracle Database 19c (19.20) on Oracle Linux 9
- Known Issues and Bugs

Supported Oracle Linux 8 Distributions for x86-64

Use this information to check supported Oracle Linux 8 distributions.

Table 4-3 x86-64 Oracle Linux 8 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Oracle Linux 8	Minimum supported versions: • Oracle Linux 8.1 with the Unbreakable Enterprise Kernel 6: 5.4.17-2011.0.7.el8uek.x86_64 or later • Oracle Linux 8 with the Red Hat Compatible Kernel: 4.18.0-80.el8.x86_64 or later • Starting with Oracle Database 19c Release 19.21 the following minimum version is supported: Oracle Linux 8.8 with the Unbreakable Enterprise Kernel 7: 5.15.0-202.135.2.el8uek.x86_64 or later • Starting with Oracle Grid Infrastructure 19c Release 19.23, the following minimum version is supported: Oracle Linux 8.8 with the Unbreakable Enterprise Kernel 7: 5.15.0-202.135.2.el8uek.x86_64 or later **Note**: Oracle recommends that you update Oracle Linux to the latest available version and release level.

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Table 4-3 (Cont.) x86-64 Oracle Linux 8 Minimum Operating System Requirements

Item	Requirements
Packages for Oracle Linux 8	Subscribe to the Oracle Linux 8 channel on the Unbreakable Linux Network, or configure a yum repository from the Oracle Linux yum server website, and then install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`. The Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, automatically installs all required packages listed in the table below, their dependencies for Oracle Grid Infrastructure and Oracle Database installations, and also performs other system configuration. If you install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, then you do not have to install these packages, as the Oracle Database Preinstallation RPM automatically installs them. bc binutils compat-openssl10 elfutils-libelf elfutils-libelf-devel fontconfig glibc glibc-devel ksh libaio libaio-devel libXrender libX11 libXau libXi libXtst libgcc libnsl librdmacm libstdc++ libstdc++-devel libxcb libibverbs libasan liblsan make policycoreutils policycoreutils-python-utils rng-tools smartmontools sysstat **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

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Table 4-3 (Cont.) x86-64 Oracle Linux 8 Minimum Operating System Requirements

Item	Requirements
Optional Packages for Oracle Linux 8	Based on your requirement, install the latest released versions of the following packages: ipmiutil (for Intelligent Platform Management Interface) libnsl2 (for Oracle Database Client only) libnsl2-devel (for Oracle Database Client only) libvirt-libs (for KVM) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS)
Patches and Known Issues	• For a list of latest Oracle Database Release Updates (RU) and Release Update Revisions (RUR) patches for Oracle Linux Enterprise Linux 8 and Red Hat Enterprise Linux 8, visit My Oracle Support • For a list of known issues and open bugs for Oracle Linux 8 and Red Hat Enterprise Linux 8, read the Oracle Database Release Notes
KVM virtualization	Kernel-based virtual machine (KVM), also known as KVM virtualization, is certified on Oracle Database 19c for all supported Oracle Linux 8 distributions. For more information on supported virtualization technologies for Oracle Database, refer to the virtualization matrix: https://www.oracle.com/database/technologies/virtualization-matrix.html

Supported Oracle Linux 7 Distributions for x86-64

Use the following information to check supported Oracle Linux 7 distributions:

Table 4-4 x86-64 Oracle Linux 7 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Oracle Linux 7	Minimum supported versions: • Oracle Linux 7.4 with the Unbreakable Enterprise Kernel 4: 4.1.12-124.19.2.el7uek.x86_64 or later • Oracle Linux 7.4 with the Unbreakable Enterprise Kernel 5: 4.14.35-1818.1.6.el7uek.x86_64 or later • Oracle Linux 7.7 with the Unbreakable Enterprise Kernel 6: 5.4.17-2011.4.4.el7uek.x86_64 or later • Oracle Linux 7.5 with the Red Hat Compatible Kernel: 3.10.0-862.11.6.el7.x86_64 or later **Note**: • Oracle recommends that you update Oracle Linux to the latest available version and release level. • Oracle Database 19c continues to be supported on Oracle Linux 7 and Red Hat Enterprise Linux 7, however, Oracle strongly recommends that you upgrade your operating system to Oracle Linux 8 or Red Hat Enterprise Linux 8 or later.

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Table 4-4 (Cont.) x86-64 Oracle Linux 7 Minimum Operating System Requirements

Item	Requirements
Packages for Oracle Linux 7	Subscribe to the Oracle Linux 7 channel on the Unbreakable Linux Network, or configure a yum repository from the Oracle Linux yum server website, and then install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`. The Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, automatically installs all required packages listed in the table below, their dependencies for Oracle Grid Infrastructure and Oracle Database installations, and also performs other system configuration. If you install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, then you do not have to install these packages, as the Oracle Database Preinstallation RPM automatically installs them. bc binutils compat-libcap1 compat-libstdc++-33 elfutils-libelf elfutils-libelf-devel fontconfig-devel glibc glibc-devel ksh libaio libaio-devel libXrender libXrender-devel libX11 libXau libXi libXtst libgcc libstdc++ libstdc++-devel libxcb make policycoreutils policycoreutils-python smartmontools sysstat **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

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Table 4-4 (Cont.) x86-64 Oracle Linux 7 Minimum Operating System Requirements

Item	Requirements
Optional Packages for Oracle Linux 7	Based on your requirement, install the latest released versions of the following packages: ipmiutil (for Intelligent Platform Management Interface) net-tools (for Oracle RAC and Oracle Clusterware) libvirt-libs (for KVM) nfs-utils (for Oracle ACFS) python (for Oracle ACFS Remote) python-configshell (for Oracle ACFS Remote) python-rtslib (for Oracle ACFS Remote) python-six (for Oracle ACFS Remote) targetcli (for Oracle ACFS Remote)
KVM virtualization	Kernel-based virtual machine (KVM), also known as KVM virtualization, is certified on Oracle Database 19c for all supported Oracle Linux 7 distributions. For more information on supported virtualization technologies for Oracle Database, refer to the virtualization matrix: https://www.oracle.com/database/technologies/virtualization-matrix.html

Related Topics

- Installing Operating System Packages
  Learn how to install the latest version of your Oracle Linux and SUSE Linux Enterprise Server operating system packages listed earlier.

Related Topics

- Installing Operating System Packages
  Learn how to install the latest version of your Oracle Linux and SUSE Linux Enterprise Server operating system packages listed earlier.

Supported Red Hat Enterprise Linux 10 Distributions for x86-64

Use this information to check supported Red Hat Enterprise Linux 10 distributions.

Table 4-5 x86-64 Red Hat Enterprise Linux 10 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Red Hat Enterprise Linux 10	Starting with Oracle Database 19c (19.32), the Red Hat Enterprise Linux x86-64 operating system is supported with the following minimum supported version: Red Hat Enterprise Linux 10: 6.12.0-55.40.1.0.1.el10_0.x86_64 or later

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Table 4-5 (Cont.) x86-64 Red Hat Enterprise Linux 10 Minimum Operating System Requirements

Item	Requirements
Packages for Red Hat Enterprise Linux 10	Install the latest released versions of the following packages: bc binutils elfutils-libelf fontconfig glibc glibc-devel ksh libaio libgcc libibverbs libnsl libnsl2 libnsl2-devel libstdc++ libvirt-libs libxcb libX11 libXau libXi libXrender libXtst libxcrypt-compat make policycoreutils policycoreutils-python-utils smartmontools sysstat xz-devel
Optional Packages for Red Hat Enterprise Linux 10	ipmiutil (for Intelligent Platform Management Interface) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS)
Patches and Known Issues	• Installing Oracle Database 19c on Oracle Linux 10 and Red Hat Enterprise Linux 10 • Known Issues and Bugs for Oracle Linux 10 and Red Hat Enterprise Linux 10 • Open Bugs Affecting Linux

Supported Red Hat Enterprise Linux 9 Distributions for x86-64

Use the following information to check supported Red Hat Enterprise Linux 9 distributions:

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Table 4-6 x86-64 Red Hat Enterprise Linux 9 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Red Hat Enterprise Linux 9	Starting with Oracle Database 19c Release 19.19, the following minimum versions are supported: • Red Hat Enterprise Linux 9: 5.14.0-70.22.1.el9_0.x86_64 or later
Packages for Red Hat Enterprise Linux 9	Install the latest released versions of the following packages: bc binutils compat-openssl11 elfutils-libelf fontconfig glibc glibc-devel ksh libaio libasan liblsan libX11 libXau libXi libXrender libXtst libxcrypt-compat libgcc libibverbs libnsl librdmacm libstdc++ libxcb libvirt-libs make policycoreutils policycoreutils-python-utils smartmontools sysstat xz-devel **Note:** If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

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Table 4-6 (Cont.) x86-64 Red Hat Enterprise Linux 9 Minimum Operating System Requirements

Item	Requirements
Optional Packages for Red Hat Enterprise Linux 9	Based on your requirement, install the latest released versions of the following packages: chkconfig (for Oracle Database and Oracle RAC only) glibc-headers (for application development only) ipmiutil (for Intelligent Platform Management Interface) libnsl2 (for Oracle Database Client only) libnsl2-devel (for Oracle Database Client only) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS)

Related Topics

- Installing Oracle Database 19c (19.19) on Red Hat Enterprise Linux 9
- Installing Oracle Database 19c (19.20) on Red Hat Enterprise Linux 9
- Known Issues and Bugs

Supported Red Hat Enterprise Linux 8 Distributions for x86-64

Use this information to check supported Red Hat Enterprise Linux 8 distributions.

Table 4-7 x86-64 Red Hat Enterprise Linux 8 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Red Hat Enterprise Linux 8	Minimum supported version: • Red Hat Enterprise Linux 8: 4.18.0-80.el8.x86_64 or later

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Table 4-7 (Cont.) x86-64 Red Hat Enterprise Linux 8 Minimum Operating System Requirements

Item	Requirements
Packages for Red Hat Enterprise Linux 8	Install the latest released versions of the following packages: bc binutils elfutils-libelf elfutils-libelf-devel glibc glibc-devel ksh libaio libaio-devel libXrender libX11 libXau libXi libXtst libgcc libnsl librdmacm libstdc++ libstdc++-devel libxcb libibverbs make policycoreutils policycoreutils-python-utils smartmontools sysstat **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.
Optional Packages for Red Hat Enterprise Linux 8	Based on your requirement, install the latest released versions of the following packages: ipmiutil (for Intelligent Platform Management Interface) libnsl2 (for Oracle Database Client only) libnsl2-devel (for Oracle Database Client only) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS)
Patches and Known Issues	• For a list of latest Oracle Database Release Updates (RU) and Release Update Revisions (RUR) patches for Oracle Linux Enterprise Linux 8 and Red Hat Enterprise Linux 8, visit My Oracle Support • For a list of known issues and open bugs for Oracle Linux 8 and Red Hat Enterprise Linux 8, read the Oracle Database Release Notes

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Supported Red Hat Enterprise Linux 7 Distributions for x86-64

Use the following information to check supported Red Hat Enterprise Linux 7 distributions:

Table 4-8 x86-64 Red Hat Enterprise Linux 7 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Red Hat Enterprise Linux 7	Minimum supported version: • Red Hat Enterprise Linux 7.5: 3.10.0-862.11.6.el7.x86_64 or later **Note**: Oracle Database 19c continues to be supported on Oracle Linux 7 and Red Hat Enterprise Linux 7, however, Oracle strongly recommends that you upgrade your operating system to Oracle Linux 8 or Red Hat Enterprise Linux 8 or later.
Packages for Red Hat Enterprise Linux 7	Install the latest released versions of the following packages: bc binutils compat-libcap1 compat-libstdc++-33 elfutils-libelf elfutils-libelf-devel fontconfig-devel glibc glibc-devel ksh libaio libaio-devel libX11 libXau libXi libXtst libXrender libXrender-devel libgcc libstdc++ libstdc++-devel libxcb make smartmontools sysstat **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

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Table 4-8 (Cont.) x86-64 Red Hat Enterprise Linux 7 Minimum Operating System Requirements

Item	Requirements
Optional Packages for Red Hat Enterprise Linux 7	Based on your requirement, install the latest released versions of the following packages: ipmiutil (for Intelligent Platform Management Interface) net-tools (for Oracle RAC and Oracle Clusterware) nfs-utils (for Oracle ACFS) python (for Oracle ACFS Remote) python-configshell (for Oracle ACFS Remote) python-rtslib (for Oracle ACFS Remote) python-six (for Oracle ACFS Remote) targetcli (for Oracle ACFS Remote)

Supported SUSE Linux Enterprise Server 12 Distributions for x86-64

Use the following information to check supported SUSE Linux Enterprise Server 12 distributions:

Table 4-9 x86-64 SUSE Linux Enterprise Server 12 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
SUSE Linux Enterprise Server	Minimum supported version: • SUSE Linux Enterprise Server 12 SP3: 4.4.162-94.72-default or later

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Table 4-9 (Cont.) x86-64 SUSE Linux Enterprise Server 12 Minimum Operating System Requirements

Item	Requirements
Packages for SUSE Linux Enterprise Server 12	Install the latest released versions of the following packages: bc binutils glibc glibc-devel libX11 libXau6 libXtst6 libcap-ng-utils libcap-ng0 libcap-progs libcap1 libcap2 libelf-devel libgcc_s1 libjpeg-turbo libjpeg62 libjpeg62-turbo libpcap1 libpcre1 libpcre16-0 libpng16-16 libstdc++6 libtiff5 libaio-devel libaio1 libXrender1 make mksh pixz rdma-core rdma-core-devel smartmontools sysstat xorg-x11-libs xz **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.
Optional Packages for SUSE Linux Enterprise Server 12	Based on your requirement, install the latest released versions of the following packages: net-tools (for Oracle RAC and Oracle Clusterware) nfs-kernel-server (for Oracle ACFS)

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Related Topics

- Installing Operating System Packages
  Learn how to install the latest version of your Oracle Linux and SUSE Linux Enterprise Server operating system packages listed earlier.

Supported SUSE Linux Enterprise Server 15 Distributions for x86-64

Use this information to check supported SUSE Linux Enterprise Server 15 distributions.

Table 4-10 x86-64 SUSE Linux Enterprise Server 15 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
SUSE Linux Enterprise Server	Minimum supported version: • SUSE Linux Enterprise Server 15: 4.12.14-23-default or later

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Table 4-10 (Cont.) x86-64 SUSE Linux Enterprise Server 15 Minimum Operating System Requirements

Item	Requirements
Packages for SUSE Linux Enterprise Server 15	Install the latest released versions of the following packages: bc binutils glibc glibc-devel insserv-compat libaio-devel libaio1 libX11-6 libXau6 libXext-devel libXext6 libXi-devel libXi6 libXrender-devel libXrender1 libXtst6 libcap-ng-utils libcap-ng0 libcap-progs libcap1 libcap2 libelf1 libgcc_s1 libjpeg8 libpcap1 libpcre1 libpcre16-0 libpng16-16 libstdc++6 libtiff5 libgfortran4 mksh make pixz rdma-core rdma-core-devel smartmontools sysstat systemd-sysvcompat xorg-x11-libs xz **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

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Table 4-10 (Cont.) x86-64 SUSE Linux Enterprise Server 15 Minimum Operating System Requirements

Item	Requirements
Optional Packages for SUSE Linux Enterprise Server 15	Based on your requirement, install the latest released versions of the following packages: net-tools (for Oracle RAC and Oracle Clusterware) nfs-kernel-server (for Oracle ACFS)
Patches and Known Issues	• For a list of latest Release Updates (RU) and Release Update Revisions (RUR) patches for SUSE Linux Enterprise Server 15, visit My Oracle Support • For a list of known issues and open bugs for SUSE Linux Enterprise Server 15, read the Oracle Database Release Notes

Installing Operating System Packages

Learn how to install the latest version of your Oracle Linux and SUSE Linux Enterprise Server operating system packages listed earlier.

You must install the latest version of your operating system packages from the respective operating system vendor repository by using a package manager like `YUM` or `YaST` depending on your operating system.

Ensure that the appropriate channel or repository is enabled to include these packages.

For example:

On Oracle Linux or Red Hat Enterprise Linux, to install the latest `bc` package using `YUM`, run the following command:

```
$ yum install bc
```

On SUSE Linux Enterprise Server, to install the latest `bc` package using `YaST`, run the following command:

```
$ yast --install bc
```

Operating System Requirements for IBM: Linux on System z

The Linux distributions and packages listed in this section are supported for this release on IBM: Linux on System z.

Identify the requirements for your IBM: Linux on System z distribution, and ensure that you have a supported kernel and required packages installed before starting installation.

> **Note**
>
> 32-bit packages in these requirements lists are needed only if you intend to use 32-bit client applications to access 64-bit servers.

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The platform-specific hardware and software requirements included in this guide were current when this guide was published. However, because new platforms and operating system software versions may 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:

https://support.oracle.com/

- Supported Red Hat Enterprise Linux 9 Distributions for IBM: Linux on System z
  Use the following information to check supported Red Hat Enterprise Linux 9 distributions:
- Supported Red Hat Enterprise Linux 8 Distributions for IBM: Linux on System z
  Use the following information to check supported Red Hat Enterprise Linux 8 distributions:
- Supported Red Hat Enterprise Linux 7 Distributions for IBM: Linux on System z
  Use the following information to check supported Red Hat Enterprise Linux 7 distributions:
- Supported SUSE Linux Enterprise Server 12 Distributions for IBM: Linux on System z
  Use the following information to check supported SUSE Linux Enterprise Server 12 distributions:
- Supported SUSE Linux Enterprise Server 15 Distributions for IBM: Linux on System z
  Use the following information to check supported SUSE Linux Enterprise Server 15 distributions:

Supported Red Hat Enterprise Linux 9 Distributions for IBM: Linux on System z

Use the following information to check supported Red Hat Enterprise Linux 9 distributions:

Table 4-11 Red Hat Enterprise Linux 9 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Red Hat Enterprise Linux 9	Starting with Oracle Database 19c Release 19.23, the following minimum version is supported: • Red Hat Enterprise Linux 9.2: 5.14.0-284.30.1.el9_2.s390x or later

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Table 4-11 (Cont.) Red Hat Enterprise Linux 9 Minimum Operating System Requirements

Item	Requirements
Packages for Red Hat Enterprise Linux 9	Install the latest released versions of the following packages: glibc-devel ksh libaio libasan liblsan libX11 libXau libXi libXrender libXtst libxcrypt-compat libgcc libibverbs libnsl librdmacm libstdc++ libxcb libvirt-libs make policycoreutils policycoreutils-python-utils smartmontools sysstat
Optional Packages for Red Hat Enterprise Linux 9	Based on your requirement, install the latest released versions of the following packages: chkconfig (for Oracle RAC and Oracle Clusterware only) glibc-headers (for application development only) ipmiutil (for Intelligent Platform Management Interface) libnsl2 (for Oracle Database Client only) libnsl2-devel (for Oracle Database Client only) net-tools (for Oracle RAC and Oracle Clusterware only)

Supported Red Hat Enterprise Linux 8 Distributions for IBM: Linux on System z

Use the following information to check supported Red Hat Enterprise Linux 8 distributions:

Table 4-12 Red Hat Enterprise Linux 8 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.

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Table 4-12 (Cont.) Red Hat Enterprise Linux 8 Minimum Operating System Requirements

Item	Requirements
Red Hat Enterprise Linux 8	Red Hat Enterprise Linux 8.3: 4.18.0-240.el8.s390x or later
Packages for Red Hat Enterprise Linux 8	The following packages (or later versions) must be installed: bc-1.07.1-5.el8 (s390x) binutils-2.30-79.el8 (s390x) elfutils-libelf-0.180-1.el8 (s390x) elfutils-libelf-devel-0.180-1.el8 (s390x) fontconfig-2.13.1-3.el8 (s390x) gcc-8.3.1-5.1.el8 (s390x) gcc-c++-8.3.1-5.1.el8 (s390x) glibc-2.28-127.el8_3.2 (s390x) glibc-devel-2.28-127.el8_3.2 (s390x) ksh-20120801-254.el8 (s390x) libnsl2-1.2.0-2.20180605git4a062cf.el8 (s390x) libX11-1.6.8-3.el8 (s390x) libXau-1.0.9-3.el8 (s390x) libXaw-1.0.13-10.el8 (s390x) libXi-1.7.10-1.el8 (s390x) libXrender-0.9.10-7.el8 (s390x) libXtst-1.2.3-7.el8 (s390x) libaio-0.3.112-1.el8 (s390x) libaio-devel-0.3.112-1.el8 (s390x) libattr-devel-2.4.48-3.el8 (s390x) libgcc-8.3.1-5.1.el8 (s390x) libgfortran-8.3.1-5.1.el8 (s390x) libibverbs-29.0-3.el8 (s390x) libnsl-2.28-127.el8_3.2 (s390x) librdmacm-29.0-3.el8 (s390x) libstdc++-8.3.1-5.1.el8 (s390x) libstdc++-devel-8.3.1-5.1.el8 (s390x) libxcb-1.13.1-1.el8 (s390x) make-4.2.1-10.el8 (s390x) net-tools-2.0-0.52.20160912git.el8 (s390x) pam-1.3.1-11.el8 (s390x) pam-devel-1.3.1-11.el8 (s390x) policycoreutils-2.9-9.el8 (s390x) policycoreutils-python-utils-2.9-9.el8.noarch smartmontools-7.1-1.el8 (s390x) sysstat-11.7.3-5.el8 (s390x)

Supported Red Hat Enterprise Linux 7 Distributions for IBM: Linux on System z

Use the following information to check supported Red Hat Enterprise Linux 7 distributions:

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Table 4-13 Red Hat Enterprise Linux 7 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
Red Hat Enterprise Linux 7	Red Hat Enterprise Linux 7.4: 3.10.0-693.el7.s390x or later
Packages for Red Hat Enterprise Linux 7	The following packages (or later versions) must be installed: binutils-2.25.1-31.base.el7 (s390x) compat-libcap1-1.10-7.el7 (s390x) gcc-4.8.5-16.el7 (s390x) gcc-c++-4.8.5-16.el7 (s390x) glibc-2.17-196.el7 (s390) glibc-2.17-196.el7 (s390x) glibc-devel-2.17-196.el7 (s390) glibc-devel-2.17-196.el7 (s390x) ksh-20120801-34.el7 (s390x) libX11-1.6.5-1.el7 (s390) libX11-1.6.5-1.el7 (s390x) libXaw-1.0.13-4.el7 (s390x) libXft-2.3.2-2.el7 (s390) libXi-1.7.9-1.el7 (s390) libXi-1.7.9-1.el7 (s390x) libXmu-1.1.2-2.el7 (s390) libXp-1.0.2-2.1.el7 (s390) libXtst-1.2.3-1.el7 (s390) libXtst-1.2.3-1.el7 (s390x) libaio-0.3.109-13.el7 (s390) libaio-0.3.109-13.el7 (s390x) libaio-devel-0.3.109-13.el7 (s390x) libattr-devel-2.4.46-12.el7 (s390) libattr-devel-2.4.46-12.el7 (s390x) libgcc-4.8.5-16.el7 (s390) libgcc-4.8.5-16.el7 (s390x) libgfortran-4.8.5-16.el7 (s390x) libstdc++-4.8.5-16.el7 (s390x) libstdc++-devel-4.8.5-16.el7 (s390x) make-3.82-23.el7 (s390x) pam-1.1.8-18.el7 (s390x) pam-devel-1.1.8-18.el7 (s390x) sysstat-10.1.5-12.el7 (s390x)

Supported SUSE Linux Enterprise Server 12 Distributions for IBM: Linux on System z

Use the following information to check supported SUSE Linux Enterprise Server 12 distributions:

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Table 4-14 SUSE Linux Enterprise Server 12 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
SUSE Linux Enterprise Server 12	SUSE Linux Enterprise Server 12: 4.4.73-5-default s390x or later
Packages for SUSE Linux Enterprise Server 12	The following packages (or later versions) must be installed: binutils-2.26.1-9.12.1 (s390x) gcc-4.8-6.189 (s390x) gcc-c++-4.8-6.189 (s390x) glibc-2.22-61.3 (s390x) glibc-2.22-61.3 (s390) glibc-devel-2.22-61.3 (s390x) glibc-devel-2.22-61.3 (s390) libaio-devel-0.3.109-17.15 (s390x) libaio1-0.3.109-17.15 (s390x) libaio1-0.3.109-17.15 (s390) libX11-6-1.6.2-11.1 (s390x) libXau6-1.0.8-4.58 (s390x) libXau6-1.0.8-4.58 (s390x) libXaw7-1.0.12-4.1 (s390x) libXext6-1.3.2-3.61 (s390x) libXext6-1.3.2-3.61 (s390) libXft2-2.3.1-9.32 (s390x) libXft2-2.3.1-9.32 (s390) libXi6-1.7.4-17.1 (s390x) libXi6-1.7.4-17.1 (s390) libXmu6-1.1.2-3.60 (s390x) libXp6-1.0.2-3.58 (s390x) libXp6-1.0.2-3.58 (s390) libXtst6-1.2.2-7.1 (s390x) libXtst6-1.2.2-7.1 (s390) libcap2-2.22-13.1 (s390x) libstdc++48-devel-4.8.5-30.1 (s390) libstdc++48-devel-4.8.5-30.1 (s390x) libstdc++6-6.2.1+r239768-2.4 (s390) libstdc++6-6.2.1+r239768-2.4 (s390x) libxcb1-1.10-3.1 (s390x) libxcb1-1.10-3.1 (s390) libXmu6-1.1.2-3.60 (s390x) mksh-50-2.13 (s390x) make-4.0-4.1 (s390x)

Supported SUSE Linux Enterprise Server 15 Distributions for IBM: Linux on System z

Use the following information to check supported SUSE Linux Enterprise Server 15 distributions:

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Table 4-15 SUSE Linux Enterprise Server 15 Minimum Operating System Requirements

Item	Requirements
SSH Requirement	Ensure that OpenSSH is installed on your servers. OpenSSH is the required SSH software.
SUSE Linux Enterprise Server 15	SUSE Linux Enterprise Server 15: 5.3.18-57-default s390x or later

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Table 4-15 (Cont.) SUSE Linux Enterprise Server 15 Minimum Operating System Requirements

Item	Requirements
Packages for SUSE Linux Enterprise Server 15	The following packages (or later versions) must be installed: bc-1.07.1-11.37.s390x.rpm binutils-2.35.1-7.18.1.s390x gcc-7-3.3.22.s390x gcc-c++-7-3.3.22.s390x glibc-2.31-7.30.s390x glibc-devel-2.31-7.30.s390x libaio-devel-0.3.109-1.25.s390x libaio1-0.3.109-1.25.s390x libX11-6-1.6.5-3.15.1.s390x libXau6-1.0.8-1.26.s390x libXaw7-1.0.13-3.3.8.s390x libXext6-1.3.3-1.30.s390x libXft2-2.3.2-1.33.s390x libXi-devel-1.7.9-3.2.1.s390x libXi6-1.7.9-3.2.1.s390x libXmu6-1.1.2-1.30.s390x libXp6-1.0.3-1.24.s390x libXrender-devel-0.9.10-1.30.s390x libXrender1-0.9.10-1.30.s390x libXtst6-1.2.3-1.24.s390x libcap-ng-utils-0.7.9-4.37.s390x libcap-ng0-0.7.9-4.37.s390x libcap-progs-2.26-4.6.1.s390x libcap1-1.97-1.15.s390x libcap2-2.26-4.6.1.s390x libelf1-0.168-4.5.3.s390x libgcc_s1-10.2.1+git583-1.3.4.s390x libjpeg8-8.1.2-5.15.7.s390x libpcap1-1.9.1-1.33.s390x libpcre1-8.41-4.20.s390x libstdc++6-10.2.1+git583-1.3.4.s390x libtiff5-4.0.9-5.30.28.s390x libgfortran4-7.5.0+r278197-4.25.1.s390x libxcb1-1.13-3.5.1.s390x libXmu6-1.1.2-1.30.s390x mksh-56c-1.10.s390x make-4.2.1-7.3.2.s390x net-tools-2.0+git20170221.479bb4a-3.11.s390x net-tools-deprecated-2.0+git20170221.479bb4a-3.11.s390x.rpm pixz-1.0.6-1.13.s390x rdma-core-31.0-2.14.s390x rdma-core-devel-31.0-2.14.s390x smartmontools-7.0-6.1.s390x sysstat-12.0.2-3.27.1.s390x xorg-x11-libs-7.6.1-1.16.noarch xz-5.2.3-4.3.1.s390x

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Table 4-15 (Cont.) SUSE Linux Enterprise Server 15 Minimum Operating System Requirements

Item	Requirements
	Note: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install (where available) the latest 32-bit versions of the packages listed in this table.

Operating System Requirements for Linux for Arm (aarch64)

The Linux distribution and packages listed in this section are supported for this release on Linux for Arm (aarch64).

Identify the requirements for your Linux distribution, and ensure that you have a supported kernel and required packages installed before starting installation.

The platform-specific hardware and software requirements included in this guide were current when this guide was published. However, because new platforms and operating system software versions may 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:

https://support.oracle.com/

- Supported Oracle Linux 8 Distributions on Linux for Arm (aarch64)
  Use the following information to check supported Oracle Linux 8 distributions:

Supported Oracle Linux 8 Distributions on Linux for Arm (aarch64)

Use the following information to check supported Oracle Linux 8 distributions:

Table 4-16 Linux Arm (aarch64) Oracle Linux 8 Minimum Operating System Requirements

Item	Requirements
Oracle Linux 8	Starting with Oracle Database 19c Release 19.19, the Linux for Arm (aarch64) operating system is supported with the following minimum supported version: Oracle Linux 8.6 with Unbreakable Enterprise Kernel 7: 5.15.0-6.80.3.1.el8uek.aarch64 or later **Note:** • Oracle recommends that you update Oracle Linux 8 to the latest available release level. • The Oracle Database 19c Release 19.19 Linux for Arm (aarch64) includes all the content from the Oracle Database 19c RU (19.19).

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Table 4-16 (Cont.) Linux Arm (aarch64) Oracle Linux 8 Minimum Operating System Requirements

Item	Requirements
Packages for Oracle Linux 8	Install the latest released versions of the following packages: Subscribe to the Oracle Linux 8 channel on the Unbreakable Linux Network, or configure a yum repository from the Oracle Linux yum server website, and then install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`. The Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, automatically installs all required packages listed in the table below, their dependencies for Oracle Grid Infrastructure and Oracle Database installations, and also performs other system configuration. If you install the Oracle Database Preinstallation RPM, `oracle-database-preinstall-19c`, then you do not have to install these packages, as the Oracle Database Preinstallation RPM automatically installs them. bc binutils elfutils-libelf elfutils-libelf-devel fontconfig-devel gcc gcc-c++ glibc glibc-devel ksh libaio libaio-devel libgcc libgfortran libibverbs libnsl libnsl2 librdmacm libstdc++ libstdc++-devel libxcb libX11 libXau libXi libXrender libXtst make policycoreutils policycoreutils-python-utils smartmontools sysstat

Related Topics

- Installation Requirements for Programming Environments for Linux for Arm (aarch64)
  Ensure that your system meets the requirements for the programming environment you want to configure:

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- Issues Affecting Linux for Arm (aarch64) for Oracle Database 19c

Additional Drivers and Software Packages for Linux

Information about optional drivers and software packages.

You are not required to install additional drivers and packages, but you may choose to install or configure these drivers and packages.

- Installing PAM for Login Authentication on Linux
  Pluggable Authentication Modules (PAM) is a system of libraries that handle user authentication tasks for applications.
- Installing OCFS2
  You can use Oracle Cluster File System 2 (OCFS2) with Oracle Grid Infrastructure. However, you are not required to use OCFS2.
- Installing Oracle Messaging Gateway
  Oracle Messaging Gateway is installed with Enterprise Edition of Oracle Database. However, you may require a CSD or Fix Packs.
- Installation Requirements for ODBC and LDAP
  Review these topics to install Open Database Connectivity (ODBC) and Lightweight Directory Access Protocol (LDAP).
- Installation Requirements for Programming Environments for Linux
  Review the following section to install programming environments:
- Installation Requirements for Web Browsers
  Web browsers are required only if you intend to use Oracle Enterprise Manager Database Express and Oracle Enterprise Manager Cloud Control. Web browsers must support JavaScript, and the HTML 4.0 and CSS 1.0 standards.

Installing PAM for Login Authentication on Linux

Pluggable Authentication Modules (PAM) is a system of libraries that handle user authentication tasks for applications.

On Linux, external scheduler jobs require PAM. Oracle strongly recommends that you install the latest Linux-PAM library for your Linux distribution.

Use a package management system (`yum`, `up2date`, `YaST`) for your distribution to install the latest `pam` (Pluggable Authentication Modules for Linux) library.

Installing OCFS2

You can use Oracle Cluster File System 2 (OCFS2) with Oracle Grid Infrastructure. However, you are not required to use OCFS2.

OCFS2 is a POSIX-compliant general purpose shared disk cluster file system for Linux. OCFS2 is supported for this release only with Oracle Linux.

An OCFS2 installation consists of two parts, the kernel module and the tools module.

The supported version of the OCFS2 kernel module depends on the version of Unbreakable Enterprise Kernel available with Oracle Linux. Run the following command to install the latest version of the OCFS2 kernel module:

```
# yum install kernel-uek ocfs2
```


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OCFS2 Release 1.8.6–9 is the supported version of OCFS2 tools module for this release. After you install the OCFS2 kernel module, run the following command, to install the OCFS2 tools module:

```
# yum install ocfs2-tools-1.8.6-9
```

Note

- Each cluster node should run the same version of OCFS2 modules and a compatible version of Unbreakable Enterprise Kernel.
- OCFS2 is not supported on Linux for Arm (aarch64).

https://oss.oracle.com/projects/ocfs2/

Installing Oracle Messaging Gateway

Oracle Messaging Gateway is installed with Enterprise Edition of Oracle Database. However, you may require a CSD or Fix Packs.

If you require a CSD or Fix Packs for IBM WebSphere MQ, then see the following website for more information:

https://www.ibm.com/support/

Note

- Oracle Messaging Gateway does not support the integration of Advanced Queuing with TIBCO Rendezvous on IBM: Linux on System z.
- Oracle Messaging Gateway is not supported on Linux for Arm (aarch64).

Related Topics

- *Oracle Database Advanced Queuing User's Guide*

Installation Requirements for ODBC and LDAP

Review these topics to install Open Database Connectivity (ODBC) and Lightweight Directory Access Protocol (LDAP).

- About ODBC Drivers and Oracle Database
  Open Database Connectivity (ODBC) is a set of database access APIs that connect to the database, prepare, and then run SQL statements on the database.
- Installing ODBC Drivers for Linux x86-64
  If you intend to install Oracle's ODBC driver, then you must also install the most recent ODBC Driver Manager for Linux.
- About LDAP and Oracle Plug-ins
  Lightweight Directory Access Protocol (LDAP) is an application protocol for accessing and maintaining distributed directory information services over IP networks.
- Installing the LDAP Package
  LDAP is included in a default Linux operating system installation.

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About ODBC Drivers and Oracle Database

Open Database Connectivity (ODBC) is a set of database access APIs that connect to the database, prepare, and then run SQL statements on the database.

An application that uses an ODBC driver can access non-uniform data sources, such as spreadsheets and comma-delimited files.

Installing ODBC Drivers for Linux x86-64

If you intend to install Oracle's ODBC driver, then you must also install the most recent ODBC Driver Manager for Linux.

Download and install the ODBC Driver Manager and Linux RPMs from the following website:

http://www.unixodbc.org

Review the minimum supported ODBC driver releases, and install ODBC drivers of the following or later releases for all Linux distributions:

```
unixODBC-2.3.4 or later
```

About LDAP and Oracle Plug-ins

Lightweight Directory Access Protocol (LDAP) is an application protocol for accessing and maintaining distributed directory information services over IP networks.

You require the LDAP package if you want to use features requiring LDAP, including the Oracle Database scripts `odisrvreg` and `oidca` for Oracle Internet Directory, or `schemasync` for third-party LDAP directories.

Installing the LDAP Package

LDAP is included in a default Linux operating system installation.

If you did not perform a default Linux installation, and you intend to use Oracle scripts requiring LDAP, then use a package management system (`up2date`, `YaST`) for your distribution to install a supported LDAP package for your distribution, and install any other required packages for that LDAP package.

Installation Requirements for Programming Environments for Linux

Review the following section to install programming environments:

- Installation Requirements for Programming Environments for Linux x86-64
  Ensure that your system meets the requirements for the programming environment you want to configure:
- Installation Requirements for Programming Environments for Linux for Arm (aarch64)
  Ensure that your system meets the requirements for the programming environment you want to configure:
- Installation Requirements for Programming Environments for IBM: Linux on System z
  Ensure that your system meets the requirements for the programming environment you want to configure:

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Installation Requirements for Programming Environments for Linux x86-64

Ensure that your system meets the requirements for the programming environment you want to configure:

Table 4-17 Requirements for Programming Environments for Linux X86–64

Programming Environments	Support Requirements
Java Database Connectivity (JDBC) / JDBC Oracle Call Interface (JDBC OCI)	JDK 8 (Java SE Development Kit) with the JNDI extension with Oracle Java Database Connectivity.
Oracle Call Interface (OCI) Oracle C++ Call Interface Pro*C/C++	Latest released version of the Intel C/C++ Compiler or the GNU C and C++ compilers. Oracle C++ Call Interface (OCCI) applications can be built with the latest released version of the g++ or Intel C++ Compiler used with the standard template libraries of the `gcc` compilers listed in this table.
`gcc` compiler packages	Install the latest released versions of the `gcc` packages listed here. gcc gcc-c++ gcc-info gcc-locale gcc48 gcc48-info gcc48-locale gcc48-c++ **Note**: If you intend to use 32-bit client applications to access 64-bit servers, then you must also install the latest 32-bit versions of the packages listed in this table.
Oracle XML Developer's Kit (XDK)	Oracle XML Developer's Kit is supported with the same compilers as OCCI.
Pro*COBOL	• Micro Focus Visual COBOL for Eclipse 2.3 - Update 2 • Micro Focus Visual COBOL v6.0
Python	`cx_oracle` users should install Python 3.9 or later. Python 3.9 is the minimum supported version on Oracle Linux 9. For installing Python on Oracle Linux 9, see Installing Python.

Installation Requirements for Programming Environments for Linux for Arm (aarch64)

Ensure that your system meets the requirements for the programming environment you want to configure:

Table 4-18 Requirements for Programming Environments for Linux for Arm (aarch64)

Programming Environments	Support Requirements
Java Database Connectivity (JDBC) / JDBC Oracle Call Interface (JDBC OCI)	JDK 8 (Java SE Development Kit) with the JNDI extension with Oracle Java Database Connectivity.

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Table 4-18 (Cont.) Requirements for Programming Environments for Linux for Arm (aarch64)

Programming Environments	Support Requirements
Oracle Call Interface (OCI) Oracle C++ Call Interface Pro*C/C++	The GNU C and C++ compilers listed in this table. Oracle C++ Call Interface (OCCI) applications can be built with g++ used with the standard template libraries of the `gcc` compilers listed in this table.
`gcc` compiler packages	Install the latest released versions of the `gcc` packages listed here. gcc gcc-c++
Oracle XML Developer's Kit (XDK)	Oracle XML Developer's Kit is supported with the same compilers as OCCI.

Installation Requirements for Programming Environments for IBM: Linux on System z

Ensure that your system meets the requirements for the programming environment you want to configure:

Table 4-19 Requirements for Programming Environments for IBM: Linux on System z

Programming Environments	Support Requirements
Java Database Connectivity (JDBC) / Oracle Call Interface (OCI)	JDK 8 (Java SE Development Kit) with the JNDI extension with Oracle Java Database Connectivity.
Pro*COBOL	Micro Focus Visual COBOL v6.0 Micro Focus Server Express 5.1 Micro Focus Visual COBOL Development Hub 2.3 - Update 2

Installation Requirements for Web Browsers

Web browsers are required only if you intend to use Oracle Enterprise Manager Database Express and Oracle Enterprise Manager Cloud Control. Web browsers must support JavaScript, and the HTML 4.0 and CSS 1.0 standards.

https://support.oracle.com

Related Topics

- *Oracle Enterprise Manager Cloud Control Basic Installation Guide*

Checking Kernel and Package Requirements for Linux

Verify your kernel and packages to see if they meet minimum requirements for installation.

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1. To determine the distribution and version of Linux installed, enter one of the following commands:

```
# cat /etc/oracle-release
# cat /etc/redhat-release
# cat /etc/os-release
# lsb_release -id
```

2. To determine if the required kernel errata is installed, enter the following command:

```
# uname -r
```

The following is an example of the output this command displays on an Oracle Linux 7 system:

```
4.14.35-1902.0.18.el7uek.x86_6
```

Review the required errata level for your distribution. If the errata level is previous to the required minimum errata update, then obtain and install the latest kernel update from your Linux distributor.

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

```
# rpm -q package_name
```

Alternatively, if you require specific system architecture information, then enter the following command:

```
# rpm -qa --queryformat "%{NAME}-%{VERSION}-%{RELEASE} (%{ARCH})\n" | grep
package_name
```

You can also combine a query for multiple packages, and review the output for the correct versions. For example:

```
# rpm -q binutils compat-libstdc++ gcc glibc libaio libgcc libstdc++ \
make sysstat unixodbc
```

If a package is not installed, then install it from your Linux distribution media or download the required package version from your Linux distributor's website.

Setting Clock Source for VMs on Linux x86-64

Oracle recommends that you set the clock source to `tsc` for better performance in virtual environments (VM) on Linux x86-64.

1. As the `root` user, check if the `tsc` clock source is available on your system.

```
# cat /sys/devices/system/clocksource/clocksource0/available_clocksource
kvm-clock tsc acpi_pm
```

2. If the `tsc` clock source is available, then set `tsc` as the current clock source.

```
# echo "tsc">/sys/devices/system/clocksource/clocksource0/
current_clocksource
```


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3. Verify that the current clock source is set to `tsc`.

   ```
   # cat /sys/devices/system/clocksource/clocksource0/current_clocksource
   tsc
   ```

4. Using any text editor, append the `clocksource` directive to the `GRUB_CMDLINE_LINUX` line in the `/etc/default/grub` file to retain this clock source setting even after a reboot.

   ```
   GRUB_CMDLINE_LINUX="rd.lvm.lv=ol/root rd.lvm.lv=ol/swap rhgb quiet
   numa=off transparent_hugepage=never clocksource=tsc"
   ```

5. Run the following command to update `GRUB` and ensure that these settings are retained even after a reboot:

   ```
   # grub2-mkconfig -o /boot/grub2/grub.cfg
   ```

Confirming Host Name Resolution

Check to ensure that the host name for your server is resolvable.

Typically, the computer on which you want to install Oracle Database is connected to a network. Ensure that the computer host name is resolvable, either through a Domain Name System (DNS), a network information service (NIS), or a centrally-maintained TCP/IP host file, such as `/etc/hosts`. Use the `ping` command to ensure that your computer host name is resolvable. For example:

```
ping myhostname
pinging myhostname.example.com [192.0.2.2] with 32 bytes of data:
Reply from 192.0.2.2: bytes=32 time=138ms TTL=56
```

Related Topics

- Configuring Networks for Oracle Database
  If you install Oracle Databases on servers with multiple Oracle homes, multiple aliases, or without a static IP address, then review these network configuration topics.

Setting and Disabling Transparent HugePages on UEK Kernels

Learn when to set Transparent HugePages and when to disable Transparent HugePages depending on your UEK kernel version.

- Setting Transparent HugePages to madvise
  Transparent HugePages memory is enabled by default with Oracle Linux. However, for optimal performance, Oracle recommends that you set Transparent HugePages to `madvise` on all Oracle Database servers running UEK7 and later kernels before you start the installation.
- Disabling Transparent HugePages
  On Oracle Database servers running UEK release earlier than UEK7, Oracle recommends that you disable Transparent HugePages before you start installation.

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Setting Transparent HugePages to madvise

Transparent HugePages memory is enabled by default with Oracle Linux. However, for optimal performance, Oracle recommends that you set Transparent HugePages to `madvise` on all Oracle Database servers running UEK7 and later kernels before you start the installation.

On Oracle Database servers running UEK release earlier than UEK7, Oracle recommends that you disable Transparent HugePages before you start the installation. See Disabling Transparent HugePages. Later on, if the UEK version is upgraded to UEK7 or later, apply the steps in this topic.

If you install Oracle Database Preinstallation RPM, then it sets Transparent HugePages to `madvise` on all Oracle Database servers running UEK7 and later kernels.

To set `madvise` on Transparent HugePages:

1. For Oracle Linux and Red Hat Enterprise Linux, add or modify the `transparent_hugepage=madvise` parameter in the `/etc/default/grub` file. For example:

   ```
   GRUB_TIMEOUT=5
   GRUB_DISTRIBUTOR="$(sed 's, release .*$,,g' /etc/system-release)"
   GRUB_DEFAULT=saved
   GRUB_DISABLE_SUBMENU=true
   GRUB_TERMINAL_OUTPUT="console"
   GRUB_CMDLINE_LINUX="crashkernel=auto rhgb quiet
   transparent_hugepage=madvise"
   GRUB_DISABLE_RECOVERY="true"
   ```

   > **Note**
   >
   > The file name may vary depending on your operating system and hardware. For example, on Oracle Cloud Infrastructure (OCI) the `grub.cfg` file is located at `/boot/efi/EFI/redhat/`. Check your operating system documentation for the exact file name.

2. Run the `grub2-mkconfig` command to regenerate the `grub.cfg` file.

   On Oracle Linux 8:

   ```
   # grub2-mkconfig -o /boot/grub2/grub.cfg
   ```

   On Oracle Linux 9 and later:

   ```
   grub2-mkconfig -o /boot/grub2/grub.cfg --update-bls-cmdline
   ```

3. Restart the system to make the changes permanent. If you do not want to restart your system, then enter the following command:

   ```
   # echo madvise >
         /sys/kernel/mm/transparent_hugepage/enabled
   ```

4. To check if Transparent HugePages is enabled and configured with `madvise`, run one of the following commands as the `root` user:

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Oracle Linux kernels:

```
# cat /sys/kernel/mm/transparent_hugepage/enabled
```

Red Hat Enterprise Linux kernels:

```
# cat /sys/kernel/mm/redhat_transparent_hugepage/enabled
```

The following is a sample output that shows Transparent HugePages is being used and set to `madvise`.

```
always [madvise] never
```

Disabling Transparent HugePages

On Oracle Database servers running UEK release earlier than UEK7, Oracle recommends that you disable Transparent HugePages before you start installation.

Transparent HugePages memory differs from standard HugePages memory because the kernel `khugepaged` thread allocates memory dynamically during runtime. Standard HugePages memory is pre-allocated at startup, and does not change during runtime.

> **Note**
>
> Although Transparent HugePages is disabled on UEK2 and later UEK kernels, Transparent HugePages may be enabled by default on your Linux system.

Transparent HugePages memory is enabled by default with Oracle Linux 6 and later, Red Hat Enterprise Linux 6 and later, SUSE 11 and later, kernels.

Transparent HugePages can cause memory allocation delays during runtime. To avoid performance issues, Oracle recommends that you disable Transparent HugePages on all Oracle Database servers. Oracle recommends that you instead use standard HugePages for enhanced performance.

To check if Transparent HugePages is enabled, run one of the following commands as the `root` user:

Red Hat Enterprise Linux kernels:

```
# cat /sys/kernel/mm/redhat_transparent_hugepage/enabled
```

Other kernels:

```
# cat /sys/kernel/mm/transparent_hugepage/enabled
```

The following is a sample output that shows Transparent HugePages are being used as the [always] flag is enabled.

```
[always] never
```


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> **Note**
>
> If Transparent HugePages is removed from the kernel, then neither `/sys/kernel/mm/transparent_hugepage` nor `/sys/kernel/mm/redhat_transparent_hugepage files` exist.

To disable Transparent HugePages:

1. For Oracle Linux 7, Oracle Linux 8, Red Hat Enterprise Linux 7, and Red Hat Enterprise Linux 8, add or modify the `transparent_hugepage=never` parameter in the `/etc/default/grub` file:

   ```
   transparent_hugepage=never
   ```

   For example:

   ```
   GRUB_TIMEOUT=5
   GRUB_DISTRIBUTOR="$(sed 's, release .*$,,g' /etc/system-release)"
   GRUB_DEFAULT=saved
   GRUB_DISABLE_SUBMENU=true
   GRUB_TERMINAL_OUTPUT="console"
   GRUB_CMDLINE_LINUX="crashkernel=auto rhgb quiet transparent_hugepage=never"
   GRUB_DISABLE_RECOVERY="true"
   ```

   > **Note**
   >
   > The file name may vary for your operating systems. Check your operating system documentation for the exact file name and the steps to disable Transparent HugePages.

2. Run the `grub2-mkconfig` command to regenerate the `grub.cfg` file.

   ```
   # grub2-mkconfig -o /boot/grub2/grub.cfg
   ```

3. Restart the system to make the changes permanent.

Using Automatic SSH Configuration During Installation

To install Oracle software, configure secure shell (SSH) connectivity between all cluster member nodes.

Oracle Universal Installer (OUI) uses the `ssh` and `sftp` commands during installation to run remote commands on and copy files to the other cluster nodes. You must configure SSH so that these commands do not prompt for a password.

> **Note**
>
> Oracle configuration assistants use SSH for configuration operations from local to remote nodes. Oracle Enterprise Manager also uses SSH. RSH is no longer supported.

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You can configure SSH from the OUI interface during installation for the user account running the installation. The automatic configuration creates passwordless SSH connectivity between all cluster member nodes. Oracle recommends that you use the automatic procedure if possible.

To enable the script to run, you must remove `stty` commands from the profiles of any existing Oracle software installation owners you want to use, and remove other security measures that are triggered during a login, and that generate messages to the terminal. These messages, mail checks, and other displays prevent Oracle software installation owners from using the SSH configuration script that is built into OUI. If they are not disabled, then SSH must be configured manually before an installation can be run.

In rare cases, Oracle Clusterware installation can fail during the "AttachHome" operation when the remote node closes the SSH connection. To avoid this problem, set the timeout wait to unlimited by setting the following parameter in the SSH daemon configuration file `/etc/ssh/sshd_config` on all cluster nodes:

```
LoginGraceTime 0
```

Related Topics

- Preventing Installation Errors Caused by Terminal Output Commands
  During an Oracle Grid Infrastructure installation, OUI uses SSH to run commands and copy files to the other nodes. During the installation, hidden files on the system (for example, `.bashrc` or `.cshrc`) can cause `makefile` and other installation errors if they contain terminal output commands.

Verifying the Disk I/O Scheduler on Linux 8 and Later Systems

Disk I/O schedulers reorder, delay, or merge requests for disk I/O to achieve better throughput and lower latency.

Linux has multiple disk I/O schedulers available, including `mq-deadline`, `none`, `kyber`, and `bfq` on Oracle Linux 8 and later, RHEL 8 and later, and SUSE Linux Enterprise Server 15 and later systems. You should consult with your storage vendor for the appropriate I/O scheduler configuration to achieve best performance on Oracle Automatic Storage Management (Oracle ASM).

In general, Oracle recommends that you set the I/O Scheduler to `mq-deadline` for rotating storage devices (HDDs) and to `none` for non-rotating storage devices such as SSDs and NVMe on Oracle Linux 8 and later, RHEL 8 and later, and SUSE Linux Enterprise Server 15 and later systems.

On all cluster nodes, enter the following command as `root` to verify the configured disk I/O scheduler value.

```
cat /sys/block/${ASM_DISK}/queue/scheduler
none [mq-deadline] kyber bfq
```

In this example, the default disk I/O scheduler is `mq-deadline` and `ASM_DISK` is a rotational Oracle ASM disk device.

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> **Note**
>
> Contact your storage vendor for more information about how to configure I/O scheduler on Linux for your storage devices.

Verifying the Disk I/O Scheduler on Linux 7 Systems

Disk I/O schedulers reorder, delay, or merge requests for disk I/O to achieve better throughput and lower latency.

Linux has multiple disk I/O schedulers available, including `deadline`, `noop`, `anticipatory`, and Completely Fair Queuing (`cfq`) on Oracle Linux 7, Red Hat Enterprise Linux 7, and SUSE Linux Enterprise Server 12 systems. You should consult with your storage vendor for the appropriate I/O scheduler configuration to achieve best performance on Oracle Automatic Storage Management (Oracle ASM).

In general, Oracle recommends that you set the I/O Scheduler to `deadline` for rotating storage devices (HDDs) and to `none` for non-rotating storage devices such as SSDs and NVMe on Oracle Linux 7, Red Hat Enterprise Linux 7, and SUSE Linux Enterprise Server 12 systems.

On each cluster node, enter the following command as `root` to verify the configured disk I/O scheduler value.

```
cat /sys/block/${ASM_DISK}/queue/scheduler
noop [deadline] cfq
```

In this example, the default disk I/O scheduler is `deadline` and `ASM_DISK` is a rotational Oracle ASM disk device.

> **Note**
>
> Contact your storage vendor for more information about how to configure I/O scheduler on Linux for your storage devices.

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5

Configuring Users, Groups and Environments for Oracle Grid Infrastructure and Oracle Database

Before installation, create operating system groups and users, and configure user environments.

- Required Operating System Groups and Users
  Oracle software installations require an installation owner, an Oracle Inventory group, which is the primary group of all Oracle installation owners, and at least one group designated as a system privileges group.
- Oracle Installations with Standard and Job Role Separation Groups and Users
  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.
- Creating Operating System Privileges Groups
  The following sections describe how to create operating system groups for Oracle Grid Infrastructure and Oracle Database:
- Creating Operating System Oracle Installation User Accounts
  Before starting installation, create Oracle software owner user accounts, and configure their environments.
- Creating Oracle Database Vault User Accounts
  If you intend to use Oracle Database Vault by default, then you must create an Oracle Database Vault user account, and configure that user.
- Unsetting Oracle Installation Owner Environment Variables
  Unset Oracle installation owner environment variables before you start the installation.

Required Operating System Groups and Users

Oracle software installations require an installation owner, an Oracle Inventory group, which is the primary group of all Oracle installation owners, and at least one group designated as a system privileges group.

Review group and user options with your system administrator. If you have system administration privileges, then review the topics in this section and configure operating system groups and users as needed.

- Determining If an Oracle Inventory and Oracle Inventory Group Exist
  Determine if you have an existing Oracle central inventory, and ensure that you use the same Oracle Inventory for all Oracle software installations. Also, ensure that all Oracle software users you intend to use for installation have permissions to write to this directory.
- Creating the Oracle Inventory Group If an Oracle Inventory Does Not Exist
  Create an Oracle Inventory group manually as part of a planned installation, particularly where more than one Oracle software product is installed on servers.

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- About Oracle Installation Owner Accounts
  Select or create an Oracle installation owner for your installation, depending on the group and user management plan you want to use for your installations.
- Identifying an Oracle Software Owner User Account
  You must create at least one software owner user account the first time you install Oracle software on the system. Either use an existing Oracle software user account, or create an Oracle software owner user account for your installation.

Determining If an Oracle Inventory and Oracle Inventory Group Exist

Determine if you have an existing Oracle central inventory, and ensure that you use the same Oracle Inventory for all Oracle software installations. Also, ensure that all Oracle software users you intend to use for installation have permissions to write to this directory.

When you install Oracle software on the system for the first time, OUI creates the `oraInst.loc` file. This file identifies the name of the Oracle Inventory group (by default, `oinstall`), and the path of the Oracle central inventory directory. If you have an existing Oracle central inventory, then ensure that you use the same Oracle Inventory for all Oracle software installations, and ensure that all Oracle software users you intend to use for installation have permissions to write to this directory.

```
oraInst.loccentral_inventory_locationgroup

inventory_loc=central_inventory_location
inst_group=group
```

Use the `more` command to determine if you have an Oracle central inventory on your system. For example:

```
# more /etc/oraInst.loc

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

Use the command `grep groupname /etc/group` to confirm that the group specified as the Oracle Inventory group still exists on the system. For example:

```
$ grep oinstall /etc/group
oinstall:x:54321:grid,oracle
```

> **Note**
>
> Do not put the `oraInventory` directory under the Oracle base directory for a new installation, because that can result in user permission errors for other installations.

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

Create an Oracle Inventory group manually as part of a planned installation, particularly where more than one Oracle software product is installed on servers.

By default, if an oraInventory group does not exist, then the installer uses the primary group of the installation owner for the Oracle software being installed as the oraInventory group. Ensure

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that this group is available as a primary group for all planned Oracle software installation owners.

`oraInst.loc`

```
# /usr/sbin/groupadd -g 54321 oinstall
```

About Oracle Installation Owner Accounts

Select or create an Oracle installation owner for your installation, depending on the group and user management plan you want to use for your installations.

You must create a software owner for your installation in the following circumstances:

- If an Oracle software owner user does not exist; for example, if this is the first installation of Oracle software on the system.
- If an Oracle software owner user exists, but you want to use a different operating system user, with different group membership, to separate Oracle Grid Infrastructure administrative privileges from Oracle Database administrative privileges.

In Oracle documentation, a user created to own only Oracle Grid Infrastructure software installations is called the Grid user (`grid`). This user owns both the Oracle Clusterware and Oracle Automatic Storage Management binaries. A user created to own either all Oracle installations, or one or more Oracle database installations, is called the Oracle user (`oracle`). You can have only one Oracle Grid Infrastructure installation owner, but you can have different Oracle users to own different installations.

Oracle software owners must have the Oracle Inventory group as their primary group, so that each Oracle software installation owner can write to the central inventory (oraInventory), and so that OCR and Oracle Clusterware resource permissions are set correctly. The database software owner must also have the OSDBA group and (if you create them) the OSOPER, OSBACKUPDBA, OSDGDBA, OSRACDBA, and OSKMDBA groups as secondary groups.

Identifying an Oracle Software Owner User Account

You must create at least one software owner user account the first time you install Oracle software on the system. Either use an existing Oracle software user account, or create an Oracle software owner user account for your installation.

To use an existing user account, obtain the name of an existing Oracle installation owner from your system administrator. Confirm that the existing owner is a member of the Oracle Inventory group.

For example, if you know that the name of the Oracle Inventory group is `oinstall`, then an Oracle software owner should be listed as a member of `oinstall`:

```
$ grep "oinstall" /etc/group
oinstall:x:54321:grid,oracle
```

You can then use the ID command to verify that the Oracle installation owners you intend to use have the Oracle Inventory group as their primary group. For example:

```
$ id oracle
uid=54321(oracle) gid=54321(oinstall) groups=54321(oinstall),54322(dba),
```


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```
54323(oper),54324(backupdba),54325(dgdba),54326(kmdba),54327(asmdba),54330(rac
dba)


$ id grid
uid=54331(grid) gid=54321(oinstall)
groups=54321(oinstall),54327(asmdba),54329(asmadmin),54330(racdba)
```

> **Note**
>
> For Oracle Restart installations, to successfully install Oracle Database, ensure that the `grid` user is a member of the `racdba` group.

After you create operating system groups, create or modify Oracle user accounts in accordance with your operating system authentication planning.

Related Topics

- Creating an Oracle Software Owner User
  If the Oracle software owner user (`oracle` or `grid`) does not exist, or if you require a new Oracle software owner user, then create it as described in this section.
- Modifying Oracle Owner User Groups
  If you have created an Oracle software installation owner account, but it is not a member of the groups you want to designate as the OSDBA, OSOPER, OSDBA for ASM, ASMADMIN, or other system privileges group, then modify the group settings for that user before installation.

Oracle Installations with Standard and Job Role Separation Groups and Users

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.

Review the following sections to understand more about a Job Role Separation deployment:

- About Oracle Installations with Job Role Separation
  Job role separation requires that you create different operating system groups for each set of system privileges that you grant through operating system authorization.
- Standard Oracle Database Groups for Database Administrators
  Oracle Database has two standard administration groups: OSDBA, which is required, and OSOPER, which is optional.
- Extended Oracle Database Groups for Job Role Separation
  Oracle Database provides an extended set of database groups to grant task-specific system privileges for database administration.
- Creating an ASMSNMP User
  The `ASMSNMP` user is an Oracle ASM user with privileges to monitor Oracle ASM instances. You are prompted to provide a password for this user during installation.
- Oracle Automatic Storage Management Groups for Job Role Separation
  Oracle Grid Infrastructure operating system groups provide their members task-specific system privileges to access and to administer Oracle Automatic Storage Management.

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About Oracle Installations with Job Role Separation

Job role separation requires that you create different operating system groups for each set of system privileges that you grant through operating system authorization.

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

With Oracle Database job role separation, each Oracle Database installation has separate operating system groups to provide authorization for system privileges on that Oracle Database. Multiple databases can, therefore, be installed on the cluster without sharing operating system authorization for system privileges. In addition, each Oracle software installation is owned by a separate installation owner, to provide operating system user authorization for modifications to Oracle Database binaries. Note that any Oracle software owner can start and stop all databases and shared Oracle Grid Infrastructure resources such as Oracle ASM or Virtual IP (VIP). Job role separation configuration enables database security, and does not restrict user roles in starting and stopping various Oracle Clusterware resources.

You can choose to create one administrative user and one group for operating system authentication for all system privileges on the storage and database tiers. For example, you can designate the `oracle` user to be the installation owner for all Oracle software, and designate `oinstall` to be the group whose members are granted all system privileges for Oracle Clusterware; all system privileges for Oracle ASM; all system privileges for all Oracle Databases on the servers; and all `OINSTALL` system privileges for installation owners. This group must also be the Oracle Inventory group.

If you do not want to use role allocation groups, then Oracle strongly recommends that you use at least two groups:

- A system privileges group whose members are granted administrative system privileges, including OSDBA, OSASM, and other system privileges groups.
- An installation owner group (the `oraInventory` group) whose members are granted Oracle installation owner system privileges (the `OINSTALL` system privilege).

> **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.

Related Topics

- *Oracle Database Administrator's Guide*
- *Oracle Automatic Storage Management Administrator's Guide*

Standard Oracle Database Groups for Database Administrators

Oracle Database has two standard administration groups: OSDBA, which is required, and OSOPER, which is optional.

- The OSDBA group (typically, `dba`)

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

If you do not create separate OSDBA, OSOPER, and OSASM groups for the Oracle ASM instance, then operating system user accounts that have the SYSOPER and SYSASM privileges must be members of this group. The name used for this group in Oracle code examples is dba. If you do not designate a separate group as the OSASM group, then the OSDBA group you define is also by default the OSASM group.

- The OSOPER group for Oracle Database (typically, oper)

  OSOPER grants the OPERATOR privilege to start up and shut down the database (the SYSOPER privilege). By default, members of the OSDBA group have all privileges granted by the SYSOPER privilege.

Extended Oracle Database Groups for Job Role Separation

Oracle Database provides an extended set of database groups to grant task-specific system privileges for database administration.

The extended set of Oracle Database system privileges groups are task-specific and less privileged than the OSDBA/SYSDBA system privileges. They are designed to provide privileges to carry out everyday database operations. Users granted these system privileges are also authorized through operating system group membership.

You do not have to create these specific group names, but during interactive and silent installation, you must assign operating system groups whose members are granted access to these system privileges. You can assign the same group to provide authorization for these privileges, but Oracle recommends that you provide a unique group to designate each privilege.

The subset of OSDBA job role separation privileges and groups consist of the following:

- OSBACKUPDBA group for Oracle Database (typically, backupdba)

  Create 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 (typically, dgdba)

  Create 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). To use this privilege, add the Oracle Database installation owners as members of this group.

- The OSKMDBA group for encryption key management (typically, kmdba)

  Create 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). To use this privilege, add the Oracle Database installation owners as members of this group.

- The OSRACDBA group for Oracle Real Application Clusters Administration (typically, racdba)

  Create this group if you want a separate group of operating system users to have a limited set of Oracle Real Application Clusters (RAC) administrative privileges (the SYSRAC privilege). To use this privilege:

  – Add the Oracle Database installation owners as members of this group.

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  - For Oracle Restart configurations, if you have a separate Oracle Grid Infrastructure installation owner user (`grid`), then you must also add the `grid` user as a member of the OSRACDBA group of the database to enable Oracle Grid Infrastructure components to connect to the database.

Related Topics

- *Oracle Database Administrator's Guide*
- *Oracle Database Security Guide*

Creating an ASMSNMP User

The `ASMSNMP` user is an Oracle ASM user with privileges to monitor Oracle ASM instances. You are prompted to provide a password for this user during installation.

In addition to the OSASM group, whose members are granted the SYSASM system privilege to administer Oracle ASM, Oracle recommends that you create a less privileged user, `ASMSNMP`, and grant that user SYSDBA privileges to monitor the Oracle ASM instance. Oracle Enterprise Manager uses the `ASMSNMP` user to monitor Oracle ASM status.

During installation, you are prompted to provide a password for the `ASMSNMP` user. You can create an operating system authenticated user, or you can create an Oracle Database user called `asmsnmp`. In either case, grant the user SYSDBA privileges.

Oracle Automatic Storage Management Groups for Job Role Separation

Oracle Grid Infrastructure operating system groups provide their members task-specific system privileges to access and to administer Oracle Automatic Storage Management.

- The OSASM group for Oracle ASM Administration (typically, `asmadmin`)

  Create this group as a separate group to separate administration privileges groups for Oracle ASM and Oracle Database administrators. Members of this group are granted the SYSASM system privileges to administer Oracle ASM. 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, it is referred to as `asmadmin`.

  Oracle ASM can support multiple databases. If you have multiple databases on your system, and use multiple OSDBA groups so that you can provide separate SYSDBA privileges for each database, then you should create a group whose members are granted the OSASM/SYSASM administrative privileges, and create a grid infrastructure user (grid) that does not own a database installation, so that you separate Oracle Grid Infrastructure SYSASM administrative privileges from a database administrative privileges group.

  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 RDBMS instance.

  If you do not designate a separate group as the OSASM group, but you do define an OSDBA group for database administration, then by default the OSDBA group you define is also defined as the OSASM group.

- The OSOPER group for Oracle ASM (typically, `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 instance administrative privileges (the SYSOPER for ASM privilege), including starting up and stopping the Oracle ASM instance.

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By default, members of the OSASM group also have all privileges granted by the SYSOPER for ASM privilege.

Creating Operating System Privileges Groups

The following sections describe how to create operating system groups for Oracle Grid Infrastructure and Oracle Database:

- Creating the OSDBA for ASM Group
  You must designate a group as the OSDBA for ASM (`asmdba`) group during installation. Members of this group are also allowed to access the Oracle Automatic Storage Management (Oracle ASM) disk devices.
- Creating the OSOPER for ASM Group
  You can choose to designate a group as the OSOPER for ASM group (`asmoper`) during installation. Members of this group are granted startup and shutdown privileges to Oracle Automatic Storage Management.
- Creating the OSDBA Group for Database Installations
  Each Oracle Database requires an operating system group to be designated as the OSDBA group. Members of this group are granted the SYSDBA system privileges to administer the database.
- Creating an OSOPER Group for Database Installations
  Create an OSOPER group only if you want to identify a group of operating system users with a limited set of database administrative privileges (SYSOPER operator privileges).
- Creating the OSBACKUPDBA Group for Database Installations
  You must designate a group as the OSBACKUPDBA group during installation. Members of this group are granted the SYSBACKUP privileges to perform backup and recovery operations using RMAN or SQL*Plus.
- Creating the OSDGDBA Group for Database Installations
  You must designate a group as the OSDGDBA group during installation. Members of this group are granted the SYSDG privileges to perform Data Guard operations.
- Creating the OSKMDBA Group for Database Installations
  You must designate a group as the OSKMDBA group during installation. Members of this group are granted the SYSKM privileges to perform Transparent Data Encryption keystore operations.
- Creating the OSRACDBA Group for Database Installations
  You must designate a group as the OSRACDBA group during database installation. Members of this group are granted the SYSRAC privileges to perform day–to–day administration of Oracle databases on an Oracle RAC cluster.

Creating the OSDBA for ASM Group

You must designate a group as the OSDBA for ASM (`asmdba`) group during installation. Members of this group are also allowed to access the Oracle Automatic Storage Management (Oracle ASM) disk devices.

The Oracle ASM disk devices should be owned by this group.

Create an OSDBA for ASM group using the group name `asmdba` unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54327 asmdba
```


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Creating the OSOPER for ASM Group

You can choose to designate a group as the OSOPER for ASM group (`asmoper`) during installation. Members of this group are granted startup and shutdown privileges to Oracle Automatic Storage Management.

If you want to create an OSOPER for ASM group, use the group name `asmoper` unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54328 asmoper
```

Creating the OSDBA Group for Database Installations

Each Oracle Database requires an operating system group to be designated as the OSDBA group. Members of this group are granted the SYSDBA system privileges to administer the database.

You must create an OSDBA group in the following circumstances:

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

Create the OSDBA group using the group name `dba`, unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54322 dba
```

Creating an OSOPER Group for Database Installations

Create an OSOPER group only if you want to identify a group of operating system users with a limited set of database administrative privileges (SYSOPER operator privileges).

For most installations, it is sufficient to create only the OSDBA group. However, to use an OSOPER group, create it in the following circumstances:

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

If the OSOPER group does not exist, or if you require a new OSOPER group, then create it. Use the group name `oper` unless a group with that name already exists. For example:

```
# groupadd -g 54323 oper
```


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Creating the OSBACKUPDBA Group for Database Installations

You must designate a group as the OSBACKUPDBA group during installation. Members of this group are granted the SYSBACKUP privileges to perform backup and recovery operations using RMAN or SQL*Plus.

Create the OSBACKUPDBA group using the group name `backupdba`, unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54324 backupdba
```

Creating the OSDGDBA Group for Database Installations

You must designate a group as the OSDGDBA group during installation. Members of this group are granted the SYSDG privileges to perform Data Guard operations.

Create the OSDGDBA group using the group name `dgdba`, unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54325 dgdba
```

Creating the OSKMDBA Group for Database Installations

You must designate a group as the OSKMDBA group during installation. Members of this group are granted the SYSKM privileges to perform Transparent Data Encryption keystore operations.

If you want a separate group for Transparent Data Encryption, then create the OSKMDBA group using the group name `kmdba` unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54326 kmdba
```

Creating the OSRACDBA Group for Database Installations

You must designate a group as the OSRACDBA group during database installation. Members of this group are granted the SYSRAC privileges to perform day–to–day administration of Oracle databases on an Oracle RAC cluster.

Create the OSRACDBA group using the groups name `racdba` unless a group with that name already exists:

```
# /usr/sbin/groupadd -g 54330 racdba
```

Creating Operating System Oracle Installation User Accounts

Before starting installation, create Oracle software owner user accounts, and configure their environments.

Oracle software owner user accounts require resource settings and other environment configuration. To protect against accidents, Oracle recommends that you create one software installation owner account for each Oracle software program you install.

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- Creating an Oracle Software Owner User
  If the Oracle software owner user (`oracle` or `grid`) does not exist, or if you require a new Oracle software owner user, then create it as described in this section.
- Environment Requirements for Oracle Software Owners
  You must make the following changes to configure Oracle software owner environments:
- Procedure for Configuring Oracle Software Owner Environments
  Configure each Oracle installation owner user account environment:
- Modifying Oracle Owner User Groups
  If you have created an Oracle software installation owner account, but it is not a member of the groups you want to designate as the OSDBA, OSOPER, OSDBA for ASM, ASMADMIN, or other system privileges group, then modify the group settings for that user before installation.
- Checking Resource Limits for Oracle Software Installation Users
  For each installation software owner user account, check the resource limits for installation.
- Setting Remote Display and X11 Forwarding Configuration
  If you are on a remote terminal, and the local system has only one visual (which is typical), then use the following syntax to set your user account `DISPLAY` environment variable:
- Preventing Installation Errors Caused by Terminal Output Commands
  During an Oracle Grid Infrastructure installation, OUI uses SSH to run commands and copy files to the other nodes. During the installation, hidden files on the system (for example, `.bashrc` or `.cshrc`) can cause `makefile` and other installation errors if they contain terminal output commands.

Creating an Oracle Software Owner User

If the Oracle software owner user (`oracle` or `grid`) does not exist, or if you require a new Oracle software owner user, then create it as described in this section.

The following example shows how to create the user `oracle` with the user ID 54321; with the primary group `oinstall`; and with secondary groups `dba`, `asmdba`, `backupdba`, `dgdba`, `kmdba`, and `racdba`:

```
# /usr/sbin/useradd -u 54321 -g oinstall -G
dba,asmdba,backupdba,dgdba,kmdba,racdba oracle
```

The following example shows how to create the user `grid` with the user ID 54331; with the primary group `oinstall`; and with secondary groups `asmadmin`, `asmdba`, and `racdba`:

```
# /usr/sbin/useradd -u 54331 -g oinstall -G asmadmin,asmdba,racdba grid
```

You must note the user ID number for installation users, because you need it during preinstallation.

Environment Requirements for Oracle Software Owners

You must make the following changes to configure Oracle software owner environments:

- Set the installation software owner user (`grid`, `oracle`) default file mode creation mask (umask) to 022 in the shell startup file. Setting the mask to 022 ensures that the user performing the software installation creates files with 644 permissions.

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- Set ulimit settings for file descriptors and processes for the installation software owner (`grid`, `oracle`).
- Set the DISPLAY environment variable in preparation for running an Oracle Universal Installer (OUI) installation.

> ⚠ **Caution**
>
> If you have existing Oracle installations that you installed with the user ID that is your Oracle Grid Infrastructure software owner, then unset all Oracle environment variable settings for that user.

Procedure for Configuring Oracle Software Owner Environments

Configure each Oracle installation owner user account environment:

1. Start an X terminal session (`xterm`) on the server where you are running the installation.
2. Enter the following command to ensure that X Window applications can display on this system, where hostname is the fully qualified name of the local host from which you are accessing the server:

   ```
   $ xhost + hostname
   ```

3. If you are not logged in as the software owner user, then switch to the software owner user you are configuring. For example, with the user `grid`:

   ```
   $ su - grid
   ```

   On systems where you cannot run `su` commands, use `sudo` instead:

   ```
   $ sudo -u grid -s
   ```

4. To determine the default shell for the user, enter the following command:

   ```
   $ echo $SHELL
   ```

5. Open the user's shell startup file in any text editor:
   - Bash shell (`bash`):

     ```
     $ vi .bash_profile
     ```

   - Bourne shell (`sh`) or Korn shell (`ksh`):

     ```
     $ vi .profile
     ```

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

     ```
     % vi .login
     ```


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

   ```
   umask 022
   ```

7. If the `ORACLE_SID`, `ORACLE_HOME`, or `ORACLE_BASE` environment variables are set in the file, then remove these lines from the file.
8. Save the file, and exit from the text editor.
9. To run the shell startup script, enter one of the following commands:
   - Bash shell:

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

   - Bourne, Bash, or Korn shell:

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

   - C shell:

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

10. Use the following command to check the PATH environment variable:

    ```
    $ echo $PATH
    ```

    Remove any Oracle environment variables.
11. Unset any Oracle environment variables.

    If you have an existing Oracle software installation, and you are using the same user to install this installation, then unset the $ORACLE_HOME, $ORA_NLS10, and $TNS_ADMIN environment variables.

    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, except as directed by Oracle Support.
12. If you are not installing the software on the local system, then enter a command similar to the following to direct X applications to display on the local system:
    - Bourne, Bash, or Korn shell:

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

    - C shell:

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

    In this example, `local_host` is the host name or IP address of the system (your workstation, or another client) on which you want to display the installer.
13. If the `/tmp` directory has less than 1 GB of free space, then identify a file system with at least 1 GB of free space and set the `TMP` and `TMPDIR` environment variables to specify a temporary directory on this file system:

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

a. Use the `df -h` command to identify a suitable file system with sufficient free space.

b. If necessary, enter commands similar to the following to create a temporary directory on the file system that you identified, and set the appropriate permissions on the directory:

```
$ sudo -s
# mkdir /mount_point/tmp
# chmod 775 /mount_point/tmp
# exit
```

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

Bourne, Bash, or Korn shell:

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

C shell:

```
% setenv TMP /mount_point/tmp
% setenv TMPDIR /mount_point/tmp
```

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

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

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

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Modifying Oracle Owner User Groups

If you have created an Oracle software installation owner account, but it is not a member of the groups you want to designate as the OSDBA, OSOPER, OSDBA for ASM, ASMADMIN, or other system privileges group, then modify the group settings for that user before installation.

> **Warning**
>
> Each Oracle software owner must be a member of the same central inventory group. Do not modify the primary group of an existing Oracle software owner account, or designate different groups as the OINSTALL group. If Oracle software owner accounts have different groups as their primary group, then you can corrupt the central inventory.

During installation, the user who is installing the software should have the OINSTALL group as its primary group, and it must be a member of the operating system groups appropriate for your installation. For example:

```
# /usr/sbin/usermod -g oinstall -G
dba,asmdba,backupdba,dgdba,kmdba,racdba[,oper] oracle
```

Checking Resource Limits for Oracle Software Installation Users

For each installation software owner user account, check the resource limits for installation.

On Oracle Linux systems, Oracle recommends that you install Oracle Database Preinstallation RPMs to meet preinstallation requirements like configuring your operating system to set the resource limits in the `limits.conf` file.

Use the following ranges as guidelines for resource allocation to Oracle software installation owners for standard installations and to Oracle Grid Infrastructure software installation owners for job role separation:

Table 5-1 Oracle Software Installation Owner and Oracle Grid Infrastructure Software Installation Owner Resource Limit Recommended Ranges

Resource Shell Limit	Resource	Soft Limit	Hard Limit
Open file descriptors	nofile	at least 1024	at least 65536
Number of processes available to a single user	nproc	at least 2047	at least 16384
Size of the stack segment of the process	stack	at least 10240 KB	at least 10240 KB, and at most 32768 KB

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Table 5-1 (Cont.) Oracle Software Installation Owner and Oracle Grid Infrastructure Software Installation Owner Resource Limit Recommended Ranges

Resource Shell Limit	Resource	Soft Limit	Hard Limit
Maximum locked memory limit	memlock	at least 90 percent of the current RAM when HugePages memory is enabled and at least 3145728 KB (3 GB) when HugePages memory is disabled. **Note:** `unlimited` on Exadata systems.	at least 90 percent of the current RAM when HugePages memory is enabled and at least 3145728 KB (3 GB) when HugePages memory is disabled **Note:** `unlimited` on Exadata systems.

To check resource limits:

1. Log in as an installation owner.
2. Check the soft and hard limits for the file descriptor setting. Ensure that the result is in the recommended range. For example:

```
$ ulimit -Sn
1024
$ ulimit -Hn
65536
```

3. Check the soft and hard limits for the number of processes available to a user. Ensure that the result is in the recommended range. For example:

```
$ ulimit -Su
2047
$ ulimit -Hu
16384
```

4. Check the soft limit for the stack setting. Ensure that the result is in the recommended range. For example:

```
$ ulimit -Ss
10240
$ ulimit -Hs
32768
```

5. Repeat this procedure for each Oracle software installation owner.

If necessary, update the resource limits in the `/etc/security/limits.conf` configuration file for the installation owner. However, the configuration file may be distribution specific. Contact your system administrator for distribution specific configuration file information.

> **Note**
>
> If you make changes to an Oracle installation user account and that user account is logged in, then changes to the `limits.conf` file do not take effect until you log these users out and log them back in. You must do this before you use these accounts for installation.

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Setting Remote Display and X11 Forwarding Configuration

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

Remote Display

```
Bourne, Korn, and Bash shells

$ export DISPLAY=hostname:0


C shell

% setenv DISPLAY hostname:0
```

For example, if you are using the Bash shell and if your host name is `local_host`, then enter the following command:

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

X11 Forwarding

To ensure that X11 forwarding does not cause the installation to fail, use the following procedure to create a user-level SSH client configuration file for Oracle installation owner user accounts:

1. Using any text editor, edit or create the software installation owner's `~/.ssh/config file`.
2. Ensure that the `ForwardX11` attribute in the `~/.ssh/config` file is set to `no`. For example:

   ```
   Host *
       ForwardX11 no
   ```

3. Ensure that the permissions on `~/.ssh` are secured to the Oracle installation owner user account. For example:

   ```
   $ ls -al .ssh
   total 28
   drwx------  2 grid oinstall 4096 Jun 21 2020
   drwx------ 19 grid oinstall 4096 Jun 21 2020
   -rw-r--r--  1 grid oinstall 1202 Jun 21 2020 authorized_keys
   -rwx------  1 grid oinstall  668 Jun 21 2020 id_dsa
   -rwx------  1 grid oinstall  601 Jun 21 2020 id_dsa.pub
   -rwx------  1 grid oinstall 1610 Jun 21 2020 known_hosts
   ```

Preventing Installation Errors Caused by Terminal Output Commands

During an Oracle Grid Infrastructure installation, OUI uses SSH to run commands and copy files to the other nodes. During the installation, hidden files on the system (for

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example, `.bashrc` or `.cshrc`) can cause `makefile` and other installation errors if they contain terminal output commands.

To avoid this problem, you must modify hidden files in each Oracle installation owner user home directory to suppress all output on `STDOUT` or `STDERR` (for example, `stty`, `xtitle`, and other such commands) as in the following examples:

Bourne, Bash, or Korn shell:

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

C shell:

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

> **Note**
>
> If the remote shell can load hidden files that contain `stty` commands, then OUI indicates an error and stops the installation.

Creating Oracle Database Vault User Accounts

If you intend to use Oracle Database Vault by default, then you must create an Oracle Database Vault user account, and configure that user.

You must create the Database Vault Owner account before you can use Oracle Database Vault. You can also create a Database Vault Account Manager administrative account.

Oracle Database Vault installs a baseline database auditing policy. This policy covers the access control configuration information stored in Oracle Database Vault database tables, information stored in Oracle Catalog (rollback segments, tablespaces, and so on), the use of system privileges, and Oracle Label Security configuration. When you install Oracle Database Vault, the security specific database initialization parameters are initialized with default values.

Related Topics

- *Oracle Database Vault Administrator's Guide*

Unsetting Oracle Installation Owner Environment Variables

Unset Oracle installation owner environment variables before you start the installation.

The environment variables you have set for the Oracle installation owner account you use to run the installation can cause issues if they are set to values that conflict with the values needed for installation.

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

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ORA_CRS_HOME as an environment variable except under explicit direction from Oracle Support.

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, and any other environment variable set for the Oracle installation user that is connected with Oracle software homes.

Also, ensure that the `$ORACLE_HOME/bin` path is removed from your PATH environment variable.

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6

Configuring Networks for Oracle Database

If you install Oracle Databases on servers with multiple Oracle homes, multiple aliases, or without a static IP address, then review these network configuration topics.

If you are installing Oracle Database on a server with a static host name and IP address and at least one network interface, then no special network configuration is required.

> **Note**
>
> If you have a firewall running, ensure that all the required ports are open. See, Oracle Database Component Port Numbers and Protocols for a list of port numbers and protocols configured for Oracle Database components.

- About Oracle Database Network Configuration Options
  You can enable database clients to connect to servers associated with multiple IP addresses, and you can install Oracle Database on servers with no network connections, and set up database services after installation.
- About Assigning Global Database Names During Installation
  The database name input field is used to set the `DB_NAME`, `DB_UNIQUE_NAME`, and `DB_DOMAIN` Oracle initialization parameter values.
- Network Configuration for Computers Completed After Installation
  You must confirm that a non-networked computer can connect to itself to ensure that you can configure client network resolution after installation. A non-networked computer is a computer that does not have a fixed network address, such as a computer using DHCP.
- Network Configuration for Multihome Computers
  You must set the `ORACLE_HOSTNAME` environment variable to install Oracle Database on a multihomed computer. A multihomed computer is associated with multiple IP addresses.
- Setting the ORACLE_HOSTNAME Environment Variable
  Run the commands shown in this example as the Oracle user account to set the `ORACLE_HOSTNAME` environment variable.
- Network Configuration for Computers with Multiple Aliases
  You must set the `ORACLE_HOSTNAME` environment variable to install Oracle Database on a multialias computer. A multialias computer is one to which multiple aliases resolve.

About Oracle Database Network Configuration Options

You can enable database clients to connect to servers associated with multiple IP addresses, and you can install Oracle Database on servers with no network connections, and set up database services after installation.

Typically, the computer on which you want to install Oracle Database is a server running a single database instance, with a single host name that is resolvable on a network. Oracle Universal Installer uses the host name and Oracle Database instance information to set up

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network services automatically. The database provides database services to clients using a connect descriptor that resolves to the host name where the database instance is running.

However, you can configure Oracle Database on servers with the following nonstandard configurations:

- **Multihomed Computers**: Servers with multiple Oracle Database installations
- **Multiple Alias Computers**: Servers with multiple aliases, so that more than one host name resolves to the computer
- **Non-Networked computers**: Servers that do not have network connectivity at the time of installation

About Assigning Global Database Names During Installation

The database name input field is used to set the `DB_NAME`, `DB_UNIQUE_NAME`, and `DB_DOMAIN` Oracle initialization parameter values.

The Oracle Database software identifies a database by its global database name. A global database name consists of the database name and database domain. Usually, the database domain is the same as the network domain, but it need not be. The global database name uniquely distinguishes a database from any other database in the same network. You specify the global database name when you create a database during the installation or using the Oracle Database Configuration Assistant.

```
sales.us.example.com
```

Here:

- `sales.us` is the name of the database. The database name, `DB_UNIQUE_NAME`, portion is a string of no more than 30 characters that can contain alphanumeric characters, underscore (_), dollar sign ($), and pound sign (#) but must begin with an alphabetic character. No other special characters are permitted in a database name.
- `sales.us` is also the `DB_NAME`. The `DB_NAME` initialization parameter specifies a database identifier of up to eight characters.
- `example.com` is the database domain in which the database is located. In this example, the database domain equals the network domain. Together, the database name and the database domain make the global database name unique. The domain portion is a string of no more than 128 characters that can contain alphanumeric characters, underscore (_), and pound sign (#). The `DB_DOMAIN` initialization parameter specifies the database domain name.

However, the `DB_NAME` parameter need not necessarily be the first eight characters of `DB_UNIQUE_NAME`.

The `DB_NAME` parameter and the `DB_DOMAIN` parameter combine to create the global database name value.

The system identifier (SID) identifies a specific database instance. The SID uniquely distinguishes the instance from any other instance on the same computer. Each database instance requires a unique SID and database name. In most cases, the SID equals the database name portion of the global database name.

Related Topics

- *Oracle Database Reference*

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- *Oracle Database Administrator's Guide*

Network Configuration for Computers Completed After Installation

You must confirm that a non-networked computer can connect to itself to ensure that you can configure client network resolution after installation. A non-networked computer is a computer that does not have a fixed network address, such as a computer using DHCP.

You can install Oracle Database on a non-networked computer. If the computer, such as a laptop, is configured for DHCP and you plan to connect the computer to the network after the Oracle Database installation, then use the `ping` command on the computer on which you want to install the database to check if the computer can connect to itself. Perform this step by first using only the host name and then using the fully qualified name, which should be in the `/etc/hosts` file.

If you connect the computer to a network after installation, then the Oracle Database instance on the computer can work with other instances on the network. The computer can use a static IP or DHCP, depending on the network to which you are connected.

When you run the `ping` command on the computer itself, the ping command should return the IP address of the computer. If the `ping` command fails, then contact your network administrator.

Network Configuration for Multihome Computers

You must set the `ORACLE_HOSTNAME` environment variable to install Oracle Database on a multihomed computer. A multihomed computer is associated with multiple IP addresses.

Typically, a server configured to run multiple Oracle Database Oracle homes is configured with multiple network interface cards. A host name resolves to an IP address configured for one network card for each Oracle Database. You can also set up aliases for host names. By default, during installation, Oracle Universal Installer uses the value set for the environment variable `ORACLE_HOSTNAME` set for the Oracle installation user account running the installation to find the host name. If the user environment variable `ORACLE_HOSTNAME` is not set for the Oracle user, and you are installing on a computer that has multiple network cards, then Oracle Universal Installer determines the host name from the `/etc/hosts` file and the information you provide during the installation session.

Oracle Database clients connecting to the database must be able to access the computer by using either the alias for the host name, or by using the host name associated with that instance. To verify that the client can resolve to the database using both alias and host name, use the `ping` command to check connectivity to the host name both for the database on the server (host name only), and for the fully qualified domain name (host name and domain name).

> **Note**
>
> Clients must be able to obtain a response using the `ping` command both for the host name and for the fully qualified domain name. If either test fails, then contact your network administrator to resolve the issue.

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Setting the ORACLE_HOSTNAME Environment Variable

Run the commands shown in this example as the Oracle user account to set the ORACLE_HOSTNAME environment variable.

The following example shows the commands to run on the Oracle user account to set the ORACLE_HOSTNAME environment variable. In this example, the fully qualified host name is somehost.example.com.

Bourne, Bash or Korn Shell

```
$ export ORACLE_HOSTNAME=somehost.example.com
```

C Shell

```
% setenv ORACLE_HOSTNAME somehost.example.com
```

Network Configuration for Computers with Multiple Aliases

You must set the ORACLE_HOSTNAME environment variable to install Oracle Database on a multialias computer. A multialias computer is one to which multiple aliases resolve.

A computer with multiple aliases is a computer that is registered with the naming service under a single IP address, but which resolves multiple aliases to that address. The naming service resolves any of those aliases to the same computer. Before installing Oracle Database on such a computer, set the Oracle installation owner environment variable ORACLE_HOSTNAME to the computer whose host name you want to use.

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Supported Storage Options for Oracle Database and Oracle Grid Infrastructure

Review supported storage options as part of your installation planning process.

- Supported Storage Options for Oracle Database
  The following table shows the storage options supported for Oracle Database binaries and files:
- About Oracle Grid Infrastructure for a Standalone Server
  If you plan to use Oracle Automatic Storage Management (Oracle ASM), then you must install Oracle Restart before installing your database.
- About Upgrading Existing Oracle Automatic Storage Management Instances
  Oracle Automatic Storage Management (Oracle ASM) upgrades are carried out during an Oracle Grid Infrastructure upgrade.
- About Managing Disk Groups for Older Database Versions
  When you install earlier Oracle Database releases on Oracle Grid Infrastructure, use Oracle ASM Configuration Assistant (Oracle ASMCA) to create and modify disk groups.
- Oracle ACFS and Oracle ADVM
  Oracle Automatic Storage Management Cluster File System (Oracle ACFS) extends Oracle ASM technology to support of all of your application data in both single instance and cluster configurations.
- File System Options for Oracle Database
  If you install Oracle Database files on a file system, then Oracle Database Configuration Assistant creates the database files in a directory on a file system mounted on the computer.
- Guidelines for Placing Oracle Database Files On a File System or Logical Volume
  If you choose to place the Oracle Database files on a file system, then use the following guidelines when deciding where to place them:
- About NFS Storage for Data Files
  Review this section for NFS storage configuration guidelines.
- About Direct NFS Client Mounts to NFS Storage Devices
  Direct NFS (dNFS) Client integrates the NFS client functionality directly in the Oracle software to optimize the I/O path between Oracle and the NFS server. This integration can provide significant performance improvements.

Supported Storage Options for Oracle Database

The following table shows the storage options supported for Oracle Database binaries and files:

> **Note**
>
> The ACFS storage option on IBM AIX is deprecated in Oracle Database 19c.

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Table 7-1 Supported Storage Options for Oracle Database

Storage Option	Oracle Database Binaries	Oracle Database Data Files	Oracle Database Recovery Files
Oracle Automatic Storage Management (Oracle ASM) **Note**: Loopback devices are not supported for use with Oracle ASM	No	Yes	Yes
Oracle Automatic Storage Management Cluster File System (Oracle ACFS)	Yes	Yes (Oracle Database 12*c* Release 1 (12.1) and later)	Yes (Oracle Database 12*c* Release 1 (12.1) and later
Local file system	Yes	Yes, but not recommended	Yes, but not recommended
NVMe over Fabrics (NVMe-oF) storage devices	Yes	Yes	Yes **Note:** In Oracle Database 19c, NVMe-oF uses the kernel initiator, which exposes the disks as block devices.
Network file system (NFS) on a network-attached storage (NAS) filer	Yes	Yes	Yes
Oracle Memory Speed	No	Yes	Yes

Guidelines for Storage Options

Use the following guidelines when choosing storage options:

- Oracle strongly recommends that you use a dedicated set of disks for Oracle ASM.
- You can choose any combination of the supported storage options for each file type provided that you satisfy all requirements listed for the chosen storage options.
- You can use Oracle ASM to store Oracle Clusterware files.
- Direct use of raw or block devices is not supported.

Related Topics

- *Oracle Database Upgrade Guide*

About Oracle Grid Infrastructure for a Standalone Server

If you plan to use Oracle Automatic Storage Management (Oracle ASM), then you must install Oracle Restart before installing your database.

Oracle Grid Infrastructure for a standalone server is a version of Oracle Grid Infrastructure that supports single instance databases. This support includes volume management, file system, and automatic restart capabilities. Oracle Grid Infrastructure for a standalone server includes Oracle Restart and Oracle Automatic Storage Management. Oracle combined the two infrastructure products into a single set of binaries that is installed into an Oracle Restart home.

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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.

Oracle Automatic Storage Management is a volume manager and a file system for Oracle Database files that supports single-instance Oracle Database and Oracle Real Application Clusters (Oracle RAC) configurations. Oracle Automatic Storage Management also supports a general purpose file system for your application needs, including Oracle Database binaries. Oracle Automatic Storage Management is Oracle's recommended storage management solution that provides an alternative to conventional volume managers, and file systems.

Oracle Restart improves the availability of your Oracle database by providing the following services:

- When there is a hardware or a software failure, Oracle Restart automatically starts all Oracle components, including the Oracle database instance, Oracle Net Listener, database services, and Oracle ASM.
- Oracle Restart starts components in the proper order when the database host is restarted.
- Oracle Restart runs periodic checks to monitor the status of Oracle components. If a check operation fails for a component, then the component is shut down and restarted.

Note the following restrictions for using Oracle Restart:

- You can neither install Oracle Restart on an Oracle Grid Infrastructure cluster member node, nor add an Oracle Restart server to an Oracle Grid Infrastructure cluster member node. Oracle Restart supports single-instance databases on one server, while Oracle Grid Infrastructure for a Cluster supports single-instance or Oracle RAC databases on a cluster.
- If you want to use Oracle ASM or Oracle Restart, then you should install Oracle Grid Infrastructure for a standalone server before you install and create the database. Otherwise, you must install Oracle Restart, and then manually register the database with Oracle Restart.
- You can use the Oracle Restart implementation of Oracle Grid Infrastructure only in single-instance (nonclustered) environments. Use Oracle Grid Infrastructure with Oracle Clusterware for clustered environments.

About Upgrading Existing Oracle Automatic Storage Management Instances

Oracle Automatic Storage Management (Oracle ASM) upgrades are carried out during an Oracle Grid Infrastructure upgrade.

If you are upgrading from Oracle ASM 11g Release 2 (11.2.0.4) or later, then Oracle ASM is always upgraded with Oracle Grid Infrastructure as part of the upgrade, and Oracle Automatic Storage Management Configuration Assistant (Oracle ASMCA) is started by the root scripts during upgrade. Subsequently, you can use Oracle ASMCA (located in `Grid_home/bin`) to configure failure groups, Oracle ASM volumes, and Oracle Automatic Storage Management Cluster File System (Oracle ACFS).

Oracle ASMCA cannot perform a separate upgrade of Oracle ASM from a prior release to the current release.

Upgrades of Oracle ASM from releases prior to 11g Release 2 (11.2) are not supported.

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Related Topics

- *Oracle Automatic Storage Management Administrator's Guide*
- *Oracle Database Upgrade Guide*

About Managing Disk Groups for Older Database Versions

When you install earlier Oracle Database releases on Oracle Grid Infrastructure, use Oracle ASM Configuration Assistant (Oracle ASMCA) to create and modify disk groups.

Releases prior to Oracle Database 11*g* Release 2 used Oracle Database Configuration Assistant (Oracle DBCA) to perform administrative tasks on Oracle ASM. Starting with Oracle Database 11*g* Release 2 (11.2), Oracle ASM is installed as part of an Oracle Grid Infrastructure installation. You can no longer use Oracle DBCA to perform administrative tasks on Oracle ASM.

See Also

Oracle Automatic Storage Management Administrator's Guide for details about configuring disk group compatibility for databases using Oracle Database 11*g* software with this release of Oracle Grid Infrastructure.

Oracle ACFS and Oracle ADVM

Oracle Automatic Storage Management Cluster File System (Oracle ACFS) extends Oracle ASM technology to support of all of your application data in both single instance and cluster configurations.

Note

The ACFS storage option on IBM AIX is deprecated in Oracle Database 19c.

To align the support for the IBM AIX platform, Oracle Automatic Storage Management Cluster File System (ACFS) on IBM AIX (called Oracle Advanced Cluster File System starting with Oracle Database 21c) is deprecated in Oracle Database 19c. For data or files currently stored on an ACFS file system that cannot be stored in the Oracle database, the IBM General Parallel File System (GPFS) can be used.

Oracle Automatic Storage Management Dynamic Volume Manager (Oracle ADVM) provides volume management services and a standard disk device driver interface to clients. Oracle ACFS communicates with Oracle ASM through the Oracle ADVM interface.

- Oracle ACFS and Oracle ADVM Support on Linux x86–64
  Oracle ACFS and Oracle ADVM are supported on Oracle Linux, Red Hat Enterprise Linux, and SUSE Linux Enterprise Server.
- Restrictions and Guidelines for Oracle ACFS
  Review these topics as part of your storage plan for using Oracle ACFS for single instance and cluster configurations.

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Related Topics

- *Oracle Automatic Storage Management Administrator's Guide*

Oracle ACFS and Oracle ADVM Support on Linux x86–64

Oracle ACFS and Oracle ADVM are supported on Oracle Linux, Red Hat Enterprise Linux, and SUSE Linux Enterprise Server.

Table 7-2 Platforms That Support Oracle ACFS and Oracle ADVM

Platform / Operating System	Kernel
Oracle Linux 10	Starting with Oracle Database 19c (19.32), all Oracle Linux 10 and later compatible kernels
Oracle Linux 9	Starting with Oracle Database 19c (19.21), all Oracle Linux 9.2 and later compatible kernels
Oracle Linux 8	All Oracle Linux 8 compatible kernels
Oracle Linux 7	All Oracle Linux 7 compatible kernels, except Unbreakable Enterprise Kernel 6 (UEK 6) and later UEK kernels.
Red Hat Enterprise Linux 10	Starting with Oracle Database 19c (19.32), all Red Hat Enterprise Linux 10 and later compatible kernels
Red Hat Enterprise Linux 9	Starting with Oracle Database 19c (19.21), all Red Hat Enterprise Linux 9.2 and later compatible kernels
Red Hat Enterprise Linux 8	All Red Hat Enterprise Linux 8 compatible kernels
Red Hat Enterprise Linux 7	All Red Hat Enterprise Linux 7 compatible kernels
SUSE Linux Enterprise Server 12	All SUSE Linux Enterprise Server 12 compatible kernels
SUSE Linux Enterprise Server 15	All SUSE Linux Enterprise Server 15 compatible kernels
Linux Containers	Not supported

Note

Full Security Enhanced Linux (SELinux) support is available in Oracle Grid Infrastructure releases 19.27, 21.18, 23.7 and later. Refer to your Linux vendor documentation for information about using per-file context labels. When using SELinux with Oracle ACFS in releases prior to these, ensure that the Oracle ACFS file systems are mounted with an SELinux default context. Refer to your Linux vendor documentation for information about the context mount option.

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Important

You must apply patches to some of the Linux kernel versions for successful Oracle Grid Infrastructure installation. Refer to the following notes for more information:

- My Oracle Support Note 1369107.1 for more information and a complete list of platforms and releases that support Oracle ACFS and Oracle ADVM:

  https://support.oracle.com/rs?type=doc&id=1369107.1

- Patch Set Updates for Oracle Products (My Oracle Support Note 854428.1) for current release and support information:

  https://support.oracle.com/rs?type=doc&id=854428.1

Restrictions and Guidelines for Oracle ACFS

Review these topics as part of your storage plan for using Oracle ACFS for single instance and cluster configurations.

Note

The ACFS storage option on IBM AIX is deprecated in Oracle Database 19c.

- Oracle Automatic Storage Management Cluster File System (Oracle ACFS) provides a general purpose file system.
- You can only use Oracle ACFS when Oracle ASM is configured.
- Note the following general guidelines and restrictions for placing Oracle Database and Oracle Grid Infrastructure files on Oracle ACFS:
  - You can place Oracle Database binaries, data files, and administrative files (for example, trace files) on Oracle ACFS.
  - Oracle ACFS does not support encryption or replication with Oracle Database data files, tablespace files, control files, redo logs, archive logs, RMAN backups, Data Pump dumpsets, and flashback files.
  - You can place Oracle Database homes on Oracle ACFS only if the database release is Oracle Database 11g Release 2, or more recent releases. You cannot install earlier releases of Oracle Database on Oracle ACFS.
  - For installations on Oracle Clusterware, you cannot place Oracle Clusterware files on Oracle ACFS.
- Oracle Restart does not support root-based Oracle Clusterware resources. For this reason, the following restrictions apply if you run Oracle ACFS on an Oracle Restart Configuration:
  - Starting with Oracle Database 18c, configuration assistants do not allow the creation of Oracle Database homes on Oracle ACFS in an Oracle Restart configuration.
  - Oracle Restart does not support Oracle ACFS resources on all platforms.
  - Starting with Oracle Database 12c, Oracle Restart configurations do not support the Oracle ACFS registry.
  - On Linux, Oracle ACFS provides an automated mechanism to load and unload drivers and mount and unmount Oracle ACFS file systems on system restart and shutdown.

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However, Oracle ACFS does not provide automated recovery of mounted file systems when the system is running. Other than Linux, Oracle ACFS does not provide this automated mechanism on other operating systems.

  - Creating Oracle data files on an Oracle ACFS file system is not supported in Oracle Restart configurations. Creating Oracle data files on an Oracle ACFS file system is supported on Oracle Grid Infrastructure for a cluster configurations.

- Oracle ACFS and Oracle ADVM are not supported on IBM AIX Workload Partitions (WPARs).

Related Topics

- *Oracle Automatic Storage Management Administrator's Guide*

File System Options for Oracle Database

If you install Oracle Database files on a file system, then Oracle Database Configuration Assistant creates the database files in a directory on a file system mounted on the computer.

Oracle recommends that the file system be separate from the file systems used by the operating system or the Oracle Database software.

The file system can be any of the following:

Standard Oracle Database Creation Options

- A file system on a disk that is physically attached to the system.

  If you are creating a database on basic disks that are not logical volumes or RAID devices, then Oracle recommends that you follow the Optimal Flexible Architecture (OFA) recommendations and distribute the database files over many disks.

- A file system on a logical volume manager (LVM) volume or a RAID device.

  If you are using multiple disks in an LVM or RAID configuration, then Oracle recommends that you use the Stripe and Mirror Everything (S.A.M.E) methodology to increase performance and reliability. Using this methodology, you do not have to specify multiple file system mount points for the database storage.

- A network file system (NFS) mounted from a network-attached storage (NAS) device. You also have the option to use Direct NFS Client, which simplifies the administration of NFS configurations and also improves performance.

Advanced Oracle Database Creation Options

- The three file system options available to standard Oracle Database installations.
- With Oracle Managed Files, you specify file system directories in which the database automatically creates, names, and manages files at the database object level.

  If you use the Oracle Managed Files feature, then you must specify only the database object name instead of file names when creating or deleting database files.

Related Topics

- Oracle RAC Technologies Matrix for Linux Platforms
- *Oracle Database Administrator's Guide*

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Guidelines for Placing Oracle Database Files On a File System or Logical Volume

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

- The default path suggested by Oracle Universal Installer for the database file directory is a subdirectory of the Oracle base directory.
- You can choose either a single file system or more than one file system to store the database files:
  - If you want to use a single file system, then choose a file system on a physical device that is dedicated to the database.

    For best performance and reliability, choose a RAID device or a logical volume on more than one physical device, and implement a stripe-and-mirror-everything (SAME) storage policy.
  - If you want to use more than one file system, then choose file systems on separate physical devices that are dedicated to the database.

    This method enables you to distribute physical input-output operations and create separate control files on different devices for increased reliability. It also enables you to fully implement Oracle Optimal Flexible Architecture (OFA) guidelines. Choose the Advanced database creation option to implement this method.
- If you intend to create a preconfigured database during the installation, then the file system (or file systems) that you choose must have at least 2 GB of free disk space.

  For production databases, you must estimate the disk space requirement depending on the use of the database.
- For optimum performance, the file systems that you choose must be on physical devices that are used only by the database.
- The Oracle user running the Oracle Database installation must have write permissions to create the files in the path that you specify.

About NFS Storage for Data Files

Review this section for NFS storage configuration guidelines.

Network-Attached Storage and NFS Protocol

Network-attached storage (NAS) systems use the network file system (NFS) protocol to access files over a network, which enables client servers to access files over networks as easily as to storage devices attached directly to the servers. You can store data files on supported NFS systems. NFS is a shared file system protocol, so NFS can support both single instance and Oracle Real Application Clusters databases.

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> **Note**
>
> The performance of Oracle software and databases stored on NAS devices depends on the performance of the network connection between the servers and the network-attached storage devices. For better performance, Oracle recommends that you connect servers to NAS devices using private dedicated network connections. NFS network connections should use Gigabit Ethernet or better.

Refer to your vendor documentation to complete NFS configuration and mounting.

Requirements for Using NFS Storage

Before you start installation, NFS file systems must be mounted and available to servers.

About Direct NFS Client Mounts to NFS Storage Devices

Direct NFS (dNFS) Client integrates the NFS client functionality directly in the Oracle software to optimize the I/O path between Oracle and the NFS server. This integration can provide significant performance improvements.

Direct NFS Client supports NFSv3, NFSv4, NFSv4.1, and pNFS protocols to access the NFS server. Direct NFS Client also simplifies, and in many cases automates, the performance optimization of the NFS client configuration for database workloads.

Starting with Oracle Database 12c Release 2, when you enable Direct NFS, you can also enable the Direct NFS dispatcher. The Direct NFS dispatcher consolidates the number of TCP connections that are created from a database instance to the NFS server. In large database deployments, using Direct NFS dispatcher improves scalability and network performance. Parallel NFS deployments also require a large number of connections. Hence, the Direct NFS dispatcher is recommended with Parallel NFS deployments too.

Direct NFS Client can obtain NFS mount points either from the operating system mount entries, or from the `oranfstab` file.

Direct NFS Client Requirements

- NFS servers must have write size values (`wtmax`) of 32768 or greater to work with Direct NFS Client.
- NFS mount points must be mounted both by the operating system kernel NFS client and Direct NFS Client, even though you configure Direct NFS Client to provide file service.

  If Oracle Database cannot connect to an NFS server using Direct NFS Client, then Oracle Database connects to the NFS server using the operating system kernel NFS client. When Oracle Database fails to connect to NAS storage though Direct NFS Client, it logs an informational message about the Direct NFS Client connect error in the Oracle alert and trace files.
- Follow standard guidelines for maintaining integrity of Oracle Database files mounted by both operating system NFS and by Direct NFS Client.

Direct NFS Mount Point Search Order

Direct NFS Client searches for mount entries in the following order:

1. `$ORACLE_HOME/dbs/oranfstab`

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2. `/etc/oranfstab`
3. `/etc/mtab`

Direct NFS Client uses the first matching entry as the mount point.

> **Note**
>
> You can have only one active NFS Client implementation for each instance. Enabling Direct NFS Client on an instance prevents you from using another NFS Client implementation, such as kernel NFS Client.

Default NFS Version Selection

The Direct NFS Client uses the following rules to determine the default NFS protocol version:

1. If a matching mount entry is found in `oranfstab` and `nfs_version` is specified, then dNFS uses the specified version.
2. If a matching mount entry is found in `oranfstab` and `nfs_version` is not specified, then dNFS uses NFSv3.
3. If a matching mount entry is not found in `oranfstab` or if `oranfstab` is not present, then dNFS queries the operating system mount table (`mtab`) and uses the NFS version configured for the mount.
4. If the specified version in `oranfstab` or `mtab` is NFSv4.2, then dNFS uses NFSv4.1 because NFSv4.2 is not supported.

Related Topics

- Creating an oranfstab File for Direct NFS Client
  Direct NFS uses a configuration file, `oranfstab`, to determine the available mount points.
- Configuring NFS Buffer Size Parameters for Oracle Database
  Set the values for the NFS buffer size parameters `rsize` and `wsize` to at least 32768.

> **See Also**
>
> - *Oracle Database Reference* for information about setting the `enable_dnfs_dispatcher` parameter in the initialization parameter file to enable Direct NFS dispatcher
> - *Oracle Database Performance Tuning Guide* for performance benefits of enabling Parallel NFS and Direct NFS dispatcher
> - *Oracle Automatic Storage Management Administrator's Guide* for guidelines about managing Oracle Database data files created with Direct NFS Client or kernel NFS

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8

Configuring File System Storage for Oracle Database

Complete these procedures to use file system storage for Oracle Database.

For optimal database organization and performance, Oracle recommends that you install data files and the Oracle Database software in different disks.

- Deploying Oracle Direct NFS
  If you plan to place storage on Network File System (NFS) protocol devices, then Oracle recommends that you use Oracle Direct NFS (dNFS) to take advantage of performance optimizations built into the Oracle Direct NFS client.
- Deploying the Oracle Memory Speed File System
  Learn how to deploy the Oracle Memory Speed (OMS) file system on your persistent memory (PMEM) storage devices with a single-instance Oracle Database.
- Migrating Oracle Database to Oracle Memory Speed
  Starting with Oracle Database 19c Release Update (19.12) you can migrate your database files to Oracle Memory Speed (OMS) storage using SQL and RMAN commands.

Deploying Oracle Direct NFS

If you plan to place storage on Network File System (NFS) protocol devices, then Oracle recommends that you use Oracle Direct NFS (dNFS) to take advantage of performance optimizations built into the Oracle Direct NFS client.

- Configuring NFS Buffer Size Parameters for Oracle Database
  Set the values for the NFS buffer size parameters `rsize` and `wsize` to at least 32768.
- Checking TCP Network Protocol Buffer for Direct NFS Client
  Check your TCP network buffer size to ensure that it is adequate for the speed of your servers.
- Creating an oranfstab File for Direct NFS Client
  Direct NFS uses a configuration file, `oranfstab`, to determine the available mount points.
- Enabling and Disabling Direct NFS Client Control of NFS
  By default, Direct NFS Client is installed in a disabled state with single-instance Oracle Database installations. Before enabling Direct NFS, you must configure an `oranfstab` file.
- Enabling Hybrid Columnar Compression on Direct NFS Client
  Perform these steps to enable Hybrid Columnar Compression (HCC) on Direct NFS Client:

Related Topics

- My Oracle Support note 1496040.1

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Configuring NFS Buffer Size Parameters for Oracle Database

Set the values for the NFS buffer size parameters `rsize` and `wsize` to at least 32768.

For example, to use `rsize` and `wsize` buffer settings with the value 32768 for an Oracle Database data files mount point, set mount point parameters to values similar to the following:

```
nfs_server:/vol/DATA/oradata /home/oracle/netapp nfs\
rw,bg,hard,nointr,rsize=32768,wsize=32768,tcp,actimeo=0,vers=3,timeo=600
```

Direct NFS Client issues writes at `wtmax` granularity to the NFS server.

Related Topics

- My Oracle Support note 359515.1

Checking TCP Network Protocol Buffer for Direct NFS Client

Check your TCP network buffer size to ensure that it is adequate for the speed of your servers.

By default, the network buffer size is set to 1 MB for TCP, and 2 MB for UDP. The TCP buffer size can set a limit on file transfers, which can negatively affect performance for Direct NFS Client users.

To check the current TCP buffer size, enter the following command:

```
# sysctl -a |grep -e net.ipv4.tcp_[rw]mem
```

The output of this command is similar to the following:

```
net.ipv4.tcp_rmem = 4096        87380   1056768
net.ipv4.tcp_wmem = 4096        16384   1056768
```

Oracle recommends that you set the value based on the link speed of your servers. For example, perform the following steps:

1. As `root`, use a text editor to open `/etc/sysctl.conf`, and add or change the following:

   ```
   net.ipv4.tcp_rmem = 4096        87380   4194304
   net.ipv4.tcp_wmem = 4096        16384   4194304
   ```

2. Apply your changes by running the following command:

   ```
   # sysctl -p
   ```

3. Restart the network:

   ```
   # /etc/rc.d/init.d/network restart
   ```


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Creating an oranfstab File for Direct NFS Client

Direct NFS uses a configuration file, `oranfstab`, to determine the available mount points.

Create an `oranfstab` file with the following attributes for each NFS server that you want to access using Direct NFS Client:

- `server`

  The NFS server name.

  For NFS setup with Kerberos authentication, the `server` attribute name must be the fully-qualified name of the NFS server. This `server` attribute name is used to create service principal for Ticket Granting Service (TGS) request from the Kerberos server. If you are configuring external storage snapshot cloning, then the NFS `server` name should be a valid host name. For all other scenarios, the NFS `server` name can be any unique name.

- `local`

  Up to four paths on the database host, specified by IP address or by name, as displayed using the `ifconfig` command run on the database host.

- `path`

  Up to four network paths to the NFS server, specified either by IP address, or by name, as displayed using the `ifconfig` command on the NFS server.

- `export`

  The exported path from the NFS server.

- `mount`

  The corresponding local mount point for the exported volume.

- `mnt_timeout`

  Specifies (in seconds) the time Direct NFS Client should wait for a successful mount before timing out. This parameter is optional. The default timeout is 10 minutes (600).

- `nfs_version`

  Specifies the NFS protocol version used by Direct NFS Client. Possible values are NFSv3, NFSv4, NFSv4.1, and pNFS. The default version is NFSv3. If you select NFSv4.x, then you must configure the value in `oranfstab` for `nfs_version`.

  Specify `nfs_version` as `pNFS`, if you want to use Direct NFS with Parallel NFS. Direct NFS supports only the default `sys` security authentication with Parallel NFS. Direct NFS does not support Parallel NFS when combined with any of the Kerberos authentication parameters.

- `security_default`

  Specifies the default security mode applicable for all the exported NFS server paths for a server entry. This parameter is optional. `sys` is the default value. See the description of the `security` parameter for the supported security levels for the `security_default` parameter.

- `security`

  Specifies the security level, to enable security using Kerberos authentication protocol with Direct NFS Client. This optional parameter can be specified per export-mount pair. The supported security levels for the `security_default` and `security` parameters are:

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`sys`: UNIX level security AUTH_UNIX authentication based on user identifier (UID) and group identifier (GID) values. This is the default value for security parameters.
`krb5`: Direct NFS runs with plain Kerberos authentication. Server is authenticated as the real server which it claims to be.
`krb5i`: Direct NFS runs with Kerberos authentication and NFS integrity. Server is authenticated and each of the message transfers is checked for integrity.
`krb5p`: Direct NFS runs with Kerberos authentication and NFS privacy. Server is authenticated, and all data is completely encrypted.

The `security` parameter, if specified, takes precedence over the `security_default` parameter. If neither of these parameters are specified, then `sys` is the default authentication.

For NFS server Kerberos security setup, review the relevant NFS server documentation. For Kerberos client setup, review the relevant operating system documentation.

- `dontroute`

  Specifies that outgoing messages should not be routed by the operating system, but instead sent using the IP address to which they are bound.

  > **Note**
  >
  > The `dontroute` option is a POSIX option, which sometimes does not work on Linux systems with multiple paths in the same subnet.

- `management`

  Enables Direct NFS Client to use the management interface for SNMP queries. You can use this parameter if SNMP is running on separate management interfaces on the NFS server. The default value is the server parameter value.

- `community`

  Specifies the community string for use in SNMP queries. Default value is `public`.

The following examples show three possible NFS server entries in `oranfstab`. A single `oranfstab` can have multiple NFS server entries.

Example 8-1 Using Local and Path NFS Server Entries

The following example uses both local and path. Because they are in different subnets, you do not have to specify `dontroute`.

```
server: MyDataServer1
local: 192.0.2.0
path: 192.0.2.1
local: 192.0.100.0
path: 192.0.100.1
export: /vol/oradata1 mount: /mnt/oradata1
```

Example 8-2 Using Local and Path in the Same Subnet, with dontroute

Local and path in the same subnet, where `dontroute` is specified:

```
server: MyDataServer2
local: 192.0.2.0
path: 192.0.2.128
```


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```
local: 192.0.2.1
path: 192.0.2.129
dontroute
export: /vol/oradata2 mount: /mnt/oradata2
```

Example 8-3 Using Names in Place of IP Addresses, with Multiple Exports, management and community

```
server: MyDataServer3
local: LocalPath1
path: NfsPath1
local: LocalPath2
path: NfsPath2
local: LocalPath3
path: NfsPath3
local: LocalPath4
path: NfsPath4
dontroute
export: /vol/oradata3 mount: /mnt/oradata3
export: /vol/oradata4 mount: /mnt/oradata4
export: /vol/oradata5 mount: /mnt/oradata5
export: /vol/oradata6 mount: /mnt/oradata6
management: MgmtPath1
community: private
```

Example 8-4 Using Kerberos Authentication with Direct NFS Export

The `security` parameter overrides `security_default`:

```
server:  nfsserver
 local: 192.0.2.0
 path: 192.0.2.2
 local: 192.0.2.3
 path: 192.0.2.4
 export: /private/oracle1/logs  mount: /logs  security: krb5
 export: /private/oracle1/data  mount: /data  security: krb5p
 export: /private/oracle1/archive mount: /archive security: sys
 export: /private/oracle1/data1 mount: /data1
 security_default: krb5i
```

Related Topics

- About Direct NFS Client Mounts to NFS Storage Devices
  Direct NFS (dNFS) Client integrates the NFS client functionality directly in the Oracle software to optimize the I/O path between Oracle and the NFS server. This integration can provide significant performance improvements.

Enabling and Disabling Direct NFS Client Control of NFS

By default, Direct NFS Client is installed in a disabled state with single-instance Oracle Database installations. Before enabling Direct NFS, you must configure an `oranfstab` file.

Use these procedures to enable or disable Direct NFS Client Oracle Disk Manager Control of NFS

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Enabling Direct NFS Client Control of NFS

1. Change the directory to `$ORACLE_HOME/rdbms/lib`.
2. Enter the following command:

```
make -f ins_rdbms.mk dnfs_on
```

Disabling Direct NFS Client Control of NFS

1. Log in as the Oracle software installation owner, and disable Direct NFS Client using the following commands:

```
cd $ORACLE_HOME/rdbms/lib
make -f ins_rdbms.mk dnfs_off
```

2. Remove the `oranfstab` file.

> **Note**
>
> If you remove an NFS path that an Oracle Database is using, then you must restart the database for the change to take effect.

Enabling Hybrid Columnar Compression on Direct NFS Client

Perform these steps to enable Hybrid Columnar Compression (HCC) on Direct NFS Client:

1. Ensure that SNMP is enabled on the ZFS storage server. For example:

```
$ snmpget -v1 -c public server_name .1.3.6.1.4.1.42.2.225.1.4.2.0
SNMPv2-SMI::enterprises.42.2.225.1.4.2.0 = STRING: "Sun Storage 7410"
```

2. If SNMP is enabled on an interface other than the NFS server, then configure `oranfstab` using the management parameter.
3. If SNMP is configured using a community string other than public, then configure `oranfstab` file using the community parameter.
4. Ensure that `libnetsnmp.so` is installed by checking if `snmpget` is available.

Deploying the Oracle Memory Speed File System

Learn how to deploy the Oracle Memory Speed (OMS) file system on your persistent memory (PMEM) storage devices with a single-instance Oracle Database.

To use your single-instance Oracle Database with OMS, perform the following steps:

1. Set-up the hardware and operating system components.
2. Set-up the OMS file system.
3. Deploy Oracle Database with OMS.

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- About Oracle Memory Speed
  Oracle recommends that you use Oracle Database with the Oracle Memory Speed (OMS) file system to fully utilize the potential of persistent memory (PMEM) devices safely in data centers.
- Requirements and Guidelines for Oracle Memory Speed
  Review these requirements and guidelines before you deploy Oracle Memory Speed (OMS) as your file system.
- Setting-Up Hardware and Operating System Components for OMS
  Verify if HugePages is available, configure the PMEM device, and create and mount a DAX-capable file system on the device.
- Setting-Up the Oracle Memory Speed File System
  After configuring the system components, set up the Oracle Memory Speed (OMS) file system by creating and mounting the file system.
- Deploying Oracle Database with Oracle Memory Speed
  Learn the steps to use Oracle Memory Speed (OMS) in Oracle Database.
- omsfscmds Command Reference
  Use the various `omsfscmds` commands to perform basic file system operations, such as `mkfs`, `mount`, and `umount`.

About Oracle Memory Speed

Oracle recommends that you use Oracle Database with the Oracle Memory Speed (OMS) file system to fully utilize the potential of persistent memory (PMEM) devices safely in data centers.

Persistent memory is a new tier in the computer system memory hierarchy. PMEM performance and access characteristics are similar to volatile memory. However, unlike volatile memory and similar to existing storage systems, the data is not lost on system restarts and power failures.

PMEM devices are usually deployed on a DAX-enabled file system. The files placed directly on DAX-enabled file systems backed by PMEM devices may become corrupt in certain scenarios. Applications accessing these files through the file-system kernel interface may also experience higher overhead and lower performance. To avoid these pitfalls, Oracle recommends that you deploy Oracle Database with OMS to eliminate data corruption that may occur when writing to files on a DAX-enabled file system on a raw PMEM device. An Oracle Database deployed on OMS will exhibit I/O performance close to that of the underlying hardware. Also, OMS uses advanced techniques to reduce TLB misses and reduce CPU cache usage and misses.

With PMEM as the backing device, OMS utilizes a memory-mapped file hosted on an XFS-based, DAX-enabled file system to perform I/O operations. You must export the PMEM device as a file using a DAX-enabled file system, such as XFS.

Benefits of the Oracle Memory Speed File System

- Supports control files, redo log files, data files, and temporary files
- Enables applications to take advantage of the speed and persistence of PMEM devices
- Eliminates the inherent corruption hazard that arises from the lower atomic write size
- OMS is a user-space file system that eliminates the user space to kernel context switch overhead
- Avoids multiple data copies
- OMS takes advantage of HugePages to reduce TLB misses and improve performance

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- Bypasses the CPU cache for I/O through non-temporal stores. This enables applications to take advantage of the local cache
- Allows you to examine files even when the database instance is not running
- Provides rich diagnostic data

Requirements and Guidelines for Oracle Memory Speed

Review these requirements and guidelines before you deploy Oracle Memory Speed (OMS) as your file system.

Requirements

- An Intel Cascade Lake or Intel Ice Lake based server or later. Ice Lake based servers implement enhanced CPU cache flushing algorithms that may potentially improve PMEM performance.
- Persistent Memory Devices (PMEM) in each socket capable of memory interleaving. You should populate the PMEM DIMMs and the DRAM DIMMs in the memory channels per Intel guidelines.
- Oracle Linux with HugePages support starting with kernel UEK5.
- A Direct Access (DAX-capable) file system such as XFS.

Guidelines

- Oracle supports the OMS file system only for single instance Oracle Database deployments. To protect the data created by your single-instance Oracle Database, Oracle recommends that you configure Oracle Data Guard. Oracle Data Guard ensures that if there is any error in the primary instance, the database can fail over to the standby database. See the *Oracle Data Guard Concepts and Administration* for more information.

Related Topics

- *Oracle Data Guard Concepts and Administration*

Setting-Up Hardware and Operating System Components for OMS

Verify if HugePages is available, configure the PMEM device, and create and mount a DAX-capable file system on the device.

- Verifying HugePages Availability
  Ensure that the underlying Linux kernel supports HugePages.
- Configuring PMEM Devices
  On your Intel Persistent Memory (PMEM) device, use the `ipmctl` utility to configure the PMEM mode and the `ndctl` utility for namespace management.
- Setting-Up a DAX-Capable File System
  Learn how to create and mount a DAX-capable file system.
- Create an Uber File for Oracle Memory Speed
  After mounting the DAX file system, create an uber file for the Oracle Memory Speed (OMS) file system.

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Verifying HugePages Availability

Ensure that the underlying Linux kernel supports HugePages.

HugePages not only reduces TLB misses but also substantially reduces the memory footprint for virtual to physical address translation.

To determine the HugePages size on your system, run:

```
$grep Hugepagesize /proc/meminfo
Hugepagesize: 2048 kB
```

In this example, the HugePages size is 2 MiB (mebibyte).

> **Note**
>
> An MiB (mebibyte) is a unit of measure that represents 1024 * 1024 bytes.

Oracle recommends Oracle Linux 7 with the Unbreakable Enterprise Kernel 5 or later for HugePages support.

Configuring PMEM Devices

On your Intel Persistent Memory (PMEM) device, use the `ipmctl` utility to configure the PMEM mode and the `ndctl` utility for namespace management.

A PMEM device can operate in App Direct mode, Memory Mode, or Mixed Mode. To use OMS, you should configure your PMEM device in the `app direct` mode by using the BIOS.

1. In your BIOS, select **EDKII**, **Socket Config**, **Memory Config**, **Memory Map**, **Volatile Mode** and set it to **1LM**.
2. Log in as `root` and check the currently configured capacity:

   ```
   $ su -
   # ipmctl show -memoryresources
   ```

   The output is similar to the following:

   ```
   Capacity=3029.4 GiB
   MemoryCapacity=0.0 GiB
   AppDirectCapacity=3024.0 GiB
   UnconfiguredCapacity=0.0 GiB
   InaccessibleCapacity=5.4 GiB
   ReservedCapacity=0.0 GiB
   ```

   In this example, the system has an aggregate capacity of 3024 GiB (3247 GB).

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> **Note**
>
> A GiB (gibibyte) is a unit of measure that represents 1024 MiB (mebibytes), equivalent to 2^{30} bytes.

3. Verify if the regions are configured in `app direct` mode.

```
# ipmctl show -region
```

The output is similar to the following:

```
SocketID | ISetID             | PersistentMemoryType | Capacity  |
FreeCapacity | HealthState
==========================================================================
====================
0x0000   | 0x97407f48df982ccc | AppDirect            | 1512.0 GiB | 0.0
GiB      | Healthy
0x0001   | 0xfb907f48d59a2ccc | AppDirect            | 1512.0 GiB | 0.0
GiB      | Healthy
```

In this example, there are two PMEM devices; one per socket. Each PMEM device or region has a capacity of 1512 GiB and supports AppDirect mode.

4. Create the namespace by running the `ndctl` command for each region. In this example, run the command twice as there are two regions in the preceding example.

```
# ndctl create-namespace
# ndctl create-namespace
```

5. Check if the namespaces are created.

```
# ndctl list -u
```

The output is similar to the following:

```
[
  {
    "dev":"namespace1.0",
    "mode":"fsdax",
    "map":"dev",
    "size":"1488.37 GiB (1598.13 GB)",
    "uuid":"f8ec094d-5a69-4f87-9198-fb9117f2ea8e",
    "sector_size":512,
    "align":2097152,
    "blockdev":"pmem1"
  },
  {
    "dev":"namespace0.0",
    "mode":"fsdax",
    "map":"dev",
    "size":"1488.37 GiB (1598.13 GB)",
    "uuid":"8924aa35-701f-40cc-ba08-654aa5729611",
    "sector_size":512,
```


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```
    "align":2097152,
    "blockdev":"pmem0"
  }
]
```

In this example, two namespaces `namespace0.0` and `namespace1.0` are now available for NUMA `nodes 0` and `node 1` respectively. The block device paths for namespaces `namespace0.0` and `namespace1.0` are `/dev/pmem0` and `/dev/pmem1` respectively.

6. Ensure that the PMEM device starts at a 2 MiB aligned physical address.

   To determine the alignment of the persistent memory namespaces, view the `/proc/iomem` file.

   ```
   # cat /proc/iomem | grep namespace
     3060000000-1aa5fffffff : namespace0.0
     1da00000000-353fffffff : namespace1.0
   ```

   Check if the hexadecimal addresses are aligned at a 2 MiB boundary.

   ```
   0x3060000000 = 198144 MiB

   0x1da00000000 = 1941504 MiB
   ```

   In this example, both addresses are aligned at a 2 MiB boundary.

7. Create two partitions on your PMEM storage device. One small partition of approximately 5 percent for metadata and the rest for the data.

   On `/dev/pmem0` create 2 partitions `pmem0p1` and `pmem0p2`.

   Here `pmem0p1` is the smaller metadata partition and `pmem0p2` is the larger data partition.

   In the following example, 5 percent of the total space of 1488.37 GiB would be approximately 75 GiB. Partition the device as follows:

   a. Launch `parted` and select the device.

      ```
      # parted /dev/pmem0

      GNU Parted 3.2
      Using /dev/pmem0
      Welcome to GNU Parted! Type 'help' to view a list of commands.
      ```

   b. Create the first new 75 GiB partition using the `mkpart` command.

      ```
      (parted) mkpart
      Partition type? primary/extended? p
      File system type? [ext2]? xfs
      Start? 2MiB
      End? 75GiB
      ```

   c. Create the second new partition using the `mkpart` command.

      ```
      (parted) mkpart
      Partition type? primary/extended? p
      File system type? [ext2]? xfs
      ```


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```
Start? 75GiB
End? -2MiB
```

d. Quit `parted` and return to the shell prompt.

```
(parted) q
Information: You may need to update /etc/fstab.
```

Similarly, partition the `/dev/pmem1` device.

8. Ensure that you align the starting sector of the data partition at 2 MiB.

The starting sector number of the data partition should be a multiple of 4096 when you run the `fdisk -l` command.

Run the `fdisk -l` command on `/dev/pmem0` and `/dev/pmem1` to check if the sector is aligned properly.

```
# fdisk -l /dev/pmem0

Disk /dev/pmem1: 1598.1 GB, 1598128390144 bytes, 3121344512 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk label type: dos
Disk identifier: 0xc1d8d265

      Device Boot      Start         End      Blocks   Id  System
/dev/pmem0p1            4096   157286399    78641152   83  Linux
/dev/pmem0p2       157286400  3121340415  1482027008   83  Linux


# fdisk -l /dev/pmem1

Disk /dev/pmem1: 1598.1 GB, 1598128390144 bytes, 3121344512 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk label type: dos
Disk identifier: 0x0003b5eb

      Device Boot      Start         End      Blocks   Id  System
/dev/pmem1p1            4096   157286399    78641152   83  Linux
/dev/pmem1p2       157286400  3121340415  1482027008   83  Linux
```

In these examples the starting sector of the data partitions are multiples of 4096, which confirms that the data partition is aligned at 2 MiB.

```
157286400 / 4096 = 38400
```

Setting-Up a DAX-Capable File System

Learn how to create and mount a DAX-capable file system.

The XFS file system features DAX-capable mounts. Ensure that XFS creates mappings from the physical pages in the PMEM device to virtual pages using HugePages mappings.

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1. Create an XFS file system with the data partition as the real time device and an extent size of 2 MiB. Configuring the data partition as a real time device guarantees 2 MiB aligned extents.

```
# mkfs.xfs -f -m rmapbt=0,reflink=0 -d rtinherit=1 -r rtdev=/dev/
pmem0p2,extsize=2m /dev/pmem0p1
meta-data=/dev/pmem0p1           isize=256    agcount=4, agsize=2097152
blks
         =                       sectsz=4096  attr=2, projid32bit=1
         =                       crc=0        finobt=0, sparse=0,
rmapbt=0, reflink=0
data     =                       bsize=4096   blocks=8388608, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version 2              bsize=4096   ascii-ci=0 ftype=1
log      =internal log           bsize=4096   blocks=4096, version=2
         =                       sectsz=4096  sunit=1 blks, lazy-count=1
realtime =/dev/pmem0p2           extsz=2097152 blocks=381771264,
rtextents=745647
```

2. Mount the Persistent Memory (PMEM) device with DAX option using the following real time device mount options.

```
# mount /dev/pmem0p1 /mnt/pmem0 -o dax,rtdev=/dev/pmem0p2
```

3. Verify if the file system is mounted with the `dax` option.

```
# mount | grep dax

/dev/pmem0p1 on /mnt/pmem0 type xfs
(rw,relatime,attr2,dax,inode64,rtdev=/dev/pmem0p2,noquota)
```

4. Format the `/dev/pmem1` device and mount and verify the `dax` option in the mount point.

```
# mkfs.xfs -f -m rmapbt=0,reflink=0 -d rtinherit=1 -r rtdev=/dev/
pmem1p2,extsize=2m /dev/pmem1p1

# mount /dev/pmem1p1 /mnt/pmem1 -o dax,rtdev=/dev/pmem1p2

# mount | grep dax

/dev/pmem0p1 on /mnt/pmem0 type xfs
(rw,relatime,attr2,dax,inode64,rtdev=/dev/pmem0p2,noquota)
/dev/pmem1p1 on /mnt/pmem1 type xfs
(rw,relatime,attr2,dax,inode64,rtdev=/dev/pmem1p2,noquota)
```

Create an Uber File for Oracle Memory Speed

After mounting the DAX file system, create an uber file for the Oracle Memory Speed (OMS) file system.

An uber file is similar to a volume in a traditional kernel-based file system. The uber file stores all the metadata and data for OMS.

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1. Use `fallocate` to create uber files in the DAX-mounted file systems.

   ```
   # fallocate -l 800G /mnt/pmem0/omsuberfile.$ORACLE_SID
   # fallocate -l 800G /mnt/pmem1/omsuberfile.$ORACLE_SID
   ```

   In this example, `fallocate` creates two 800 GiB files in each of the DAX-mounted file systems. Ensure that the size of the file is an exact multiple of 2 MiB. This aligns the file extents on 2 MiB boundaries and enables access through HugePages virtual memory mappings.

2. Change the ownership of the OMS uber file to the software owner user (`oracle`) and the Oracle Inventory group (`oinstall`), with read/write permissions.

   ```
   # chown oracle:oinstall /mnt/pmem0/omsuberfile.$ORACLE_SID
   # chmod 644 /mnt/pmem0/omsuberfile.$ORACLE_SID
   ```

3. Use the `xfs_bmap` command to ensure that the extents are correctly aligned on 2 MiB boundaries.

   ```
   # xfs_bmap /mnt/pmem0/omsuberfile.$ORACLE_SID
   /mnt/pmem0/omsuberfile.test:
               0: [0..4095]: 1765978112..1765982207
               1: [4096..16773119]: 1765982208..1782751231
               2: [16773120..20971519]: 1782751232..1786949631
   ```

   The output from the `xfs_bmap` command is in the following format:

   ```
   Extent Num:[Start Offset..End Offset]:Start block..End Block
   ```

   Offset and blocks are in units of 512 bytes. The file `/mnt/pmem0/omsuberfile.$ORACLE_SID` has 3 contiguous extents numbered 0-2.

Table 8-1 Size and Alignment of Extents in the Uber File (in Bytes)

Extent	Start Offset	Start Offset Mod 2 M	Start Block	Start Block Mod 2 M	Number of 2 MiB Blocks
0	0H	0H	D285600000H	0H	1H
1	20000H	0H	D285800000H	0H	FFEH
2	0x1FFF00000H	0H	D485400000H	0H	401H

This table shows the Start Offset and Start Block converted into bytes and represented in hexadecimals. The Starts Offsets are all aligned on 2 MiB boundaries (Start Offset Mod 2 MiB is 0). The Start Block of each extent lies on a 2 MiB boundary (Start Block Mod 2 M is 0). Similarly, the size of the extents are exact multiples of 2 MiB.

The OMS uber file has a one-to-one relationship with an Oracle instance. You formalize the association by ending the uber file name with the Oracle instance identifier (SID). In the preceding example, the SID is `test`. Two uber files are `/mnt/pmem0/omsuberfile.test` and `/mnt/pmem1/omsuberfile.test`.

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Related Topics

- Verifying HugePages Behavior in XFS Files
  For best performance, map the data files placed in DAX-enabled storage in to the virtual address space using HugePages mappings. For a memory-mapped file, set up the virtual-to-physical address translations when the pages are first touched.

Setting-Up the Oracle Memory Speed File System

After configuring the system components, set up the Oracle Memory Speed (OMS) file system by creating and mounting the file system.

- About the OMS Daemon
  OMS is a user-space file system. The OMS daemon handles management and CLI operations for OMS.
- Creating and Mounting the Oracle Memory Speed File System
  Learn how to create an Oracle Memory Speed (OMS) file system and mount it.

About the OMS Daemon

OMS is a user-space file system. The OMS daemon handles management and CLI operations for OMS.

You should run the OMS daemon at start up. At start up, the OMS daemon creates a shared memory segment for the exclusive use of OMS. There is one daemon per instance. Set the instance identifier (SID) before you start the OMS daemon.

Start the OMS daemon by running the `$ORACLE_HOME/bin/oms_daemon`.

```
$ whoami
oracle
$ export ORACLE_SID="test"
$ $ORACLE_HOME/bin/oms_daemon
Starting daemon as a detached background.
OMS binary located at /mnt/data/ssd0/obase/test/bin/oms_daemon
OMS daemon startup: oms_test successfully created
OMS daemon creating tracefile
/mnt/data/ssd0/obase/diag/oms/test_oms_20758.trc
$ ipcs
------ Message Queues --------
key msqid owner perms used-bytes messages
------ Shared Memory Segments --------
key shmid owner perms bytes nattch status
0x00000000 32047104 oracle 640 135266304 1
$ ls -l $ORACLE_HOME/dbs/*.ora
-rwx------ 1 oracle dba 93 Feb 23 20:10
/mnt/data/ssd0/oracle/test/dbs/oms_test.ora
```

In this example, the daemon creates a shared memory segment with shared memory id 32047104. It also creates a configuration file `$ORACLE_HOME/dbs/oms_test.ora`.

Oracle recommends that you should not delete the shared segment manually. Similarly, you should not edit or delete the configuration file. If you accidentally kill the daemon, you can restart it by running the command `$ORACLE_HOME/bin/oms_daemon`.

Daemon traces are available in the `$ORACLE_BASE/diag/oms` directory.

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Related Topics

- Daemon Control Command Reference
  Use the `daemon` command to control the OMS daemon process.

Creating and Mounting the Oracle Memory Speed File System

Learn how to create an Oracle Memory Speed (OMS) file system and mount it.

1. Create the mount directories and remove the write and execute permissions:

```
$ mkdir /oracle/omsfs_1
$ chmod -wx /oracle/omsfs_1
$ mkdir /oracle/omsfs_2
$ chmod -wx /oracle/omsfs_2
$ ls -l /oracle


dr--r--r-- 2 oracle dba 6 Feb 23 21:36 omsfs_1
dr--r--r-- 2 oracle dba 6 Feb 23 21:36 omsfs_2
```

2. Start the `omsfscmds` utility and create and mount the file systems using the `mkfs` and `mount` commands respectively.

```
$ $ORACLE_HOME/bin/omsfscmds
OMS> mkfs /mnt/pmem0/omsuberfile.test
OMS:mkfs:No blocksize specified, using 4K
OMS:mkfs: Device /mnt/pmem0/omsuberfile.test formatted with
blocksize 4096
OMS> mount /mnt/pmem0/omsuberfile.test /oracle/omsfs_1
OMS:mount: Mounted /mnt/pmem0/omsuberfile.test at
/oracle/omsfs_1
OMS> mkfs /mnt/pmem1/omsuberfile.test
OMS:mkfs:No blocksize specified, using 4K
OMS:mkfs: Device /mnt/pmem1/omsuberfile.test formatted with
blocksize 4096
OMS> mount /mnt/pmem1/omsuberfile.test /oracle/omsfs_2
OMS:mount: Mounted /mnt/pmem1/omsuberfile.test at
/oracle/omsfs_2
OMS> lsmount
fsindex : 0
Mountpt : /oracle/omsfs_1
Deviceid: /mnt/pmem0/omsuberfile.test
fsindex : 1
Mountpt : /oracle/omsfs_2
Deviceid: /mnt/pmem1/omsuberfile.test
```

   Currently, the only supported block size for OMS file systems is 4 KB. In this example, the two OMS file systems are mounted and available for use. `/dev/pmem0` resides on socket 0, hence files placed in `/oracle/omsfs_1` reside in socket 0. Similarly, `/dev/pmem1` resides in socket 1, hence files placed in `/oracle/omsfs_2` are in socket 1.

   You can mount a maximum of two file systems simultaneously. This enables OMS to use PMEM devices on two socket servers.

   OMS mount points are automatically remounted if you reboot the node and restart the daemon.

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Related Topics

- mkfs and forcemkfs Command Reference
  Use `mkfs` and `forcemkfs` to format the OMS uber file placed in a PMEM DAX mount point.
- mount, unmount and lsmount Command Reference
  Use `mount`, `umount` and, `lsmount` to manage and query the Oracle Memory Speed file system mount points.

Deploying Oracle Database with Oracle Memory Speed

Learn the steps to use Oracle Memory Speed (OMS) in Oracle Database.

- Enabling the OMS ODM Library
  Oracle routes I/O requests to the Oracle Memory Speed (OMS) file system through the Oracle Disk Manager (ODM) library.
- Turning-Off the OMS ODM Library
  Learn how to turn off the ODM library.
- Verifying HugePages Behavior in XFS Files
  For best performance, map the data files placed in DAX-enabled storage in to the virtual address space using HugePages mappings. For a memory-mapped file, set up the virtual-to-physical address translations when the pages are first touched.

Enabling the OMS ODM Library

Oracle routes I/O requests to the Oracle Memory Speed (OMS) file system through the Oracle Disk Manager (ODM) library.

1. To enable the OMS ODM library:

   ```
   $ cd $ORACLE_HOME/rdbms/lib
   $ make -f ins_rdbms.mk oms_on
   ```

2. Start the instance. Verify that the Oracle instance is using the OMS file system by searching for the following message in the alert log:

   ```
   Oracle instance running with ODM: OMS (Oracle memory speed)
   ODM Library, Version: 2.0
   ```

Oracle creates files that have a path prefix starting with `/oracle/omsfs_1` and `/oracle/omsfs_2` in the OMS file system.

Turning-Off the OMS ODM Library

Learn how to turn off the ODM library.

1. To turn off the ODM library:

   ```
   $ cd $ORACLE_HOME/rdbms/lib
   $ make -f ins_rdbms.mk oms_off
   ```


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2. Recycle the instance and ensure that the following message is not present in the alert log after instance startup

```
Oracle instance running with ODM: OMS (Oracle memory speed)
ODM Library, Version: 2.0
```

Verifying HugePages Behavior in XFS Files

For best performance, map the data files placed in DAX-enabled storage in to the virtual address space using HugePages mappings. For a memory-mapped file, set up the virtual-to-physical address translations when the pages are first touched.

If you map pages through DAX using HugePages mappings, then the pages will not use page-cache pages.

You can enable a trace to determine if the page-fault handler granularity is 2 MB or lower, and if it bypasses the page cache.

1. To view this trace, log in as `root` and run the following trace enabling command:

```
# echo 1 >
/sys/kernel/debug/tracing/events/fs_dax/dax_pmd_fault_done/
enable
```

2. Log out from `root` and create a file in the DAX-mounted XFS file system and run `mkfs` on it using the `omsfscmds` utility.
3. Log in again as `root` and run the following command to look at the generated trace:

```
# cat /sys/kernel/debug/tracing/trace
```

Regular 2 MB page faults that bypass the page cache will show the following trace with NOPAGE at the end of the trace:

```
oms_test-21456 [024] .... 13566209.645007: dax_pmd_fault_done:
dev 259:10 ino 0x2005 shared ALLOW_RETRY|KILLABLE|USER address
0x7fb717e01000 vm_start 0x7fb717e00000 vm_end 0x7fb997e00000
pgoff 0x1 max_pgoff 0x280000 NOPAGE
```

If the page fault occurs at a lower granularity of 4 KB, then you will see a FALLBACK in the page fault handler trace. This indicates that 2 MB granularity page fault handlers failed and the fallback path through the page cache is executed. Systems showing a FALLBACK trace must not be used to run OMS.

```
oms_test-21456 [024] .... 13566209.646801: dax_pmd_fault_done:
dev 259:9 ino 0xc3 shared WRITE|ALLOW_RETRY|KILLABLE|USER
address 0x7fb717e0c000 vm_start 0x7fb717e00000 vm_end
0x7fb997e00000 pgoff 0xc max_pgoff 0x280000 FALLBACK
```


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4. Tracing substantially impinges on performance. You must disable tracing before running workloads. To disable the trace, log in as `root` and run the following command:

```
# echo 0 >
/sys/kernel/debug/tracing/events/fs_dax/dax_pmd_fault_done/
enable
```

Related Topics

- Configuring HugePages

omsfscmds Command Reference

Use the various `omsfscmds` commands to perform basic file system operations, such as `mkfs`, `mount`, and `umount`.

Purpose

`omsfscmds` is a command line utility for administering Oracle Memory Speed (OMS). To use `omsfscmds`, ensure that the OMS daemon is running.

Example 8-5 omsfscmds for Mounting the File System

Set the $ORACLE SID to the same SID as the daemon and run `omsfscmds`.

```
$ $ORACLE_HOME/bin/omsfscmds
OMS> mount /mnt/pmem0/omsuberfile.test /oracle/omsfs_1
```

In this example, the PMEM device `/mnt/pmem0/omsuberfile.test` is mounted in the Oracle Database path `/oracle/omsfs_1`.

Parameters

Command	Description
`help`	Use the help command to learn more about each command.
`mkfs` *pmem_device block_size*	Use this command to format a persistent memory (PMEM) device *pmem_device* with block size *block_size*.
`forcemkfs` *pmem_device block_size*	Use this command to format the existing file system and create a new file system with persistent memory (PMEM) device *pmem_device* with block size *block_size*.
`mount` *pmem_device mount_path*	Use this command to mount a PMEM device *pmem_device* in the mount path *mount_path*.
`umount` *mount_path*	Use this command to unmount a PMEM device from the mount path *mount_path*.
`lsmount`	Use this command to list all mounted file systems.
`df` *mount_path*	Display the amount of disk space available on the file system in the *mount_path*.
`cp` *source_filepath dest_filepath*	Use this command to copy from the source file store *source_filepath* to the destination file store *dest_filepath*.

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Command	Description
`ls` *mount_path*	Use this command to list all files in the mount path *mount_path*.
`lls` *mount_path*	Use this command to list detailed information about all files in the mount path *mount_path*.
`rm` *file_path*	Use this command to delete a file in the path *file_path*.
`cd` *dir_path*	Use this command to change the current working directory to the path *dir_path*.
`pwd`	Use this command to print the current directory.
`dump` *module_option pmem_device/mount_point/ absolute_file_path dump_file_name*	Use this command to dump diagnostic information to `dump_file_name`. Available `module_option` values are `dalog`, `malog`, `dftbl`, `oftbl`, `lsom`, `lsof`, and `heap`. *pmem_device* values can be `dalog` or `dftbl`. *mount_point* values can be `malog`, `heap`, `lsom`, or `oftbl`. *absolute_file_path* value can be `lsof`.
`trace` *pmem_device trace_option_file*	Use this command to enabling tracing for `omsdaemon` and `omsfscmds`.
`daemon` *daemon_action*	Use this command to set the OMS daemon trace level. `exit` will shutdown the daemon. `trace lvl` sets the daemon trace `lvl` to low, medium, or high.
`exit`	Exit the `omsfscmds` command prompt.

Related Topics

- Oracle Memory Speed CLI Commands
  `omsfscmds` is a command line utility for administering Oracle Memory Speed (OMS). To use `omsfscmds`, ensure that the OMS daemon is running.
- Oracle Memory Speed CLI Commands
  `omsfscmds` is a command line utility for administering Oracle Memory Speed (OMS). To use `omsfscmds`, ensure that the OMS daemon is running.

Migrating Oracle Database to Oracle Memory Speed

Starting with Oracle Database 19c Release Update (19.12) you can migrate your database files to Oracle Memory Speed (OMS) storage using SQL and RMAN commands.

Before you start the migration of the database files, create an OMS file system, mount it, and enable OMS on the database instance.

- Preparing for the OMS Migration
  Create and mount an Oracle Memory Speed (OMS) file system before you start the migration.
- Adding Redo Log Files to OMS
  To achieve best redo performance, Oracle recommends that you add all members of a redo group to storage with similar characteristics. For Oracle Memory Speed (OMS) file

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system, adding all the members of the redo group to OMS provides efficient redo log write times.

- Moving Data Files to OMS
  Use this procedure if you want to move selected data files to Oracle Memory Speed (OMS) storage.
- Moving the Entire Database to OMS
  Use RMAN to move the entire database to Oracle Memory Speed (OMS) if the number of data files are large or if you want to move `root` PDB files.

Preparing for the OMS Migration

Create and mount an Oracle Memory Speed (OMS) file system before you start the migration.

1. Start the OMS daemon by running `$ORACLE_HOME/bin/oms_daemon`.

   ```
   #export ORACLE_SID="test"
   #$ORACLE_HOME/bin/oms_daemon
   ```

2. Identify the DAX-capable XFS file system. Create an OMS file system on this DAX-capable PMEM storage using the `omsfscmds` utility.
3. Mount the OMS file system you created in a unique database mount point directory such as `$ORACLE_BASE/oradata/$ORACLE_SID`.
4. Shut down the instance.
5. Enable the OMS ODM library on the database instance.

   ```
   $ cd $ORACLE_HOME/rdbms/lib
   $ make -f ins_rdbms.mk oms_on
   ```

6. If Oracle Managed File (OMF) is in use, then set the `DB_CREATE_FILE_DEST` parameter to the OMS mount directory. `DB_CREATE_FILE_DEST` specifies the default location for the Oracle Managed data files. If an Oracle parameter file is in use, then set `DB_CREATE_FILE_DEST` in the parameter file.

   If you want to create an online redo log files on OMS, then set the `db_create_online_log_dest_1` parameter to the OMS mount directory. This allows any new redo log file that you add to the database to be created on OMS storage.
7. Start the database instance. If `spfile` is in use, then set the `db_create_file_dest` and `db_create_online_log_dest_n` in the SP file:

   ```
   SQL> alter system set db_create_file_dest='OMS_MOUNT_DIR' scope=both;
   SQL> alter system set db_create_online_log_dest_1='OMS_MOUNT_DIR'
   scope=both;
   ```

   Here, *OMS_MOUNT_DIR* is the directory path where you mounted the OMS file system.

Related Topics

- About the OMS Daemon
  OMS is a user-space file system. The OMS daemon handles management and CLI operations for OMS.
- Deploying Oracle Database with Oracle Memory Speed
  Learn the steps to use Oracle Memory Speed (OMS) in Oracle Database.

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Adding Redo Log Files to OMS

To achieve best redo performance, Oracle recommends that you add all members of a redo group to storage with similar characteristics. For Oracle Memory Speed (OMS) file system, adding all the members of the redo group to OMS provides efficient redo log write times.

To add new redo log file members in OMS and drop the existing non-OMS redo files, perform these steps:

1. Identify all the existing redo group numbers configured by querying `v$log`.

   ```
   SQL> SELECT GROUP#, ARCHIVED, STATUS FROM V$LOG;
   ```

2. Add a new log group with a new log member in the OMS location.

   ```
   SQL> ALTER DATABASE ADD LOGFILE 'OMS_MOUNT_PATH/oms_redolog_2.rdo';
   ```

   This statement adds a new log group number, which can be verified by querying `v$log`.

3. If your database is set up with OMF and `db_create_online_log_dest_1` parameter is already set to point to OMS, then add the log file without specifying a log file name.

   ```
   SQL> ALTER DATABASE ADD LOGFILE;
   ```

   Query `v$logfile` to identify the new group number and log file added to the database. The block size for new members located on OMS will be 4k.

4. (Optional) If Oracle Managed Files (OMF) for redo log is enabled in your database, then change `db_create_online_log_dest_1` to point to the OMS mount path specified in step 3.

   ```
   SQL> alter system set db_create_online_log_dest_1='OMS_MOUNT_DIR'
   scope=both;
   ```

5. After you add the new redo log file in OMS, drop the non-OMS redo log file from the list in `V$LOG`.

> **Note**
>
> Before you drop the log file, ensure that the status is set to `INACTIVE`.

Example 8-6 Script for Moving Online Redo Logs

```
SET SERVEROUTPUT ON;

DECLARE

CURSOR rlc IS

SELECT GROUP# GRP, THREAD# THR, BYTES, 'NO' SRL
FROM V$LOG
UNION
```


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```
SELECT GROUP# GRP, THREAD# THR, BYTES, 'YES' SRL
FROM V$STANDBY_LOG
ORDER BY 1;

stmt VARCHAR2(2048);

BEGIN
FOR rlcRec IN rlc LOOP

IF (rlcRec.srl = 'YES') THEN
stmt := 'ALTER DATABASE ADD STANDBY LOGFILE THREAD ' ||
rlcRec.thr || ' SIZE ' || rlcRec.bytes;
EXECUTE IMMEDIATE stmt;
stmt := 'ALTER DATABASE DROP STANDBY LOGFILE GROUP ' || rlcRec.grp;
EXECUTE IMMEDIATE stmt;
ELSE
stmt := 'ALTER DATABASE ADD LOGFILE THREAD ' ||
rlcRec.thr || ' SIZE ' || rlcRec.bytes;
EXECUTE IMMEDIATE stmt;

BEGIN
stmt := 'ALTER DATABASE DROP LOGFILE GROUP ' || rlcRec.grp;
DBMS_OUTPUT.PUT_LINE(stmt);
EXECUTE IMMEDIATE stmt;
EXCEPTION
WHEN OTHERS THEN
EXECUTE IMMEDIATE 'ALTER SYSTEM SWITCH LOGFILE';
EXECUTE IMMEDIATE 'ALTER SYSTEM CHECKPOINT GLOBAL';
EXECUTE IMMEDIATE stmt;
END;

END IF;

END LOOP;

END;

/
```

See *Oracle Database Administrator's Guide* for more information about managing redo logs.

Moving Data Files to OMS

Use this procedure if you want to move selected data files to Oracle Memory Speed (OMS) storage.

> **Note**
>
> If you are connected to a CDB, ensure that you switch to the PDB before you move the data file that belongs to the PDB.

1. Choose the data file that needs to be moved to OMS by querying `v$datafile`.
2. Select `name`, `file#` from `v$datafile`.

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3. To move `file#=3` to OMS:

   ```
   SQL> alter database move datafile 3 to 'OMS_FILE_NAME';
   ```

4. If you have already set `db_create_file_dest` to point to the OMS mount directory, then move the data file.

   ```
   SQL> alter database move datafile 3;
   ```

   The online data file move command copies the data file contents from the original location and updates the control file with the new OMS file name location.

5. Use `v$datafile` to verify if the move has completed.

   ```
   SQL> select file#, name from v$datafile where file#=3;
   ```

Moving the Entire Database to OMS

Use RMAN to move the entire database to Oracle Memory Speed (OMS) if the number of data files are large or if you want to move `root` PDB files.

To migrate your entire database:

1. Backup your database.
2. Restore the file on OMS and recover the database.

Before you start the database backup:

- If you have any read-only transportable tablespaces with the `COMPATIBLE` initialization parameter set to less than `11.0.0`, then make any read-only transportable tablespaces read/write for RMAN backup to work on the tablespaces.
- If you have a physical standby database, then stop any running managed recovery:

  ```
  SQL> ALTER DATABASE RECOVER MANAGED STANDBY DATABASE CANCEL;
  ```

1. Start the RMAN session and connect to the database that you want to migrate. Perform a `level 0` copy of the database in OMS storage.

   ```
   RUN
   {
             ALLOCATE CHANNEL dev1 DEVICE TYPE DISK;
             ALLOCATE CHANNEL dev2 DEVICE TYPE DISK;
             ALLOCATE CHANNEL dev3 DEVICE TYPE DISK;
             ALLOCATE CHANNEL dev4 DEVICE TYPE DISK;
             BACKUP AS COPY
                  INCREMENTAL LEVEL 0
                  DATABASE
                  FORMAT 'oms_mount_path/%U'
                 TAG 'ORA_OMS_MIGRATION';
   }
   ```

   The format clause specifies *oms_mount_path/%U*, which corresponds to the OMS file system that you will use for storing the database.

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2. If you are not using an SPFILE, then create an SPFILE in the OMS storage using the current PFILE.

```
SQL> CREATE SPFILE='oms_mount_path/spfilesid.ora' FROM PFILE='?/dbs/
initsid.ora';
```

3. Archive the current online redo logs and back up the server parameter file `SPFILE`.

```
RMAN> SQL "ALTER SYSTEM ARCHIVE LOG CURRENT";
RMAN> BACKUP AS BACKUPSET SPFILE;
RMAN> SHUTDOWN IMMEDIATE;
```

4. If the database uses change tracking or Flashback Database, then disable these features before you shut down the database instance.

```
RMAN> SQL "ALTER DATABASE DISABLE BLOCK CHANGE TRACKING";
RMAN> SQL "ALTER DATABASE FLASHBACK OFF";
```

   You have now created a full copy of the database and the instance is shut down.

5. To start the database instance and switch to the RMAN copy in OMS storage, create a `SPFILE` in the OMS storage area.

```
RMAN> STARTUP MOUNT;
RMAN> RESTORE SPFILE TO 'oms_mount_path/spfilesid.ora';
RMAN> SHUTDOWN IMMEDIATE;
```

   Where *oms_mount_path* is the mount path to the OMS storage and *sid* is the SID of the instance.

6. Set the Oracle Managed Files (OMF) parameters to point to the OMS mount path.

```
SQL> STARTUP FORCE NOMOUNT;
SQL> ALTER SYSTEM SET DB_CREATE_FILE_DEST='oms_mount_path' SID='*';
SQL> ALTER SYSTEM SET DB_RECOVERY_FILE_DEST='oms_mount_path' SID='*';
```

7. Migrate the control files to OMS, set the control file location to the OMS path, and restore the control file from the original non-OMS location.

```
SQL> STARTUP FORCE NOMOUNT;
SQL> ALTER SYSTEM SET CONTROL_FILES='oms_mount_path' SCOPE=SPFILE SID='*';
```

8. Restore the control file.

```
RMAN> STARTUP FORCE NOMOUNT;
RMAN> RESTORE CONTROLFILE FROM 'original_cf_name';
RMAN> ALTER DATABASE MOUNT;
```

   In this example, *original_cf_name* is a control file name in the initialization parameter file before migration.

9. Migrate the data files to the OMS copy using RMAN `SWITCH DATABASE`.

```
SWITCH DATABASE TO COPY;
RUN
```


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```
{
ALLOCATE CHANNEL dev1 DEVICE TYPE DISK;
ALLOCATE CHANNEL dev2 DEVICE TYPE DISK;
ALLOCATE CHANNEL dev3 DEVICE TYPE DISK;
ALLOCATE CHANNEL dev4 DEVICE TYPE DISK;
RECOVER DATABASE;
}
```

10. Enable change tracking or Flashback Database, if the database uses these features.

    ```
    SQL> ALTER DATABASE ENABLE BLOCK CHANGE TRACKING USING FILE
    'oms_mount_path';
    SQL> ALTER DATABASE FLASHBACK ON;
    ```

11. Place the database in its normal operation mode to use OMS.
    - If the database is a primary database, then open it using:

      ```
      SQL> ALTER DATABASE OPEN;
      ```

    - If the database is a standby database, then resume managed recovery mode:

      ```
      SQL> ALTER DATABASE RECOVER MANAGED STANDBY DATABASE;
      ```

12. If you want to migrate any tempfiles to OMS, then drop the existing tempfiles and add a new temp file in the OMS mount path.

    ```
    SQL> ALTER DATABASE TEMPFILE 'tempfile_name' DROP;
    SQL> ALTER TABLESPACE temp_tbs_name ADD TEMPFILE;
    ```

    In this example, the name of the tempfile in the original storage is *tempfile_name*. The name of the temporary tablespace is *temp_tbs_name*.

To migrate online redo logs to the OMS location, see Adding Redo Log Files to OMS

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Configuring Storage for Oracle Grid Infrastructure for a Standalone Server

Complete these procedures to use Oracle Grid Infrastructure for a standalone server, which includes Oracle Automatic Storage Management (Oracle ASM).

Oracle Grid Infrastructure for a standalone server, also known as Oracle Restart, provides system support for a single-instance Oracle Database. Oracle ASM is a volume manager and a file system for Oracle database files that supports single-instance Oracle Database and Oracle Real Application Clusters (Oracle RAC) configurations. Oracle Automatic Storage Management also supports a general purpose file system for your application needs, including Oracle Database binaries. Oracle Automatic Storage Management is Oracle's recommended storage management solution. It provides an alternative to conventional volume managers and file systems.

> **Note**
>
> - If you want to use Oracle ASM or Oracle Restart, then you must install Oracle Grid Infrastructure for a standalone server before you install and create the database. Otherwise, you must manually register the database with Oracle Restart.
> - You can neither install Oracle Restart on an Oracle Grid Infrastructure cluster member node, nor add an Oracle Restart server to an Oracle Grid Infrastructure cluster member node. Oracle Restart supports single-instance databases on one server, while Oracle Grid Infrastructure for a Cluster supports single-instance or Oracle RAC databases on a cluster.

- Configuring Storage for Oracle Automatic Storage Management
  Identify storage requirements and Oracle ASM disk group options.
- Configuring Storage Device Path Persistence Using Oracle ASMLIB
  To use Oracle ASMLIB to configure Oracle ASM devices, complete the following tasks:
- Migrating from Oracle ASM Filter Driver to Oracle ASMLib for Oracle Restart
  Oracle ASM filtering is disabled starting with Linux kernel version 5.14. To continue using filtering, migrate from Oracle ASM Filter Driver (Oracle ASMFD) to Oracle ASMLib 3.1 in *rolling mode*.
- Deconfiguring Oracle ASM Filter Driver
  If Oracle ASM Filter Driver (Oracle ASMFD) is installed but you do not use it for device path persistence, then deconfigure Oracle ASMFD.
- Creating DAS or SAN Disk Partitions for Oracle Automatic Storage Management
  You can use direct-attached storage (DAS) and storage area network (SAN) disks with Oracle ASM.
- Creating Directories for Oracle Database Files
  You can store Oracle Database and recovery files on a separate file system from the configuration files.

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- Creating Files on a NAS Device for Use with Oracle Automatic Storage Management
  If you have a NAS storage device, then you can create zero-padded files in an NFS mounted directory and use those files as disk devices in an Oracle ASM disk group.

Configuring Storage for Oracle Automatic Storage Management

Identify storage requirements and Oracle ASM disk group options.

> **Note**
>
> Oracle ASM Filter Driver (ASMFD) is deprecated on both Linux and Oracle Solaris beginning with Oracle Database 19c. It will be desupported in a future release.
> On Linux systems running kernel 5.14 or higher (including Oracle Linux, RedHat Enterprise Linux, and SUSE Linux Enterprise Server), ASMFD filtering is already disabled and will not be supported going forward. Oracle recommends moving to ASMlib v3 for those environments, as it provides equivalent functionality. For details, see My Oracle Support Document 2806979.1. Migration steps are available for Oracle Restart and Oracle Grid Infrastructure. On Oracle Solaris, ASMFD is deprecated, but remains fully supported. No immediate action is required until a formal desupport notice is issued.

- Identifying Storage Requirements for Oracle Automatic Storage Management
  To identify the storage requirements for using Oracle ASM, you must determine the number of devices and the amount of free disk space that you require.
- Oracle ASM Disk Space Requirements
  Determine the total amount of Oracle Automatic Storage Management (Oracle ASM) disk space that you require for the database files and recovery files.
- ASM Disk Group Options for Installation
  Plan how you want to configure Oracle ASM disk groups for deployment.
- Using an Existing Oracle ASM Disk Group
  Use Oracle Enterprise Manager Cloud Control or the Oracle ASM command line tool (`asmcmd`) to identify existing disk groups, and to determine if sufficient space is available in the disk group.

Related Topics

- Migrating from Oracle ASM Filter Driver to Oracle ASMLib
- Oracle Automatic Storage Management Filter Driver (ASMFD) (Doc ID 2806979.1)
- *Oracle Automatic Storage Management Administrator's Guide*

Identifying Storage Requirements for Oracle Automatic Storage Management

To identify the storage requirements for using Oracle ASM, you must determine the number of devices and the amount of free disk space that you require.

To complete this task, perform the following steps:

1. Determine whether you want to use Oracle ASM for Oracle Database files, recovery files, or both. Oracle Database files include data files, control files, redo log files, the server parameter file, and the password file.

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During the database installation, you have the option to select either a file system or Oracle ASM as the storage mechanism for Oracle Database files. Similarly, you also have the option to select either a file system or Oracle ASM as the storage mechanism for your recovery files.

> **Note**
>
> You do not have to use the same storage mechanism for both Oracle Database files and recovery files. You can use a file system for one file type and Oracle ASM for the other.

If you select Oracle ASM as your storage option for Oracle Database files, then depending on your choice in the Specify Recovery Options screen, you have the following recovery options:

- If you select the Oracle ASM option for your recovery files, then Oracle Universal Installer provides you with only the option to use the same disk group for both Oracle Database files and recovery files.
- If you decide not to enable recovery during the database installation, then, after the database installation, you can modify the `DB_RECOVERY_FILE_DEST` parameter to enable the fast recovery area.

2. Choose the Oracle ASM redundancy level to use for each Oracle ASM disk group that you create.

   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, as follows:

   - **External redundancy**

     This option does not allow Oracle ASM to mirror the contents of the disk group. Oracle recommends that you select this redundancy level either when the disk group contains devices, such as RAID devices, that provide their own data protection or when the database does not require uninterrupted access to data.

   - **Normal redundancy**

     To optimize performance and reliability in a normal redundancy disk group, Oracle ASM uses two-way mirroring for data files and three-way mirroring for control files, by default. In addition, you can choose the mirroring characteristics for individual files in a disk group.

     A normal redundancy disk group requires a minimum of two failure groups (or two disk devices) if you are using two-way mirroring. The effective disk space in a normal redundancy disk group is half the sum of the disk space of all of its devices.

     For most installations, Oracle recommends that you use normal redundancy disk groups. On Oracle Exadata, Oracle recommends that you use high redundancy disk groups for added protection against failure.

   - **High redundancy**

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

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Although high-redundancy disk groups provide a high level of data protection, you must consider the higher cost of additional storage devices before deciding to use this redundancy level.

- **Flex redundancy**

  A flex redundancy disk group is a new disk group type with features such as flexible file redundancy, mirror splitting, and redundancy change. A flex disk group can consolidate files with different redundancy requirements into a single disk group. It also provides the capability for databases to change the redundancy of its files.

  For database data, you can choose no mirroring (unprotected), two-way mirroring (mirrored), or three-way mirroring (high). A flex redundancy disk group requires a minimum of three disk devices (or three failure groups).

- **Extended redundancy**
  Extended redundancy disk group has features similar to the flex redundancy disk group. Extended redundancy is available when you configure an Oracle Extended Cluster. Extended redundancy extends Oracle ASM data protection to cover failure of sites by placing enough copies of data in different failure groups of each site.

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

   If an Oracle ASM instance is running on the system, then you can use an existing disk group to meet these storage requirements. If necessary, you can add disks to an existing disk group during the database installation.

   See, "Oracle ASM Disk Space Requirements" in *Oracle Database Installation Guide* for the Oracle ASM disk space requirements.

   > **Note**
   >
   > - The disk devices must be owned by the user performing the grid installation.
   >
   >   Check with your system administrator to determine if the disks used by Oracle ASM are mirrored at the storage level. If so, select External for the redundancy. If the disks are not mirrored at the storage level, then select Normal for the redundancy.
   > - 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 4 MB for flex disk group and 1 MB for all other disk group types. On engineered systems, the default value is 4 MB.

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

   If you intend to use a normal, high or flex redundancy disk group, then you can further protect your database against hardware failure by associating a set of disk devices in a custom failure group. By default, each device comprises its own failure group. However, if two disk devices in a normal redundancy disk group are attached to the same Host Bus Adapter (HBA), then the disk group becomes unavailable if the controller fails. The controller in this example is a single point of failure.

   To protect against failures of this type, use two HBAs, 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 HBA.

   Consider the following guidelines while defining custom failure groups:

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- You can specify custom failure groups in the **Create ASM Disk Group** screen during an Oracle Grid Infrastructure installation.
- You can also define custom failure groups after installation, using the GUI tool ASMCA, the command line tool `asmcmd`, or SQL commands.
- If you define custom failure groups, then for failure groups containing database files only, you must specify a minimum of two failure groups for normal redundancy disk groups and three failure groups for high redundancy disk groups.

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

   Use the following guidelines when identifying appropriate disk devices:

   - The disk devices must be owned by the user performing the Oracle Grid Infrastructure installation.
   - All the devices in an Oracle ASM disk group must 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.
   - 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. Oracle recommends that if you choose to use a logical volume manager, then use the logical volume manager to represent a single logical unit number (LUN) without striping or mirroring, so that you can minimize the effect on storage performance of the additional storage layer.

Related Topics

- Oracle ASM Disk Space Requirements
  Determine the total amount of Oracle Automatic Storage Management (Oracle ASM) disk space that you require for the database files and recovery files.
- *Oracle Automatic Storage Management Administrator's Guide*

Oracle ASM Disk Space Requirements

Determine the total amount of Oracle Automatic Storage Management (Oracle ASM) disk space that you require for the database files and recovery files.

Table 9-1 Oracle ASM Disk Number and Minimum Space Requirements for an Oracle database (non-CDB)

Redundancy Level	Minimum Number of Disks	Data Files	Recovery Files	Both File Types
External	1	2.5 GB	7.5 GB	10 GB
Normal or Flex with two-way mirroring	2	5.2 GB	15.6 GB	20.8 GB
High or Flex with three-way mirroring	3	7.6 GB	22.8 GB	30.4 GB

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Table 9-2 Oracle ASM Disk Number and Minimum Space Requirements for a multitenant container database (CDB) with one pluggable database (PDB)

Redundancy Level	Minimum Number of Disks	Data Files	Recovery Files	Both File Types
External	1	4 GB	12 GB	16 GB
Normal or Flex with two-way mirroring	2	8 GB	24 GB	32 GB
High or Flex with three-way mirroring	3	12 GB	36 GB	48 GB

Note

- If an Oracle ASM instance is running on the system, then you can use an existing disk group to meet these storage requirements. If necessary, you can add disks to an existing disk group during the database installation.
- The disk devices must be owned by the user performing the grid installation.

  Check with your system administrator to determine if the disks used by Oracle ASM are mirrored at the storage level. If so, select External for the redundancy. If the disks are not mirrored at the storage level, then select Normal for the redundancy.
- 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 4 MB for flex disk group and 1 MB for all other disk group types. On engineered systems, the default value is 4 MB.

ASM Disk Group Options for Installation

Plan how you want to configure Oracle ASM disk groups for deployment.

During Oracle Grid Infrastructure installation, you can create one Oracle ASM disk group. After the Oracle Grid Infrastructure installation, you can create additional disk groups using Oracle Automatic Storage Management Configuration Assistant (Oracle ASMCA), SQL*Plus, or Automatic Storage Management Command-Line Utility (ASMCMD).

Related Topics

- *Oracle Automatic Storage Management Administrator's Guide*

Using an Existing Oracle ASM Disk Group

Use Oracle Enterprise Manager Cloud Control or the Oracle ASM command line tool (`asmcmd`) to identify existing disk groups, and to determine if sufficient space is available in the disk group.

1. Connect to the Oracle ASM instance and start the instance if necessary:

```
$ $ORACLE_HOME/bin/asmcmd
ASMCMD> startup
```


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

   ```
   ASMCMD> lsdg
   ```

   or

   ```
   $ORACLE_HOME/bin/asmcmd -p lsdg
   ```

   The `lsdg` command lists information about mounted disk groups only.
3. From the output, identify a disk group with the appropriate redundancy level and note the free space that it contains.
4. If necessary, install or identify the additional disk devices required to meet the storage requirements for your installation.

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

Configuring Storage Device Path Persistence Using Oracle ASMLIB

To use Oracle ASMLIB to configure Oracle ASM devices, complete the following tasks:

> **Note**
>
> To create a database during the installation using the Oracle ASM library driver, you must choose an installation method that runs ASMCA in interactive mode. You must also change the disk discovery string to `ORCL:*`.
>
> Oracle ASMLIB is not supported on IBM:Linux on System z and Linux for Arm (aarch64).

- About Oracle ASM with Oracle ASMLIB
  Oracle ASMLIB maintains permissions and disk labels that are persistent on the storage device, so that the label is available even after an operating system upgrade.
- Installing and Configuring Oracle ASMLIB Software
  Review this information to install and configure the Oracle Automatic Storage Management library driver software manually.
- Deinstalling Oracle ASMLIB On Oracle Database
  If Oracle ASM library driver (Oracle ASMLIB) is installed but you do not use it for device path persistence, then deinstall Oracle ASMLIB:

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About Oracle ASM with Oracle ASMLIB

Oracle ASMLIB maintains permissions and disk labels that are persistent on the storage device, so that the label is available even after an operating system upgrade.

The Oracle Automatic Storage Management library driver simplifies the configuration and management of block disk devices by eliminating the need to rebind block disk devices used with Oracle Automatic Storage Management (Oracle ASM) each time the system is restarted.

With Oracle ASMLIB, you define the range of disks you want to have made available as Oracle ASM disks. Oracle ASMLIB maintains permissions and disk labels that are persistent on the storage device, so that the label is available even after an operating system upgrade.

> **Note**
>
> If you configure disks using Oracle ASMLIB, then you must change the disk discovery string to `ORCL:*`. If the diskstring is set to `ORCL:*`, or is left empty (""), then the installer discovers these disks.

Installing and Configuring Oracle ASMLIB Software

Review this information to install and configure the Oracle Automatic Storage Management library driver software manually.

Oracle ASMLib is included with the Oracle Linux packages, and with SUSE Linux Enterprise Server. If you are a member of the Unbreakable Linux Network, then you can install the Oracle ASMLib RPMs by subscribing to the Oracle Linux channel, and using `yum` to retrieve the most current package for your system and kernel. For additional information, see the following URL:

https://www.oracle.com/linux/technologies/asmlib/

> **Note**
>
> - You must install Oracle ASMLib v3 (`oracleasmlib-3.0.0 or later` and `oracleasm-support-3.0.0 or later`) on all Oracle Database servers with Oracle Linux 8 and later kernels.
> - You must install Oracle ASMLib v2 (`oracleasmlib-2.0.17 or later` and `oracleasm-support-2.1.3 or later`) on all Oracle Database servers with Oracle Linux 7 and earlier kernels.

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

   ```
   # uname -rm
   ```

2. Depending on your operating system version, refer to the following URLs for installing, configuring, and administering Oracle ASMLib.
   - For Oracle ASMLib v3, refer https://docs.oracle.com/en/operating-systems/oracle-linux/asmlib/

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- For Oracle ASMLib v2, refer https://docs.oracle.com/en/operating-systems/oracle-linux/7/asmlib/

> **See Also**
>
> My Oracle Support note 1089399.1 for information about Oracle ASMLIB support with Red Hat distributions:
>
> https://support.oracle.com/rs?type=doc&id=1089399.1

Deinstalling Oracle ASMLIB On Oracle Database

If Oracle ASM library driver (Oracle ASMLIB) is installed but you do not use it for device path persistence, then deinstall Oracle ASMLIB:

1. Log in as `root`.
2. Stop Oracle ASM and any running database instance:

   ```
   # srvctl stop database


   # srvctl stop asm
   ```

3. Stop the Oracle Restart stack:

   ```
   # cd Grid_home/bin


   # crsctl stop has
   ```

   Where, *Grid_home* is the Oracle Grid Infrastructure home directory path.
4. Unload Oracle ASMLIB without restarting the system.

   ```
   # /usr/sbin/oracleasm exit
   ```

5. Stop Oracle ASMLIB:

   ```
   # /usr/sbin/oracleasm configure -d
   ```

6. Remove the `oracleasm` library and tools RPMs:

   ```
   # rpm -e oracleasm-support


   # rpm -e oracleasmlib
   ```

7. Check if any `oracleasm` RPMs are remaining:

   ```
   # rpm -qa| grep oracleasm
   ```


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8. If any `oracleasm` configuration files are remaining, remove them:

```
# rpm -qa| grep oracleasm | xargs rpm -e


Oracle ASMLIB and associated RPMs are now removed.
```

Start the Oracle Restart stack.

Migrating from Oracle ASM Filter Driver to Oracle ASMLib for Oracle Restart

Oracle ASM filtering is disabled starting with Linux kernel version 5.14. To continue using filtering, migrate from Oracle ASM Filter Driver (Oracle ASMFD) to Oracle ASMLib 3.1 in *rolling mode*.

Prerequisites

- If Oracle ASMFD is installed and configured for an existing Oracle ASM installation, then you must explicitly deconfigure Oracle ASMFD filtering before installing and configuring Oracle ASMLib.
- Use this procedure on Oracle Linux 8 or later servers running UEK6 (kernel version `5.4.17-2136.342.1` or later).
- If the Oracle ASM disk group attribute `compatible.rdbms` is lower than 12.2.0.1.0, then set `compatible.rdbms` to 12.2.0.1.0 or higher (preferred), or apply one-off patch for bug 39030808.

1. Confirm if Oracle ASMFD is configured and running:

```
# asmcmd lsdsk
Path
AFD:DATA1
AFD:DATA2
```

   The `AFD` prefix in the results indicates that the disks are configured using Oracle ASMFD.

2. Apply the one-off patches for the following bugs to the specified Oracle homes:
   a. 37347369 (Oracle Grid Infrastructure home)
   b. 37405185 (Oracle Grid Infrastructure home)
   c. 37230154 (Oracle Grid Infrastructure home and Oracle Database home)
   d. 39030808 (Oracle Grid Infrastructure home; required only if `compatible.rdbms` is lower than 12.2.0.1.0 and you cannot set it to a higher release)
3. As the `grid` user, shut down the Oracle Restart stack:

```
$ crsctl stop has
```

4. As the `root` user, stop the Oracle ACFS kernel modules:

```
# $ORACLE_HOME/bin/acfsload stop
```


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5. Deconfigure Oracle ASMFD filtering:

   ```
   # $ORACLE_HOME/bin/asmcmd afd_deconfigure
   ```

6. Install Oracle ASMLib v3 by performing the steps in the following link:

   https://docs.oracle.com/en/operating-systems/oracle-linux/asmlib/asmlib-InstallingASMLib.html

   After installing the `oracleasm-support` and `oracleasmlib` packages, configure `oracleasm` using the management utility `/usr/sbin/oracleasm`.

7. Run the Oracle ASM initialization script and configure Oracle ASMLib:

   ```
   # /usr/sbin/oracleasm init
   # /use/sbin/oracleasm configure -i
   ```

8. Start the Oracle ASMLib service.

   ```
   # systemctl enable --now oracleasm
   ```

9. As the `root` user, scan for Oracle ASMLib-labeled disks:

   ```
   # oracleasm scandisks
   ```

   > **Note**
   >
   > Ensure that the Oracle ASM disks in `/dev` are owned by the `asmdba` group.

10. List the Oracle ASMLib disks.

    ```
    # oracleasm listdisks
    ```

    > **Note**
    >
    > The disk list must match the disk list from Step 1.

11. Start the Oracle ACFS kernel modules.

    ```
    # $ORACLE_HOME/bin/acfsload start
    ```

    > **Note**
    >
    > Run this step even if you do not use Oracle ACFS.

12. As the `grid` user, start the Oracle Restart stack.

    ```
    $ crsctl start has
    ```


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13. Confirm if Oracle ASMLib is configured and running.

```
$ asmcmd lsdsk
Path
ORCL:DATA1
ORCL:DATA2
```

The `ORCL` prefix in the results indicates that the disks are configured using Oracle ASMLib.

Related Topics

- Installing and Configuring Oracle ASMLIB Software
  Review this information to install and configure the Oracle Automatic Storage Management library driver software manually.
- Deconfiguring Oracle ASM Filter Driver
  If Oracle ASM Filter Driver (Oracle ASMFD) is installed but you do not use it for device path persistence, then deconfigure Oracle ASMFD.

Deconfiguring Oracle ASM Filter Driver

If Oracle ASM Filter Driver (Oracle ASMFD) is installed but you do not use it for device path persistence, then deconfigure Oracle ASMFD.

1. Log in as `root`.
2. Set the environment variable `$ORACLE_BASE` to a temporary location.

```
# export ORACLE_BASE=/tmp
```

3. Shut down the Oracle Restart stack.

```
# crsctl stop has
```

4. Stop Oracle ACFS kernel modules.

```
# $ORACLE_HOME/bin/acfsload stop
```

5. Deconfigure Oracle ASMFD filtering.

```
# $ORACLE_HOME/bin/asmcmd afd_deconfigure
```

6. Start Oracle ACFS kernel modules.

```
# $ORACLE_HOME/bin/acfsload start
```

> **Note**
>
> This step is required even if you do not use Oracle ACFS.

7. Start the Oracle Restart stack.

```
# crsctl start has
```


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> **Note**
>
> Starting with Oracle AI Database 26ai, Oracle ASMFD is desupported. When you upgrade from Oracle Grid Infrastructure 19c to 26ai, ensure that the Oracle ASM devices are owned by the `asmdba` group. Refer to Configuring Device Persistence Manually for Oracle ASM for more information about the Oracle ASM device user and group ownership requirements.

Creating DAS or SAN Disk Partitions for Oracle Automatic Storage Management

You can use direct-attached storage (DAS) and storage area network (SAN) disks with Oracle ASM.

To use a DAS or SAN disk in Oracle ASM, Oracle recommends that the disk have a partition table. Oracle recommends creating exactly one partition for each disk.

Creating Directories for Oracle Database Files

You can store Oracle Database and recovery files on a separate file system from the configuration files.

Perform this procedure to place the Oracle Database or recovery files on a separate file system from the Oracle base directory:

1. Use the following command to determine the free disk space on each mounted file system:

   ```
   # df -h
   ```

2. Identify the file systems to use, from the display:

Option	Description
Database Files	Select one of the following: • A single file system with at least 1.5 GB of free disk space • Two or more file systems with at least 3.5 GB of free disk space in total
Recovery Files	Choose a file system with at least 2 GB of free disk space

   If you are using the same file system for multiple file types, then add the disk space requirements for each type to determine the total disk space requirement.

3. Note the names of the mount point directories for the file systems that you identified.
4. If the user performing installation has permissions to create directories on the disks where you plan to install Oracle Database, then Oracle DBCA creates the Oracle Database file directory, and the Recovery file directory. If the user performing installation does not have write access, then you must create these directories manually.

   For example, given the user `oracle` and Oracle Inventory Group `oinstall`, and using the paths `/u03/oradata/wrk_area` for Oracle Database files, and `/u01/oradata/rcv_area` for the recovery area, these commands create the recommended

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subdirectories in each of the mount point directories and set the appropriate owner, group, and permissions on them:

- Database file directory:

  ```
  # mkdir -p /u01/oradata/
  # chown oracle:oinstall /u01/oradata/
  # chmod 775 /u01/oradata
  ```

  The default location for the database file directory is `$ORACLE_BASE/oradata`.

- Recovery file directory (fast recovery area):

  ```
  # mkdir -p /u01/oradata/rcv_area
  # chown oracle:oinstall /u01/oradata/rcv_area
  # chmod 775 /u01/oradata/rcv_area
  ```

  The default fast recovery area is `$ORACLE_BASE/fast_recovery_area`.

  Oracle recommends that you keep the fast recovery area on a separate physical disk than that of the database file directory. This method enables you to use the fast recovery area to retrieve data if the disk containing oradata is unusable for any reason.

Creating Files on a NAS Device for Use with Oracle Automatic Storage Management

If you have a NAS storage device, then you can create zero-padded files in an NFS mounted directory and use those files as disk devices in an Oracle ASM disk group.

Ensure that you specify the ASM discovery path for Oracle ASM disks.

During installation of Oracle Grid Infrastructure, Oracle Universal Installer (OUI) can create files in the NFS mounted directory you specify. The following procedure explains how to manually create files in an NFS mounted directory to use as disk devices in an Oracle ASM disk group:

1. If necessary, create an exported directory for the disk group files on the NAS device.
2. Switch user to `root`.
3. Create a mount point directory on the local system.

   For example:

   ```
   # mkdir -p /mnt/oracleasm
   ```

4. To ensure that the NFS file system is mounted when the system restarts, add an entry for the file system in the mount file `/etc/fstab`.
5. Enter a command similar to the following to mount the NFS on the local system:

   ```
   # mount /mnt/oracleasm
   ```

6. Choose a name for the disk group to create, and create a directory for the files on the NFS file system, using the disk group name as the directory name.

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For example, if you want to set up a disk group for a sales database:

```
# mkdir /mnt/oracleasm/sales1
```

7. Use commands similar to the following to create the required number of zero-padded files in this directory:

```
# dd if=/dev/zero
of=/mnt/oracleasm/sales1/disk1 bs=1024k
count=1000
```

This example creates 1 GB files on the NFS file system. You must create one, two, or three files respectively to create an external, normal, or high redundancy disk group.

> **Note**
>
> Creating multiple zero-padded files on the same NAS device does not guard against NAS failure. Instead, create one file for each NAS device and mirror them using the Oracle ASM technology.

8. Enter commands similar to the following to change the owner, group, and permissions on the directory and files that you created:

```
# chown -R grid:asmadmin /mnt/oracleasm
# chmod -R 660 /mnt/oracleasm
```

In this example, the installation owner is `grid` and the OSASM group is `asmadmin`.

9. During Oracle Database installations, edit the Oracle ASM disk discovery string to specify a regular expression that matches the file names you created.

For example:

```
/mnt/oracleasm/sales1/
```

Related Topics

- My Oracle Support Note 359515.1

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10

Installing and Configuring Oracle Grid Infrastructure for a Standalone Server

Oracle Grid Infrastructure for a standalone server includes Oracle Restart and Oracle Automatic Storage Management.

If you install Oracle Grid Infrastructure for a standalone server and then create your database, then the database is automatically added to the Oracle Restart configuration. Oracle Restart automatically restarts the database when required.

If you install Oracle Grid Infrastructure for a standalone server on a host computer on which a database already exists, then you must manually add the database, the listener, the Oracle ASM instance, and other components to the Oracle Restart configuration before you are able to configure automatic database restarts.

> **Note**
>
> Oracle Grid Infrastructure for a standalone server can support multiple single-instance databases on a single host computer.

- About Image-Based Oracle Grid Infrastructure Installation
  Installation and configuration of Oracle Grid Infrastructure software is simplified with image-based installation.
- Setup Wizard Installation Options for Creating Images
  Before you start the setup wizards for your Oracle Database or Oracle Grid Infrastructure installation, decide if you want to use any of the available image-creation options.
- Installing Oracle Grid Infrastructure for a Standalone Server with a New Database Installation
  Complete these steps to install Oracle Grid Infrastructure for a standalone server and then create a database that is managed by Oracle Restart.
- Installing Oracle Grid Infrastructure for a Standalone Server for an Existing Database
  Follow the high-level instructions in this section to install Oracle Grid Infrastructure for a standalone server and configure it for an existing Oracle Database.
- Installing Oracle Grid Infrastructure for a Standalone Server Using a Software-Only Installation
  A software-only installation only installs the Oracle Grid Infrastructure for a standalone server binaries at the specified location. You must complete a few manual configuration steps to enable Oracle Restart after you install the software.
- Testing the Oracle Automatic Storage Management Installation
  After installing Oracle Grid Infrastructure for a single instance, use the ASMCMD command-line utility to test the Oracle ASM installation.
- Relinking Oracle Restart and Oracle ASM Binaries
  Relink the Oracle Restart and Oracle ASM binaries every time you apply an operating system patch or after an operating system upgrade.

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- Configuring Oracle ASM Disk Groups Manually using Oracle ASMCA
  After installing Oracle Grid Infrastructure for a standalone server, you can also use Oracle ASMCA to create and configure disk groups, Oracle ADVM, and Oracle ACFS.
- Enabling Oracle ACFS on Oracle Restart Configurations
  You must enable root access to use Oracle ACFS.
- Applying Patches During an Oracle Grid Infrastructure Installation or Upgrade
  Starting with Oracle Grid Infrastructure 18c, you can download and apply Release Updates (RUs) and one-off patches during an Oracle Grid Infrastructure installation or upgrade.
- Patching and Switching Oracle Grid Infrastructure Homes
  Perform an out-of-place Oracle Restart patching by switching from the current Oracle Grid Infrastructure home to a patched Oracle Grid Infrastructure home.
- Changing the Oracle Grid Infrastructure Base Path
  Use this procedure to change the Oracle Grid Infrastructure base directory after installation.

About Image-Based Oracle Grid Infrastructure Installation

Installation and configuration of Oracle Grid Infrastructure software is simplified with image-based installation.

To install Oracle Grid Infrastructure, create the new Grid home with the necessary user group permissions, and then extract the image file into the newly-created Grid home, and run the setup wizard to register the Oracle Grid Infrastructure product.

Using image-based installation, you can do the following:

- Configure Oracle Grid Infrastructure for a new cluster.
- Configure Oracle Grid Infrastructure for a standalone server (Oracle Restart).
- Upgrade Oracle Grid Infrastructure.
- Setup software only.
- Add or remove nodes from your existing cluster, if the Oracle Grid Infrastructure software is already installed or configured.

This installation feature streamlines the installation process and supports automation of large-scale custom deployments. You can also use this installation method for deployment of customized images, after you patch the base-release software with the necessary Release Updates (RUs) or Release Update Revisions (RURs).

> **Note**
>
> You must extract the image software into the directory where you want your Grid home to be located, and then run the `ORACLE_HOME\gridSetup.sh` script to start the Oracle Grid Infrastructure Setup Wizard. Ensure that the Grid home directory path you create is in compliance with the Oracle Optimal Flexible Architecture recommendations.

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Setup Wizard Installation Options for Creating Images

Before you start the setup wizards for your Oracle Database or Oracle Grid Infrastructure installation, decide if you want to use any of the available image-creation options.

In image-based installations, you can start your Oracle Database installation or Oracle Grid Infrastructure installations by running the setup wizards `runInstaller` and `gridSetup.sh` respectively. Both these wizards come with the following image-creation options.

Table 10-1 Image-Creation Options for Setup Wizard

Option	Description
`-createGoldImage`	Creates a gold image from the current Oracle home.
`-destinationLocation`	Specify the complete path, or location, where the gold image will be created.
`-exclFiles`	Specify the complete paths to the files to be excluded from the newly created gold image.
`–help`	Displays help for all the available options.

For example:

```
cd $ORACLE_HOME
./runInstaller -createGoldImage -destinationLocation /tmp/my_db_images -
exclFiles /u01/app/oracle/product/19.0.0/dbhome_1/relnotes
```

```
cd Grid_home
./gridSetup.sh -createGoldImage -destinationLocation /tmp/my_grid_images -
exclFiles /u01/app/oracle/product/19.0.0/dbhome_1/relnotes
```

Where:

`/tmp/my_db_images` is a temporary file location where the image zip file is created.

`/tmp/my_grid_images` is a temporary file location where the image zip file is created.

`/u01/app/oracle/product/19.0.0/dbhome_1/relnotes` is the file to be excluded from the newly created gold image.

Refer to runInstaller -createGoldImage and gridSetup.sh -createGoldImage for more examples.

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Installing Oracle Grid Infrastructure for a Standalone Server with a New Database Installation

Complete these steps to install Oracle Grid Infrastructure for a standalone server and then create a database that is managed by Oracle Restart.

> **Note**
>
> Oracle ASM Filter Driver (ASMFD) is deprecated on both Linux and Oracle Solaris beginning with Oracle Database 19c. It will be desupported in a future release.

Install Oracle Grid Infrastructure for a standalone server, which installs Oracle Restart and Oracle ASM, and creates one disk group.

You should have your network information, storage information, and operating system users and groups available to you before you start the installation. You should also be prepared to run root scripts or provide information to automate root scripts.

1. Log in as the Oracle Restart software owner user (`oracle`).
2. If this is the first time you are installing Oracle software, then create the Oracle base and the Oracle inventory directories as per the Oracle Optimal Flexible Architecture (OFA) recommendations. Specify the correct owner, group, and permissions for these directories.

   ```
   # mkdir -p /u01/app/oracle
   # mkdir -p /u01/app/oraInventory
   # chown -R oracle:oinstall /u01/app/oracle
   # chown -R oracle:oinstall /u01/app/oraInventory
   # chmod -R 775 /u01/app
   ```

3. Download the Oracle Grid Infrastructure for a standalone server installation image files, create the grid home directory, and extract the image files in this grid home directory.

   For example:

   ```
   $ mkdir -p /u01/app/oracle/product/19.0.0/grid
   $ cd /u01/app/oracle/product/19.0.0/grid
   $ unzip -q /tmp/grid_home.zip
   ```

   > **Note**
   >
   > - Ensure that the Grid home directory path you create is in compliance with the Oracle Optimal Flexible Architecture recommendations. Also, unzip the installation image files only in this Grid home directory that you created.
   > - Oracle home or Oracle base cannot be `symlinks`, nor can any of their parent directories, all the way to up to the `root` directory.

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4. Log in as the Oracle Restart software owner user amd run `gridSetup.sh` to start the Oracle Grid Infrastructure setup wizard:

   ```
   $ Grid_home/gridSetup.sh
   ```

   Where *Grid_home* is the Oracle Grid Infrastructure home directory.

   > **Note**
   >
   > You can use the `gridSetup.sh` command with the `-applyRU` and `-applyOneOffs` options to install Release Updates (RUs) and one-off patches during an Oracle Grid Infrastructure installation or upgrade.

5. In the Select Configuration Option screen, select the **Configure Oracle Grid Infrastructure for a Standalone Server (Oracle Restart)** option to install and configure Oracle Restart and Oracle ASM. Click **Next.**
6. During installation, disk paths mounted on Oracle ASM and registered on Oracle ASMLib with the string `ORCL:*` are listed as default database storage candidate disks.
7. Configure Oracle ASM as needed with additional disk groups.
   - The default Disk Group Name is DATA. You can enter a new name for the disk group, or use the default name.
   - Any additional disk devices that you create must be owned by the user performing the grid installation.
8. Respond to the configuration prompts as needed to configure Oracle Grid Infrastructure. Click **Help** for information.
9. Provide information to automate root scripts, or run scripts as root when prompted by OUI.

   If you configure automation for running root scripts, and a root script fails, then you can fix the problem manually, and click **Retry** to run the root script again.
10. Start the Oracle Database installation, and select Oracle ASM disk groups for Oracle Database files storage. For assistance during installation, click **Help** on the Oracle Universal Installer page where you need more information.

Related Topics

- Optimal Flexible Architecture
  Oracle Optimal Flexible Architecture (OFA) rules are a set of configuration guidelines created to ensure well-organized Oracle installations, which simplifies administration, support and maintenance.
- Deinstalling Oracle ASMLIB On Oracle Database
  If Oracle ASM library driver (Oracle ASMLIB) is installed but you do not use it for device path persistence, then deinstall Oracle ASMLIB:

Related Topics

- Applying Patches During an Oracle Grid Infrastructure Installation or Upgrade
  Starting with Oracle Grid Infrastructure 18c, you can download and apply Release Updates (RUs) and one-off patches during an Oracle Grid Infrastructure installation or upgrade.
- *Oracle Automatic Storage Management Administrator's Guide*

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Installing Oracle Grid Infrastructure for a Standalone Server for an Existing Database

Follow the high-level instructions in this section to install Oracle Grid Infrastructure for a standalone server and configure it for an existing Oracle Database.

Oracle Restart can manage resources from the same release and releases up to one version lower than Oracle Restart. For instance, you can install Oracle Grid Infrastructure for a standalone server 19c (Oracle Restart) to provide services for Oracle Database 19c and Oracle Database 18c. Earlier Oracle Database releases can coexist on the same server without being managed by Oracle Restart.

To install Oracle Grid Infrastructure for a standalone server for a database that is already installed:

1. Log in as the Oracle Database software owner user.
2. Set the ORACLE_HOME and ORACLE_SID environment variables.

   Bourne, Bash or Korn shell:

   ```
   $ ORACLE_SID=orcl
   $ export ORACLE_SID
   $ ORACLE_HOME=/u01/app/oracle/product/19.0.0/dbhome_1
   $ export ORACLE_HOME
   ```

   C shell:

   ```
   % setenv ORACLE_SID orcl
   % setenv ORACLE_HOME /u01/app/oracle/product/19.0.0/dbhome_1
   ```

3. Go to the Oracle home and stop any existing database listeners.

   ```
   $ $ORACLE_HOME/lsnrctl stop listener_name
   ```

   > **Note**
   >
   > If this command throws an error, reload the listener using `lsnrctl reload LISTENER`

4. On the same host computer as the database, install Oracle Grid Infrastructure for a standalone server, and select **Configure Oracle Grid Infrastructure for a Standalone Server (Oracle Restart)** as the installation option. See, “Installing Oracle Grid Infrastructure for a Standalone Server with a New Database Installation” in *Oracle Database Installation Guide*.

   The Oracle Grid Infrastructure for a standalone server components are installed in an Oracle Grid Infrastructure Oracle home (Grid home), which is in a different location from existing Oracle Database homes.

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5. If you have an existing Oracle Database, then register it for High Availability with Oracle Restart using the `srvctl` command:

```
$ cd $ORACLE_HOME/bin
$ srvctl add database -db dbname -o oracle_home_path
```

Related Topics

- Installing Oracle Grid Infrastructure for a Standalone Server with a New Database Installation
  Complete these steps to install Oracle Grid Infrastructure for a standalone server and then create a database that is managed by Oracle Restart.
- *Oracle Database Administrator's Guide*

Installing Oracle Grid Infrastructure for a Standalone Server Using a Software-Only Installation

A software-only installation only installs the Oracle Grid Infrastructure for a standalone server binaries at the specified location. You must complete a few manual configuration steps to enable Oracle Restart after you install the software.

- About Oracle Grid Infrastructure Software-Only Installations
  Manually installing and configuring the software binaries for Oracle Grid Infrastructure.
- Installing Software Binaries for Oracle Grid Infrastructure for a Standalone Server
  Use this procedure to do a software-only installation of Oracle Grid Infrastructure for a standalone server.
- Configuring Software Binaries for Oracle Grid Infrastructure for a Standalone Server
  Use these steps to configure and activate a software-only Oracle Grid Infrastructure for a standalone server installation for Oracle Restart.

About Oracle Grid Infrastructure Software-Only Installations

Manually installing and configuring the software binaries for Oracle Grid Infrastructure.

Oracle recommends that only advanced users perform software-only installations, because this installation method provides no validation of the installation, and this installation option requires manual postinstallation steps to enable the Oracle Grid Infrastructure for a standalone server software.

Performing a software-only installation requires the following steps:

1. Installing the software binaries.
2. Configuring the software binaries.

Installing Software Binaries for Oracle Grid Infrastructure for a Standalone Server

Use this procedure to do a software-only installation of Oracle Grid Infrastructure for a standalone server.

1. Log in as the Oracle Restart software owner user (`oracle`).

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2. Download the Oracle Grid Infrastructure for a standalone server installation image files, create the Grid home directory, and extract the image files in this Grid home directory.

   For example:

   ```
   $ mkdir -p /u01/app/oracle/product/19.0.0/grid
   $ chown oracle:oinstall /u01/app/oracle/product/19.0.0/grid
   $ cd /u01/app/oracle/product/19.0.0/grid
   $ unzip -q /tmp/grid_home.zip
   ```

   > **Note**
   >
   > Ensure that the Grid home directory path you create is in compliance with the Oracle Optimal Flexible Architecture recommendations. Also, unzip the installation image files only in this Grid home directory that you created.

3. Ensure that you complete all the storage and server preinstallation requirements. Verify that your server meets the installation requirements using the following command:

   ```
   $ cd /u01/app/oracle/product/19.0.0/grid
   $ runcluvfy.sh stage -pre hacfg
   ```

4. Run `gridSetup.sh` to start the Oracle Grid Infrastructure setup wizard:

   ```
   $ Grid_home/gridSetup.sh
   ```

   Where, *Grid_home* is the Oracle Grid Infrastructure home directory.

   > **Note**
   >
   > You must install Oracle Grid Infrastructure for a standalone server from the Oracle Grid Infrastructure media.

5. In the Select Configuration Option screen, select the **Set Up Software Only** option to perform a software-only installation of Oracle Grid Infrastructure for a standalone server. Click **Next.**
6. Respond to the prompts as needed to set up Oracle Grid Infrastructure. Click **Help** for information.
7. The Oracle Grid Infrastructure setup wizard prompts you to run the `root.sh` script and, if required, the `orainstRoot.sh` script.
8. The `root.sh` script output provides information about how to proceed, depending on the configuration you plan to complete in this installation. Note this information.

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Configuring Software Binaries for Oracle Grid Infrastructure for a Standalone Server

Use these steps to configure and activate a software-only Oracle Grid Infrastructure for a standalone server installation for Oracle Restart.

Configuring With Oracle Automatic Storage Management

1. Install the software binaries. See, “Installing Software Binaries for Oracle Grid Infrastructure for a Standalone Server” in *Oracle Database Installation Guide*.
2. Run `gridSetup.sh` to start the Oracle Grid Infrastructure setup wizard.

   See, “Installing Oracle Grid Infrastructure for a Standalone Server with a New Database Installation” in *Oracle Database Installation Guide*.

Configuring Without Oracle Automatic Storage Management

1. Log in as `root` and run the `roothas.sh` script located in the *Grid_home* path, using the following syntax:

   ```
   # cd Grid_home/crs/install
   # ./roothas.sh
   ```

   Where, *Grid_home* is the Oracle Grid Infrastructure home directory.

   For example:

   ```
   # cd /u01/app/oracle/product/19.0.0/grid/crs/install
   # ./roothas.sh
   ```

2. Change directory to the path *Grid_home*`/oui/bin`.
3. Log in as the Oracle Restart software owner user and use the following command syntax, where Grid_home is the path of the Oracle Grid Infrastructure for a standalone server home.

   ```
   $ ./runInstaller -updateNodeList ORACLE_HOME=Grid_home -defaultHomeName
   CLUSTER_NODES= CRS=TRUE
   ```

   For example:

   ```
   $ ./runInstaller -updateNodeList ORACLE_HOME=/u01/app/oracle/product/
   19.0.0/grid
   -defaultHomeName CLUSTER_NODES= CRS=TRUE
   ```

4. Use the `SRVCTL` utility along with Oracle Network Configuration Assistant to add the listener to the Oracle Restart configuration.

> **Note**
>
> This procedure does not work for Oracle Restart upgrades from previous releases.

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Related Topics

- Installing Software Binaries for Oracle Grid Infrastructure for a Standalone Server
  Use this procedure to do a software-only installation of Oracle Grid Infrastructure for a standalone server.
- Installing Oracle Grid Infrastructure for a Standalone Server with a New Database Installation
  Complete these steps to install Oracle Grid Infrastructure for a standalone server and then create a database that is managed by Oracle Restart.

Testing the Oracle Automatic Storage Management Installation

After installing Oracle Grid Infrastructure for a single instance, use the ASMCMD command-line utility to test the Oracle ASM installation.

1. Open a shell window, and temporarily set the ORACLE_SID and ORACLE_HOME environment variables to specify the appropriate values for the Oracle ASM instance to use.

   For example, if the Oracle ASM SID is named +ASM and the Oracle home is located in the grid subdirectory of the ORACLE_BASE directory, then enter the following commands to create the required settings:

   Bourne, Bash or Korn shell:

   ```
   $ ORACLE_SID=+ASM
   $ export ORACLE_SID
   $ ORACLE_HOME=/u01/app/oracle/product/19.0.0/grid
   $ export ORACLE_HOME
   ```

   C shell:

   ```
   % setenv ORACLE_SID +ASM
   % setenv ORACLE_HOME /u01/app/oracle/product/19.0.0/grid
   ```

2. Use ASMCMD to list the disk groups for the Oracle ASM instance:

   ```
   $ORACLE_HOME/bin/asmcmd lsdg
   ```

   If the Oracle ASM instance is running, then ASMCMD connects by default as the SYS user with SYSASM privileges, and is available.

3. If the Oracle ASM instance is not running, then start the Oracle ASM instance using the following command:

   ```
   $ORACLE_HOME/bin/srvctl start asm
   ```

Related Topics

- *Oracle Automatic Storage Management Administrator's Guide*

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Relinking Oracle Restart and Oracle ASM Binaries

Relink the Oracle Restart and Oracle ASM binaries every time you apply an operating system patch or after an operating system upgrade.

> ⚠ **Caution**
>
> Before relinking executables, you must shut down all executables that run in the Oracle home directory that you are relinking. In addition, shut down applications linked with Oracle shared libraries.

1. Log in as `root` and unlock the grid home:

   ```
   # cd Grid_home/crs/install
   # roothas.sh -unlock
   ```

2. Log in as the `grid` user and relink the binaries:

   ```
   $ export ORACLE_HOME=Grid_home
   $ Grid_home/bin/relink
   ```

3. Log in as `root` again and perform the following steps:

   ```
   # cd Grid_home/rdbms/install/
   # ./rootadd_rdbms.sh
   # cd Grid_home/crs/install
   # roothas.sh -lock
   ```

Configuring Oracle ASM Disk Groups Manually using Oracle ASMCA

After installing Oracle Grid Infrastructure for a standalone server, you can also use Oracle ASMCA to create and configure disk groups, Oracle ADVM, and Oracle ACFS.

During Oracle Grid Infrastructure for a standalone server installation, Oracle Automatic Storage Management Configuration Assistant (Oracle ASMCA) utility creates a new Oracle Automatic Storage Management instance if there is no Oracle ASM instance currently configured on the computer. After installation, you can create and configure additional disk groups, and you can configure Oracle ADVM and Oracle ACFS.

To create disk groups or manually configure Oracle ASM disks, start Oracle ASMCA, where *Grid_home* is the path to the Oracle Grid Infrastructure home:

```
$ cd Grid_home/bin
$ ./asmca
```

Related Topics

- *Oracle Automatic Storage Management Administrator's Guide*

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Enabling Oracle ACFS on Oracle Restart Configurations

You must enable root access to use Oracle ACFS.

> **Note**
>
> The ACFS storage option on IBM AIX is deprecated in Oracle Database 19c.

To enable root access, log in as `root`, navigate to the path *Grid_home*`/crs/install`, and run the script `roothas.sh –lockacfs`.
Where, *Grid_home* is the Oracle Grid Infrastructure home directory path.

For example:

```
# cd /u01/app/oracle/product/19.0.0/grid/crs/install
# roothas.sh -lockacfs
```

> **Note**
>
> Starting with Oracle Database 12*c* Release 1 (12.1.0.2), the `roothas.sh` script replaces the `roothas.pl` script in the Oracle Grid Infrastructure home.

Applying Patches During an Oracle Grid Infrastructure Installation or Upgrade

Starting with Oracle Grid Infrastructure 18c, you can download and apply Release Updates (RUs) and one-off patches during an Oracle Grid Infrastructure installation or upgrade.

1. Download the patches you want to apply from My Oracle Support:

   https://support.oracle.com

2. Select the **Patches and Updates** tab to locate the patch.

   Oracle recommends that you select **Recommended Patch Advisor**, and enter the product group, release, and platform for your software.

3. Move the patches to an accessible directory like `/tmp`.

4. Change to the Oracle Grid Infrastructure home directory:

   ```
   $ cd /u01/app/oracle/product/19.0.0/grid
   ```

5. Apply Release Updates (RUs) and any one-off patches during the installation or upgrade process:

   ```
   $ ./gridSetup.sh -applyRU patch_directory_location -applyOneOffs
   comma_seperated_list_of_patch_directory_locations
   ```


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> **Note**
>
> You can apply RUs and one-off patches separately or together in the same command.

6. Complete the remaining steps in the Oracle Grid Infrastructure configuration wizard to complete the installation or upgrade.

Related Topics

- *Oracle Grid Infrastructure Upgrading Oracle Restart for Linux and Unix-Based Operating Systems*

Patching and Switching Oracle Grid Infrastructure Homes

Perform an out-of-place Oracle Restart patching by switching from the current Oracle Grid Infrastructure home to a patched Oracle Grid Infrastructure home.

1. Download the 19.3 Oracle Grid Infrastructure base release image files.

   https://www.oracle.com/database/technologies/oracle-database-software-downloads.html#19c

2. As the `grid` user, extract the downloaded image files into a new Oracle Grid Infrastructure home directory.

   ```
   $ mkdir -p /u01/app/oracle/product/19.17.0/grid
   $ chown grid:oinstall /u01/app/oracle/product/19.17.0/grid
   $ cd /u01/app/oracle/product/19.17.0/grid
   $ unzip -q download_location/grid.zip
   ```

   Here:

   - `/u01/app/oracle/product/19.17.0/grid` is the new Grid home.
   - `/u01/app/oracle/product/19.16.0/grid` is the old Grid home.

3. As the `grid` user, download and install the latest version of the OPatch utility in the new Grid home.

   https://updates.oracle.com/download/6880880.html

   ```
   $ mv /u01/app/oracle/product/19.17.0/grid/OPatch /u01/app/oracle/product/
   19.17.0/grid/bak_OPatch
   $ unzip latest_Opatch.zip -d /u01/app/oracle/product/19.17.0/grid/
   ```

4. Download the Oracle Database RU version that you want to apply from My Oracle Support. In this example, Oracle Database 19.17 RU.

   For more information, see, Downloading Release Update Patches

5. Download and install the latest OPatch version.

   For more information, see My Oracle Support note 274526.1.

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6. Start the Oracle Grid Infrastructure installer to perform a software-only Oracle Restart installation. You can apply the optional `-applyRU` or `-applyOneOff` flags to apply Release Updates (RUs) during the installation.

```
 $ /u01/app/oracle/product/19.17.0/grid/gridSetup.sh [-applyRU
patch_directory_location]
[-applyOneOffs comma_separated_list_of_patch_directory_locations]
```

7. Follow the steps in the configuration wizard to complete the Oracle Grid Infrastructure installation.
8. As the `root` user, perform the following steps:
   a. Relink the Oracle Grid Infrastructure binaries:

```
# /u01/app/oracle/product/19.17.0/grid/rdbms/install/rootadd_rdbms.sh
```

   b. Prepare the new home for the out-of-place patching:

```
# /u01/app/oracle/product/19.17.0/grid/crs/install/roothas.sh -prepatch
-dstcrshome
/u01/app/oracle/product/19.17.0/grid
```

      This command does not shut down any services.
9. As the `root` user, run the following command to switch to the new Oracle Grid Infrastructure home and perform the out of place patching:

```
# /u01/app/oracle/product/19.17.0/grid/crs/install/roothas.sh -postpatch -
dstcrshome
/u01/app/oracle/product/19.17.0/grid
```

   This command shuts down the old Oracle Grid Infrastructure home and starts resources from the new Oracle Grid Infrastructure home. All Oracle Grid Infrastructure services start running from the new Grid home.
10. Update the Oracle central inventory (oraInventory).

```
$ /u01/app/oracle/product/19.17.0/grid/oui/bin/runInstaller -
updateNodeList ORACLE_HOME=/u01/app/oracle/product/19.17.0/grid CRS=TRUE
$ /u01/app/oracle/product/19.16.0/grid/oui/bin/runInstaller -
updateNodeList ORACLE_HOME=/u01/app/oracle/product/19.16.0/grid CRS=FALSE
```

11. To switch back to the old Grid home:
    a. As the `root` user, run the `prepatch` script.

```
# Old_GI_Home/crs/install/roothas.sh -prepatch -dstcrshome Old_GI_Home
```

    b. As the `root` user, run the `postpatch` script.

```
# Old_GI_Home/crs/install/roothas.sh -postpatch -dstcrshome Old_GI_Home
```

    c. Update the Oracle central inventory (oraInventory).

```
$ /u01/app/oracle/product/19.16.0/grid/oui/bin/runInstaller -
updateNodeList ORACLE_HOME=/u01/app/oracle/product/19.16.0/grid CRS=TRUE
```


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```
$ /u01/app/oracle/product/19.17.0/grid/oui/bin/runInstaller -
updateNodeList ORACLE_HOME=/u01/app/oracle/product/19.17.0/grid
CRS=FALSE
```

Changing the Oracle Grid Infrastructure Base Path

Use this procedure to change the Oracle Grid Infrastructure base directory after installation.

This procedure applies to Oracle Grid Infrastructure 19c Release Update (19.21) and later releases.

> **Note**
>
> Before changing the Grid base, shut down all executables running in the Grid base directory. Additionally, shut down any applications linked to Oracle shared libraries.

1. As the `root` user, create a new Oracle base directory, then change the owner and group for the directory and files in the new Grid base.

   ```
   # mkdir -p /u02/app/grid
   # chown -R grid:oinstall /u02/app/grid
   ```

2. Stop the Oracle Restart stack and the Trace File Analyzer (TFA).

   ```
   # $ORACLE_HOME/bin/crsctl stop has
   # tfactl stop
   ```

3. Copy the Oracle Grid Infrastructure files from the old Grid base location to the new Grid base location, for example, from `/u01/app/grid` to `/u02/app/grid`.

   ```
   # cp -pR /u01/app/grid /u02/app/grid
   ```

4. Create a backup of the old Oracle base to prevent the creation of new files.

   ```
   # mv /u01/app/grid /u01/app/grid.old
   ```

5. Using a text editor, update the ORACLE_BASE parameter in the *`Grid_home`*`/crs/install/crsconfig_params` file to reflect the new Oracle base.

   ```
   ORACLE_BASE=/u02/app/grid
   ```

6. Using a text editor, update the ORACLE_BASE parameter in the *`Grid_home`*`/install/orabasetab` file to reflect the new Oracle base.

   ```
   ORACLE_BASE=/u01/app/grid:/u02/app/grid:OraGI19Home1:N:
   ```

7. Update the new Oracle base location in the *`Grid_home`*`/inventory/ContentsXML/oraclehomeproperties.xml` file and the *`Grid_home`*`/network/admin/sqlnet.ora` file.

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8. Using a text editor, update the `olrconfig_loc` parameter in the `/etc/oracle/olr.loc` file to reflect the new `ORACLE_BASE` path.

   ```
   olrconfig_loc=/u02/app/grid/crsdata/$HOSTNAME/olr/$HOSTNAME_19.olr
   ```

9. Restore the Oracle Grid Infrastructure home file permissions.

   ```
   # /u01/app/oracle/product/19.0.0/grid/crs/install/roothas.sh -init
   ```

10. Move the Oracle Autonomous Health Framework (AHF) data directory to the new Oracle base directory.

    ```
    # ahfctl movedatadir /u02/app/grid
    ```

11. Start the Oracle Restart stack.

    ```
    # $ORACLE_HOME/bin/crsctl start has
    ```


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11

Installing Oracle Database

Oracle Database and Oracle Grid Infrastructure installation software is available as image-based zip files and can be installed using several options.

You can download Oracle Database software from the Oracle website or the Oracle Software Delivery Cloud portal. In most cases, you use the graphical user interface (GUI) provided by Oracle Universal Installer to install the software. However, you can also run silent mode installations, without using the GUI. You can also use Oracle Fleet Patching and Provisioning for Oracle Database and Oracle Grid Infrastructure (clusterware) deployments.

Oracle Database software may be available on installation media on-demand.

> **Note**
>
> To install Oracle Database files on Oracle Automatic Storage Management (Oracle ASM), you must first complete an Oracle Grid Infrastructure for a standalone server installation. Oracle Grid Infrastructure for a standalone server includes Oracle Restart and Oracle ASM.
>
> To upgrade an existing Oracle ASM installation, upgrade Oracle ASM by running an Oracle Grid Infrastructure upgrade. If you do not have Oracle ASM installed and you want to use Oracle ASM as your storage option, then you must complete an Oracle Grid Infrastructure for a standalone server installation before you start your Oracle Database installation.
>
> You cannot use Oracle Universal Installer from an earlier Oracle release to install components from this release.

- About Image-Based Oracle Database Installation
  Understand image-based installation to simplify installation and configuration of Oracle Database software.
- About Deploying Oracle Database Using Oracle Fleet Patching and Provisioning
  You can use Oracle Fleet Patching and Provisioning (Oracle FPP) to provision Oracle Database software.
- Downloading Oracle Software
  Select the method you want to use to download the software.
- About Character Set Selection During Installation
  Before you create the database, decide the character set that you want to use.
- About Automatic Memory Management Installation Options
  Decide if you want to configure Automatic Memory Management during installation.
- Running the Installer in a Different Language
  Describes how to run the installer in other languages.
- Installing the Oracle Database Software
  These topics explain how to run Oracle Universal Installer to perform most database installations.

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- Installing Oracle Database Using RPM Packages
  Learn how to leverage and take advantage of an RPM framework to easily deploy Oracle Database.
- Installing Standard Edition High Availability
  Learn how to Install high availability on Oracle Database Standard Edition 2.

About Image-Based Oracle Database Installation

Understand image-based installation to simplify installation and configuration of Oracle Database software.

To install Oracle Database, create the new Oracle home, extract the image file into the newly-created Oracle home, and run the setup wizard to register the Oracle Database product.

Using image-based installation, you can install and upgrade Oracle Database for single-instance and cluster configurations. If you install or clone an Oracle Database image, then all Oracle Database options such as Oracle OLAP (`olap`) and Oracle Real Application Testing (`rat`) are enabled by default.

This installation feature streamlines the installation process and supports automation of large-scale custom deployments. You can also use this installation method for deployment of customized images, after you patch the base-release software with the necessary Release Updates (Updates) or Monthly Recommended Patches (MRPs).

> **Note**
>
> You must extract the image software (`db_home.zip`) into the directory where you want your Oracle Database home to be located, and then run the Oracle Database Setup Wizard to start the Oracle Database installation and configuration. Oracle recommends that the Oracle home directory path you create is in compliance with the Oracle Optimal Flexible Architecture recommendations.

About Deploying Oracle Database Using Oracle Fleet Patching and Provisioning

You can use Oracle Fleet Patching and Provisioning (Oracle FPP) to provision Oracle Database software.

Starting with Oracle Database 19c, Rapid Home Provisioning is renamed to Oracle Fleet Patching and Provisioning (Oracle FPP).

With Oracle Fleet Patching and Provisioning, you create, store, and manage templates of Oracle homes as images (called gold images) of Oracle software, such as databases, middleware, and applications. You can make a working copy of any gold image and then you can provision that working copy to any node in the data center or cloud computing environment.

You can use Oracle Fleet Patching and Provisioning to provision, patch, and upgrade single-instance databases running on Oracle Restart, on clusters, or on single, standalone nodes. These may be on nodes with or without Oracle Grid Infrastructure installed.

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> **Note**
>
> Oracle Fleet Patching and Provisioning is not supported on Microsoft Windows and HP-UX Itanium systems.

Related Topics

- *Oracle Fleet Patching and Provisioning Administrator's Guide*

Downloading Oracle Software

Select the method you want to use to download the software.

You can download Oracle Database software from the Oracle website or the Oracle Software Delivery Cloud portal and extract them to the Oracle home. Ensure that you review and understand the terms of the license.

- Downloading the Installation Archive Files from Oracle Website
  Download installation archive files from the Oracle website.
- Downloading the Software from Oracle Software Delivery Cloud Portal
  You can download the software from Oracle Software Delivery Cloud.

Downloading the Installation Archive Files from Oracle Website

Download installation archive files from the Oracle website.

1. Use any browser to access the software download page on the Oracle website:

   http://www.oracle.com/technetwork/indexes/downloads/index.html
2. Go to the download page for the product to install.
3. On the download page, identify the required disk space by adding the file sizes for each required file.

   The file sizes are listed next to the file names.
4. Select a file system with enough free space to store and expand the archive files.

   In most cases, the available disk space must be at least twice the size of all of the archive files.
5. On the file system, create a parent directory for each product (for example, `OraDB19c`) to hold the installation directories.
6. Download all of the installation archive files to the directory you created for the product.

   > **Note**
   >
   > For Oracle Database Client installations, there are two installation archive files available for download. The first file is the client installation binary and the second file is a client gold image file. Download the appropriate zip file based on the type of installation you want to perform.
7. Verify that the files you downloaded are the same size as the corresponding files on the Oracle website. Also verify the checksums are the same as noted on the Oracle website

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using a command similar to the following, where *filename* is the name of the file you downloaded:

```
cksum filename.zip
```

8. Extract the files in each directory that you just created.

Downloading the Software from Oracle Software Delivery Cloud Portal

You can download the software from Oracle Software Delivery Cloud.

1. Use a browser to access the Oracle Software Delivery Cloud portal:

   https://edelivery.oracle.com/

2. Click **Sign In** and enter your Oracle account username and password.
3. Type **Oracle Database** in the search bar. Click the **Add to Cart** button corresponding to the Oracle Database version that you want to download
4. In the Checkout page, click **Checkout** and deselect any products that you do not want to download.
5. Select the operating system platform on which you want to install the software from the **Platform/Languages** column.
6. Click **Continue**.
7. Review the license agreement.
8. Select the **I reviewed and accept the Oracle License Agreement** checkbox. Click **Continue**.
9. Click **Download** to start downloading the software.
10. After you download the files, click **View Digest** to verify that the checksum matches the value listed on the download page.

About Character Set Selection During Installation

Before you create the database, decide the character set that you want to use.

After a database is created, changing its character set is usually very expensive in terms of time and resources. Such operations may require converting all character data by exporting the whole database and importing it back. Therefore, it is important that you carefully select the database character set at installation time.

Oracle Database uses character sets for the following:

- Data stored in SQL character data types (`CHAR`, `VARCHAR2`, `CLOB`, and `LONG`).
- Identifiers such as table names, column names, and PL/SQL variables.
- Stored SQL and PL/SQL source code, including text literals embedded in this code.

Starting with Oracle Database 12c Release 2 (12.2), the default database character set of a database created from the General Purpose/Transaction Processing or the Data Warehousing template is Unicode `AL32UTF8`.

Unicode is the universal character set that supports most of the currently spoken languages of the world. It also supports many historical scripts (alphabets). Unicode is the native encoding

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of many technologies, including Java, XML, XHTML, ECMAScript, and LDAP. Unicode is ideally suited for databases supporting the Internet and the global economy.

Because `AL32UTF8` is a multibyte character set, database operations on character data may be slightly slower when compared to single-byte database character sets, such as `WE8ISO8859P1` or `WE8MSWIN1252`. Storage space requirements for text in most languages that use characters outside of the ASCII repertoire are higher in `AL32UTF8` compared to legacy character sets supporting the language. English data may require more space only if stored in `CLOB` (character large object) columns. Storage for non-character data types, such as `NUMBER` or `DATE`, does not depend on a character set. The universality and flexibility of Unicode usually outweighs these additional costs.

Consider legacy character sets only when the database needs to support a single group of languages and the use of a legacy character set is critical for fulfilling compatibility, storage, or performance requirements. The database character set to be selected in this case is the character set of most clients connecting to this database.

The database character set of a multitenant container database (CDB) determines which databases can be plugged in later. Ensure that the character set you choose for the CDB is compatible with the database character sets of the databases to be plugged into this CDB. If you use Unicode `AL32UTF8` as your CDB character set, then you can plug in a pluggable database (PDB) in any database character set supported by Oracle Database (with the exception of EBCDIC-based character sets).

See Also

Oracle Database Globalization Support Guide for more information about choosing a database character set for a multitenant container database (CDB)

About Automatic Memory Management Installation Options

Decide if you want to configure Automatic Memory Management during installation.

During a **Typical** installation, you create your database with Oracle Database Configuration Assistant (DBCA), and automatic memory management is enabled. If you choose **Advanced** installation, then you can either specify memory allocation manually, or enable automatic memory management.

If the total physical memory of your database instance is greater than 4 GB, then you cannot select the Oracle Automatic Memory Management option during database installation and creation. Instead, use automatic shared memory management. Automatic shared memory management automatically distributes the available memory among the various components as required, allowing the system to maximize the use of all available SGA memory.

With automatic memory management, the Oracle Database instances automatically manage and tune memory for you. With automatic memory management, you choose a memory target, and the instance automatically distributes memory between the system global area (SGA) and the instance program global area (instance PGA). As memory requirements change, the instance dynamically redistributes memory between the SGA and instance PGA.

You can enable automatic memory management either during, or after the database installation. Enabling automatic memory management after installation involves a shutdown and restart of the database.

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> **Note**
>
> By default, automatic memory management is disabled when you perform typical installation on a node that has more than 4 GB of RAM.

Related Topics

- *Oracle Database Administrator's Guide*

Running the Installer in a Different Language

Describes how to run the installer in other languages.

Your operating system locale determines the language in which the database installer runs. You can run the installer in one of these languages:

- Brazilian Portuguese (pt_BR)
- French (fr)
- German (de)
- Italian (it)
- Japanese (ja)
- Korean (ko)
- Simplified Chinese (zh_CN)
- Spanish (es)
- Traditional Chinese (zh_TW)

To run the database installer in a supported language, change the locale in which your operating system session is running before you start the installer.

If the selected language is not one of the supported languages, then the installer runs in English.

Installing the Oracle Database Software

These topics explain how to run Oracle Universal Installer to perform most database installations.

> **Note**
>
> - If you plan to use Oracle Restart or Oracle ASM, then you must install Oracle Grid Infrastructure for a standalone server before you install and create the database. Otherwise, you must manually register the database with Oracle Restart.
> - You can install Oracle Database by using the silent or response file installation method, without the GUI. This method is useful to perform multiple installations of Oracle Database.

- Setup Wizard Installation Options for Creating Images

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- Applying Patches During an Oracle Database Installation or Upgrade
  Starting with Oracle Database 18c, you can download and apply Release Updates (RUs) during an Oracle Database installation or upgrade.
- Running Oracle Database Setup Wizard to Install Oracle Database
  Extract the database image files and use the `runInstaller` command to start the installation.

Setup Wizard Installation Options for Creating Images

Before you start the setup wizards for your Oracle Database or Oracle Grid Infrastructure installation, decide if you want to use any of the available image-creation options.

In image-based installations, you can start your Oracle Database installation or Oracle Grid Infrastructure installations by running the setup wizards `runInstaller` and `gridSetup.sh` respectively. Both these wizards come with the following image-creation options.

Table 11-1 Image-Creation Options for Setup Wizard

Option	Description
`-createGoldImage`	Creates a gold image from the current Oracle home.
`-destinationLocation`	Specify the complete path, or location, where the gold image will be created.
`-exclFiles`	Specify the complete paths to the files to be excluded from the newly created gold image.
`–help`	Displays help for all the available options.

For example:

```
cd $ORACLE_HOME
./runInstaller -createGoldImage -destinationLocation /tmp/my_db_images -
exclFiles /u01/app/oracle/product/19.0.0/dbhome_1/relnotes


cd Grid_home
./gridSetup.sh -createGoldImage -destinationLocation /tmp/my_grid_images -
exclFiles /u01/app/oracle/product/19.0.0/dbhome_1/relnotes
```

Where:

`/tmp/my_db_images` is a temporary file location where the image zip file is created.

`/tmp/my_grid_images` is a temporary file location where the image zip file is created.

`/u01/app/oracle/product/19.0.0/dbhome_1/relnotes` is the file to be excluded from the newly created gold image.

Refer to runInstaller -createGoldImage and gridSetup.sh -createGoldImage for more examples.

Applying Patches During an Oracle Database Installation or Upgrade

Starting with Oracle Database 18c, you can download and apply Release Updates (RUs) during an Oracle Database installation or upgrade.

1. Download the patches you want to apply from My Oracle Support:

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https://support.oracle.com

2. Select the **Patches and Updates** tab to locate the patch.

   Oracle recommends that you select **Recommended Patch Advisor**, and enter the product group, release, and platform for your software.

3. Move the patches to an accessible directory like `/tmp`.

4. Change to the Oracle Database home directory:

   ```
   $ cd $ORACLE_HOME
   ```

5. Apply Release Updates (RUs) during the installation or upgrade process:

   ```
   $ ./runInstaller -applyRU patch_directory_location
   ```

6. Complete the remaining steps in the Oracle Database configuration wizard to complete the installation or upgrade.

Running Oracle Database Setup Wizard to Install Oracle Database

Extract the database image files and use the `runInstaller` command to start the installation.

Have all the information you need to provide regarding users groups, and storage paths before you start installation. Oracle recommends that you have your My Oracle Support credentials available during installation. You should also be prepared to run root scripts or provide information to automate root scripts.

1. Log in as the Oracle installation owner user account (`oracle`) that you want to own the software binaries.

2. If this is the first time you are installing Oracle software, then create the Oracle base and the Oracle inventory directories as per the Oracle Optimal Flexible Architecture (OFA) recommendations. Specify the correct owner, group, and permissions for these directories.

   ```
   # mkdir -p /u01/app/oracle
   # mkdir -p /u01/app/oraInventory
   # chown -R oracle:oinstall /u01/app/oracle
   # chown -R oracle:oinstall /u01/app/oraInventory
   # chmod -R 775 /u01/app
   ```

3. Download the Oracle Database installation image files (`db_home.zip`) to a directory of your choice. For example, you can download the image files to the `/tmp` directory.

4. Create an OFA-compliant Oracle home directory and extract the image files that you have downloaded in to this Oracle home directory. For example:

   ```
   $ mkdir -p /u01/app/oracle/product/19.0.0/dbhome_1
   $ cd /u01/app/oracle/product/19.0.0/dbhome_1
   $ unzip -q /tmp/db_home.zip
   ```


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> **Note**
>
> - Ensure that the Oracle home directory path you create is in compliance with the Oracle Optimal Flexible Architecture recommendations. Also, unzip the installation image files only in this Oracle home directory that you created.
> - Oracle home or Oracle base cannot be `symlinks`, nor can any of their parent directories, all the way to up to the `root` directory.

5. From the Oracle home directory, run the `runInstaller` command to start the Oracle Database Setup Wizard.

```
$ cd /u01/app/oracle/product/19.0.0/dbhome_1
$ ./runInstaller
```

> **Note**
>
> - Run the `runInstaller` command from the Oracle home directory only. Do not use the `runInstaller` command that resides at `$ORACLE_HOME/oui/bin/`, or any other location, to install Oracle Database, Oracle Database Client, or Oracle Grid Infrastructure.
> - Use the `runInstaller` command with the `-applyRU` option to install Release Updates (RUs) during an Oracle Database installation or upgrade.

6. In the Select Configuration Option screen, select **Create and configure a single instance database.**
7. Select your installation type.

   Installation screens vary depending on the installation option you select. Respond to the configuration prompts as needed.
8. Provide information to automate root scripts, or run scripts as root when prompted by the setup wizard.

   If you configure automation for running root scripts, and a root script fails, then you can fix the problem manually, and click **Retry** to run the root script again.

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

Related Topics

- Downloading Oracle Software
  Select the method you want to use to download the software.

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Installing Oracle Database Using RPM Packages

Learn how to leverage and take advantage of an RPM framework to easily deploy Oracle Database.

- About RPM-Based Oracle Database Installation
  Starting with Oracle Database 18c, you can install a single-instance Oracle Database or an Oracle Database Instant Client software using RPM packages.
- Restrictions and Guidelines for RPM-Based Installations
  Review these guidelines before you start your RPM-based Oracle Database installation.
- RPM Packages Naming Convention
  The RPM packages naming convention includes information such as the version, release, and architecture.
- Running RPM Packages to Install Oracle Database
  Perform the following steps to install and configure Oracle Database using RPM packages.

About RPM-Based Oracle Database Installation

Starting with Oracle Database 18c, you can install a single-instance Oracle Database or an Oracle Database Instant Client software using RPM packages.

An RPM-based installation performs preinstallation checks, extracts the database software, reassigns ownership of the extracted software to the preconfigured user and groups, maintains the Oracle inventory, and runs all root operations required to configure the Oracle Database software for a single-instance Oracle Database creation and configuration.

The RPM–based installation process detects when the minimum requirements for an installation are not met and prompts you to finish these minimum preinstallation requirements.

An RPM-based installation performs a software-only Oracle Database installation and creates an Oracle home. After the Oracle home is created, you can then use Oracle Database Configuration Assistant (Oracle DBCA) to create an Oracle Database.

The RPM-based installation process provides you with the option to create a database with the default settings using the `/etc/init.d/oracledb_ORCLCDB-19c` service configuration script.

Restrictions and Guidelines for RPM-Based Installations

Review these guidelines before you start your RPM-based Oracle Database installation.

- Patching Oracle Database software using RPMs is not supported. Please use the OPatch utility and follow the regular patching process to apply Oracle Database patches.
- An RPM-based Oracle Database installation is not available for Standard Edition 2.
- RPM-based database upgrades using `rpm -Uvh` is not supported. For Oracle Database upgrades, follow the regular upgrade process.
- An RPM-based installation supports the installation of multiple Oracle Database software versions into different Oracle homes on the same machine.

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RPM Packages Naming Convention

The RPM packages naming convention includes information such as the version, release, and architecture.

The naming convention for RPM packages is *name-version-release.architecture*`.rpm`

The following table describes the variables used in the RPM `oracle-database-ee-19c-1.0-1.x86_64.rpm`

Table 11-2 RPM Packages Naming Convention Example

Variable	Example	Description
name	`oracle-database-ee-19c`	The name of the Oracle Database edition and release.
version	`1.0`	The version number of the RPM package.
release	`1`	The release number of the RPM package.
architecture	`x86_64`	The architecture of the RPM package.

Related Topics

- RPM Packaging Guide
- Format of the RPM File

Running RPM Packages to Install Oracle Database

Perform the following steps to install and configure Oracle Database using RPM packages.

Installing Oracle Database RPM using yum

1. Log in as `root`.
2. If you are using Oracle Linux and have subscribed to Unbreakable Linux Network (ULN), you can install Oracle Database via a single `yum` command.

   ```
   # yum -y install oracle-database-ee-19c
   ```
   This command downloads and installs the Oracle Database Preinstallation RPM and the Oracle Database RPM packages.

   The installation of Oracle Database software is now complete, continue to the "Creating and Configuring an Oracle Database" section.

Installing Oracle Database RPM Manually

1. Log in as `root`.
2. Download and install the Oracle Database Preinstallation RPM:
   a. On Oracle Linux

      ```
      # yum -y install oracle-database-preinstall-19c
      ```


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b. On Red Hat Enterprise Linux

```
# curl -o oracle-database-preinstall-19c-1.0-1.el7.x86_64.rpm https://
yum.oracle.com/repo/OracleLinux/OL7/latest/x86_64/getPackage/oracle-
database-preinstall-19c-1.0-1.el7.x86_64.rpm
# yum -y localinstall oracle-database-
preinstall-19c-1.0-1.el7.x86_64.rpm
```

After successful installation, you can delete the downloaded RPM file:

```
# rm oracle-database-preinstall-19c-1.0-1.el7.x86_64.rpm
```

3. Access the software download page for Oracle Database RPM-based installation from Oracle Technology Network:

   https://www.oracle.com/database/technologies/oracle-database-software-downloads.html

4. Download the `.rpm` file required for performing an RPM-based installation to a directory of your choice. For example, download the `oracle-database-ee-19c-1.0-1.x86_64.rpm` file to the `/tmp` directory.

5. Install the database software using the `yum localinstall` command.

   ```
   # cd /tmp
   # yum -y localinstall oracle-database-ee-19c-1.0-1.x86_64.rpm
   ```

   Where, `oracle-database-ee-19c-1.0-1.x86_64.rpm` is the fully qualified name of the Oracle Database RPM.

The installation of Oracle Database software is now complete.

Creating and Configuring an Oracle Database

To create a sample database with the default settings, perform the following steps:

1. Log in as `root`.
2. To configure a sample Oracle Database instance, run the following service configuration script:

   ```
   # /etc/init.d/oracledb_ORCLCDB-19c configure
   ```

> **Note**
>
> You can modify the configuration parameters by editing the `/etc/sysconfig/oracledb_ORCLCDB-19c.conf` file.

This script creates a container database (`ORCLCDB`) with one pluggable database (`ORCLPDB1`) and configures the listener at the default port (1521).

Review the status information that is displayed on your screen.

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Related Topics

- Automatically Configuring Oracle Linux with Oracle Database Preinstallation RPM
  Use Oracle Database Preinstallation RPM to simplify operating system configuration in preparation for Oracle software installations.
- Downloading Oracle Software
  Select the method you want to use to download the software.
- Removing an RPM-based Oracle Database Installation
  Use this procedure to remove and deinstall a database installed using the `yum` command.

Installing Standard Edition High Availability

Learn how to Install high availability on Oracle Database Standard Edition 2.

- About Standard Edition High Availability
  Starting with Oracle Database 19c, you can install Oracle Database Standard Edition 2 in high availability mode.
- Requirements for Installing Standard Edition High Availability
  Review these requirements before you install and deploy the Standard Edition High Availability feature.
- Deploying Standard Edition High Availability
  Learn the process and options to deploy high availability on Oracle Database Standard Edition 2.

About Standard Edition High Availability

Starting with Oracle Database 19c, you can install Oracle Database Standard Edition 2 in high availability mode.

> **Note**
>
> The ACFS storage option on IBM AIX is deprecated in Oracle Database 19c.

Standard Edition High Availability provides cluster-based failover for single-instance Standard Edition Oracle Databases using Oracle Clusterware.

Oracle Standard Edition High Availability benefits from the cluster capabilities and storage solutions that are already part of Oracle Grid Infrastructure, such as Oracle Clusterware, Oracle Automatic Storage Management (Oracle ASM) and Oracle ASM Cluster File System (Oracle ACFS).

Using integrated, shared, and concurrently mounted storage, such as Oracle ASM and Oracle ACFS for database files as well as for unstructured data, enables Oracle Grid Infrastructure to restart an Oracle Database on a failover node much faster than any cluster solution that relies on failing over and remounting volumes and file systems.

Starting with Oracle Database 19c Release Update (19.7), Standard Edition High Availability is supported on Linux x86-64, Oracle Solaris on SPARC (64-bit), and Microsoft Windows.

Starting with Oracle Database 19c Release Update (19.13), Standard Edition High Availability is supported on IBM AIX on POWER Systems (64-bit) and HP-UX Itanium.

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> **Note**
>
> This section is specific to Standard Edition High Availability, which provides cluster-based database failover for Standard Edition Oracle Databases 19c. For more information about high availability options for Oracle Database, see *Oracle Clusterware Administration and Deployment Guide*.

Requirements for Installing Standard Edition High Availability

Review these requirements before you install and deploy the Standard Edition High Availability feature.

- You must configure Standard Edition High Availability using at least two nodes of a cluster running Oracle Grid Infrastructure 19.7 or later for Standalone Cluster.
- You must configure Standard Edition High Availability using an Oracle Database home of version 19.7 or later.

  > **Note**
  >
  > When updating your Oracle Database home using Release Update (RU) 19.7 or later, ensure that you apply the Oracle Clusterware (OCW) RU of the same version to the Oracle Database home.

- Ensure that all cluster nodes on which you plan to install Oracle Database have the same operating system users, groups, and resource limits for the database software owner.
- You must store the Oracle Database binaries only on local storage or Oracle Automatic Storage Management Cluster File System (Oracle ACFS).
- You must store the Oracle Database data files only on Oracle ASM or Oracle ACFS.
- If you are using Oracle ACFS for storing data files, then you must register Oracle ACFS as a clusterware resource. The Oracle Database software owner user (`oracle`) must be the mount owner of the Oracle ACFS volume. When using an Oracle home on Oracle ACFS, Oracle recommends that you have Oracle base on the local file system.
- If you are using a local file system, then you must have the same single-instance Standard Edition 2 installation and updates on each node. You must also use the same Oracle base and Oracle home directory structure on each node.
- You must perform the same Oracle home operations on all the nodes.
- You must use an SPFILE for the database instance initialization parameters and a database password file stored for the database instance initialization parameters in Oracle ASM or Oracle ACFS. This approach ensures that the parameters are consistent across all nodes and the password file is available after a failover or a relocation.
- You must register the Standard Edition 2 single-instance database with SCAN listeners as remote listener and node listeners as local listener.

Deploying Standard Edition High Availability

Learn the process and options to deploy high availability on Oracle Database Standard Edition 2.

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After installing Oracle Clusterware, as described in *Oracle Grid Infrastructure Installation and Upgrade Guide* for your platform, install single instance Standard Edition 2 Oracle Database software on the cluster nodes on which you want to configure Standard Edition High Availability.

- Installing Standard Edition High Availability Database Software on Local File System
  You can install Oracle Database software binaries on a local file system to enable the Oracle Database Standard Edition high availability feature.
- Installing Standard Edition High Availability Database Software on Oracle ACFS
  You can install Oracle Database software binaries on an Oracle ASM Cluster File System (Oracle ACFS) volume to enable the Oracle Database Standard Edition High Availability feature.

Related Topics

- *Oracle Grid Infrastructure Installation and Upgrade Guide for Linux*

Installing Standard Edition High Availability Database Software on Local File System

You can install Oracle Database software binaries on a local file system to enable the Oracle Database Standard Edition high availability feature.

Ensure that all the cluster nodes, on which you plan to configure Standard Edition High Availability, have the same operating system configuration, users, groups, resource limits, and SSH equivalence for the Oracle Database software owner user (`oracle`).

Before you start the installation, have all the information you need about users, groups, and storage paths. You should also be prepared to run root scripts or provide information to automate root scripts.

1. As the `root` user, log into the first cluster node on which you want to configure Standard Edition High Availability and create the Oracle base directory on the local file system. Follow the Oracle Optimal Flexible Architecture (OFA) recommendations and specify the correct owner, group, and permissions for this directory.

   ```
   # mkdir -p /u01/app/oracle
   # chown oracle:oinstall /u01/app/oracle
   ```

2. Log in to the first cluster node as the Oracle Database software owner user (`oracle`).
3. Download the Oracle Database 19c release 19.3 installation image file (`db_home.zip`) from Oracle Software Delivery Cloud website to a directory of your choice.

   https://edelivery.oracle.com/

4. Download the Oracle Database Release Update 19.7 or later patch from My Oracle Support to a directory of your choice and unzip it.

   https://support.oracle.com/

5. Create an OFA-compliant Oracle home directory on the local file system and extract the image files that you have downloaded in to this Oracle home directory. For example:

   ```
   $ mkdir -p /u01/app/oracle/product/19.0.0/dbhome_1
   $ cd /u01/app/oracle/product/19.0.0/dbhome_1
   $ unzip -q /tmp/db_home.zip
   ```


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6. From the Oracle home directory, run the `runInstaller` command with the `-applyRU` flag to start the Oracle Database Setup Wizard and apply the Oracle Database Release Update 19.7 or later patch during installation.

   ```
   $ ./runInstaller -applyRU patch_directory_location/patch_ID
   ```

   > **Note**
   >
   > Run the `runInstaller` command from the Oracle home directory only. Do not use the `runInstaller` command that resides at `$ORACLE_HOME/oui/bin/`, or any other location, to install Oracle Database.

7. In the Select Configuration Option screen, select **Set Up Software Only**.
8. In the Select Database Installation Option screen, select **Single instance database installation**.
9. In the Select Database Edition screen, select **Standard Edition 2**.
10. Respond to the configuration prompts as needed.
11. Provide information to automate root scripts, or run scripts as root when prompted by the setup wizard.

    If you configure automation for running root scripts, and a root script fails, then you can fix the problem manually, and click **Retry** to run the root script again.

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

12. Optional: As the `oracle` user, enable read-only Oracle home on the first cluster node.

    ```
    $ $ORACLE_HOME/bin/roohctl -enable
    ```

13. As the `root` user, create the Oracle base directory on all of the other cluster nodes on which you want to configure Standard Edition High Availability.

    ```
    # mkdir -p /u01/app/oracle
    # chown oracle:oinstall /u01/app/oracle
    ```

14. As the `oracle` user, run the `addnode.sh` script from the first node to perform the following operations on the other nodes on which you want to configure Standard Edition High Availability:
    - Copy the Oracle home directory from the first node to the other nodes.
    - Setup Oracle base and Oracle inventory directories on the other nodes.

    ```
    $ $ORACLE_HOME/addnode/addnode.sh -silent
    CLUSTER_NEW_NODES=comma_separated_list_of_other_nodes
    ```


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15. As the `root` user, run the `root.sh` script on all the other cluster nodes on which you are configuring Standard Edition High Availability.

    ```
    # /u01/app/oracle/product/19.0.0/dbhome_1/root.sh
    ```

After the Oracle Database software installation is complete, use Oracle Database Configuration Assistant (Oracle DBCA), in either interactive or silent mode, to create a Standard Edition database on the first cluster node on which you installed the Oracle Database software.

For more information about the requirements for creating a database, and the procedure for enabling and configuring Standard Edition High Availability for Oracle Databases, refer to *Oracle Database Administrator's Guide*.

Related Topics

- Response Files
  Review the following topics to install and configure Oracle Database, Oracle Grid Infrastructure, and other Oracle products using response files.
- *Oracle Grid Infrastructure Installation and Upgrade Guide for Linux*
- *Creating a Database with Oracle DBCA*

Installing Standard Edition High Availability Database Software on Oracle ACFS

You can install Oracle Database software binaries on an Oracle ASM Cluster File System (Oracle ACFS) volume to enable the Oracle Database Standard Edition High Availability feature.

Ensure that all the cluster nodes, on which you plan to configure Standard Edition High Availability, have the same operating system configuration, users, groups, resource limits, and SSH equivalence for the Oracle Database software owner user (`oracle`) between the nodes.

Before you start the installation, have all the information you need about users groups, and storage paths. You should also be prepared to run root scripts or provide information to automate root scripts.

1. As the `root` user, register Oracle ACFS as an Oracle Clusterware resource specifying the Oracle Database software owner user (`oracle`) as the mount owner.

   ```
   # Grid_home/bin/srvctl add filesystem -volume acfs_volume_name -diskgroup
   diskgroup_name -path mount_point -fstype ACFS -autostart ALWAYS -user
   oracle
   ```

   > **Note**
   >
   > Mount Oracle ACFS to a mount point where you plan to create Oracle base and Oracle home directories for this installation. For example, `/u01/app/oracle`.

2. As the `oracle` user, mount the Oracle ACFS file system on all of the cluster nodes on which you want to configure Standard Edition High Availability.

   ```
   $ Grid_home/bin/srvctl start filesystem -volume acfs_volume_name -
   diskgroup diskgroup_name
   ```


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3. As the `root` user, create the Oracle base directory in an Oracle ACFS volume on the first cluster node on which you want to configure Standard Edition High Availability. Follow the Oracle Optimal Flexible Architecture (OFA) recommendations and specify the correct owner, group, and permissions for this directory.

   ```
   # mkdir -p /u01/app/oracle
   # chown oracle:oinstall /u01/app/oracle
   ```

   > **Note**
   >
   > If you have configured the Oracle ACFS file system with the `oracle` user as the mount owner and the `/u01/app/oracle` directory as the mount point, then this step is not required.

4. Log in to the first cluster node as the Oracle Database software owner user (`oracle`).
5. Download the Oracle Database 19c release 19.3 installation image file (`db_home.zip`) from Oracle Software Delivery Cloud website to a directory of your choice.

   https://edelivery.oracle.com/
6. Download the Oracle Database Release Update 19.7 or later patch from My Oracle Support to a directory of your choice and unzip it.

   https://support.oracle.com/
7. Create an OFA-compliant Oracle home directory in an Oracle ACFS volume and extract the image files that you have downloaded in to this Oracle home directory. For example:

   ```
   $ mkdir -p /u01/app/oracle/product/19.0.0/dbhome_1
   $ cd /u01/app/oracle/product/19.0.0/dbhome_1
   $ unzip -q /tmp/db_home.zip
   ```

8. From the Oracle home directory, run the `runInstaller` command with the `-applyRU` flag to start the Oracle Database Setup Wizard and apply the Oracle Database Release Update 19.7 or later patch during installation.

   ```
   $ ./runInstaller -applyRU patch_directory_location/patch_ID
   ```

   > **Note**
   >
   > Run the `runInstaller` command from the Oracle home directory only. Do not use the `runInstaller` command that resides at `$ORACLE_HOME/oui/bin/`, or any other location, to install Oracle Database.

9. In the Select Configuration Option screen, select **Set Up Software Only**.
10. In the Select Database Installation Option screen, select **Single instance database installation**.
11. In the Select Database Edition screen, select **Standard Edition 2**.
12. Respond to the configuration prompts as needed.
13. Provide information to automate root scripts, or run scripts as root when prompted by the setup wizard.

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If you configure automation for running root scripts, and a root script fails, then you can fix the problem manually, and click **Retry** to run the root script again.

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

14. Optional: As the `oracle` user, enable read-only Oracle home on the first cluster node.

    ```
    $ $ORACLE_HOME/bin/roohctl -enable
    ```

15. Attach the Oracle home on the first node to the other cluster nodes on which you want to configure Standard Edition High Availability.

    ```
    $ $ORACLE_HOME/addnode/addnode.sh -silent
    CLUSTER_NEW_NODES=comma_separated_list_of_other_nodes
    ```

16. As the `root` user, run the `root.sh` script on all the other cluster nodes on which you are configuring Standard Edition High Availability.

    ```
    # /u01/app/oracle/product/19.0.0/dbhome_1/root.sh
    ```

After the Oracle Database software installation is complete, use Oracle Database Configuration Assistant (Oracle DBCA), in either interactive or silent mode, to create a Standard Edition database on the first cluster node on which you installed the Oracle Database software.

For more information about the requirements for creating a database, and the procedure for enabling and configuring Standard Edition High Availability for Oracle Databases, refer to *Oracle Database Administrator's Guide*.

Related Topics

- *Oracle Grid Infrastructure Installation and Upgrade Guide for Linux*
- *Configuring Oracle Automatic Storage Management Cluster File System*
- *Creating a Database with Oracle DBCA*

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12

Oracle Database Postinstallation Tasks

Complete configuration tasks after you install Oracle Database.

You are required to complete some configuration tasks after Oracle Database is installed. In addition, Oracle recommends that you complete additional tasks immediately after installation. You must also complete product-specific configuration tasks before you use those products.

> **Note**
>
> This chapter describes basic configuration only. Refer to product-specific administration and tuning guides for more detailed configuration and tuning information.

- Required Postinstallation Tasks
  Download and apply required patches for your software release after completing your initial installation.
- Recommended Postinstallation Tasks
  Oracle recommends that you complete these tasks after installation.
- About Changes in Default SGA Permissions for Oracle Database
  Starting with Oracle Database 12c Release 2 (12.2.0.1), by default, permissions to read and write to the System Global Area (SGA) are limited to the Oracle software installation owner.
- Checking Installed Oracle Database Contents and Directory Location
  Use these steps to check the contents and directory location of an Oracle Database installation:
- Enabling and Disabling Oracle Database Options After Installation
  The `chopt` tool changes your database options after installation.
- Starting Oracle Enterprise Manager Database Express
  Use these steps to log in to Oracle Enterprise Manager Database Express (EM Express).
- Creating a Fast Recovery Area
  During an Oracle Restart installation, you can create only one disk group. During an Oracle Clusterware installation, you can create multiple disk groups. If you plan to add an Oracle Database for a standalone server or an Oracle RAC database, then you should create the fast recovery area for database files.
- Cloning an Oracle Database Home
  Cloning an Oracle home involves creating a copy of the Oracle home and then configuring it for a new environment.

Required Postinstallation Tasks

Download and apply required patches for your software release after completing your initial installation.

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- Downloading Release Update Patches
  Download and install Release Updates (RU) and Monthly Recommended Patches (MRPs) patches for your Oracle software after you complete your installation.
- Unlocking and Resetting Oracle Database User Passwords
  Passwords for all Oracle system administration accounts except SYS, SYSTEM, and DBSMP are revoked after installation. Before you use a locked account, you must unlock it and reset its password.

Downloading Release Update Patches

Download and install Release Updates (RU) and Monthly Recommended Patches (MRPs) patches for your Oracle software after you complete your installation.

Oracle provides quarterly updates in the form of Release Updates (RU) and Monthly Recommended Patches (MRPs). Oracle no longer releases patch sets. For more information, see My Oracle Support Note 2285040.1.

Check the My Oracle Support website for required updates for your installation.

1. Log in to the My Oracle Support website:

   https://support.oracle.com

2. In the **My Oracle Support Support for Oracle Hardware, Software, and Managed Cloud services** section, click **Sign-in or create your Oracle account**.

   > **Note**
   >
   > If you are not a My Oracle Support registered user, then register.

3. From the search bar, select **Patches and Product Certification Matrix**. The **Patch Search** window is displayed.
4. To search for patches, in the **Patch Search** window, search by **Patch Name or Number** or **Bug Number** if you have it. Otherwise, search using the **Product**, **Release**, **Platform**, and **Language** criteria.
5. Click **Apply**. The patch search results are displayed in the main window.
6. Click the patch number in the **Patch Name** column to open the Patch details in a new window.
7. Click **Download** to download the patch. Next, uncompress the Oracle patch updates that you downloaded from My Oracle Support.
8. Click **ReadMe**.

   The README page is displayed. It contains information about the patch that you just downloaded, and how to apply the patch to your installation.

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> **Note**
>
> The use of OPatch and OPatchAuto for out-of-place patching continues to be deprecated.
> For patching in Oracle AI Database 26ai, Oracle recommends that you use out-of-place patching using Gold images to apply quarterly release updates (RUs). This deprecation does not affect in-place patching. If you want to perform in-place patching, then OPatch and OPatchAuto continue to be available for this purpose. The Oracle AI Database 26ai Free release is not supported for patching with RUs.

Related Topics

- My Oracle Support note 888.1
- Patch Delivery Methods for Oracle AI Database

Unlocking and Resetting Oracle Database User Passwords

Passwords for all Oracle system administration accounts except SYS, SYSTEM, and DBSMP are revoked after installation. Before you use a locked account, you must unlock it and reset its password.

If you created a preconfigured database during the installation, but you did not unlock accounts required to use the database, then you must unlock and reset those accounts using these procedures.

- Requirements for Database Passwords
  To secure your database, use passwords that satisfy the Oracle recommended password requirements, even the passwords for predefined user accounts.
- Oracle Database System Privileges Accounts and Passwords
  Review these system privileges accounts after installation in preparation for unlocking accounts and changing passwords.
- Guidelines for Changing System Privileges Account Passwords
  Follow these rules for changing Oracle Database system privileges account passwords.
- Locking and Unlocking User Accounts
- Using SQL*Plus to Unlock Accounts and Reset Passwords
  Use this SQL*Plus procedure to unlock and reset user account passwords.

Requirements for Database Passwords

To secure your database, use passwords that satisfy the Oracle recommended password requirements, even the passwords for predefined user accounts.

Oracle Database provides a set of predefined user accounts. Create passwords in a secure fashion. If you have default passwords, change these passwords to secure passwords.

You can manage the security for Oracle Database users in various ways:

- Enforce restrictions on the way that passwords are created
- Create user profiles
- Use user resource limits to further secure user accounts

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Related Topics

- *Oracle Database Security Guide*

Oracle Database System Privileges Accounts and Passwords

Review these system privileges accounts after installation in preparation for unlocking accounts and changing passwords.

All databases created by the Database Configuration Assistant (DBCA) include the `SYS`, `SYSTEM`, and `DBSNMP` database accounts. In addition, Oracle Database provides several other administrative accounts. Before using these accounts, you must unlock them and reset their passwords.

Starting with Oracle Database 12*c* Release 2 (12.2), only the HR sample schema is automatically installed after a database installation. All sample schemas, including HR, are distributed on GitHub:

https://github.com/oracle/db-sample-schemas

> **Note**
>
> This list contains some of the important system privileges user accounts, but it is not complete. Use Oracle Enterprise Manager Database Express 12*c* to view the complete list of database accounts.

Table 12-1 Partial List of Oracle Database System Privileges Accounts Locked After Installation

User Name	Description	For More Information
ANONYMOUS	Enables HTTP access to Oracle XML DB.	*Oracle XML DB Developer's Guide*
APEX_050100	The account that owns the Oracle Application Express schema and metadata.	*Oracle Application Express App Builder User's Guide*
APEX_PUBLIC_USER	The minimally privileged account used for Oracle Application Express configuration with Oracle Application Express Listener or Oracle HTTP Server and `mod_plsql`.	*Oracle Application Express App Builder User's Guide*
AUDSYS	The account where the unified audit data trail resides.	*Oracle Database Security Guide*
CTXSYS	The Oracle Text account.	*Oracle Text Application Developer's Guide*
DBSFWUSER	The account used to run the DBMS_SFW_ACL_ADMIN package.	*Oracle Database PL/SQL Packages and Types Reference*
DBSNMP	The account used by the Management Agent component of Oracle Enterprise Manager to monitor and manage the database.	*Oracle Enterprise Manager Cloud Control Administrator's Guide*
DIP	The account used by the Directory Integration Platform (DIP) to synchronize the changes in Oracle Internet Directory with the applications in the database.	None

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Table 12-1 (Cont.) Partial List of Oracle Database System Privileges Accounts Locked After Installation

User Name	Description	For More Information
DVSYS	There are two roles associated with this account. The Database Vault owner role manages the Database Vault roles and configurations. The Database Vault Account Manager is used to manage database user accounts. **Note**: Part of Oracle Database Vault user interface text is stored in database tables in the DVSYS schema. By default, only the English language is loaded into these tables. You can use the `DVSYS.DBMS_MACADM.ADD_NLS_DATA` procedure to add other languages to Oracle Database Vault.	*Oracle Database Vault Administrator's Guide*
DVF	The account owned by Database Vault that contains public functions to retrieve the Database Vault Factor values.	*Oracle Database Vault Administrator's Guide*
FLOWS_FILES	The account owns the Oracle Application Express uploaded files.	*Oracle Application Express App Builder User's Guide*
GGSYS	The internal account used by Oracle GoldenGate. It should not be unlocked or used for a database login.	None
GSMADMIN_INTERNAL	The internal account that owns the Global Data Services schema. It should not be unlocked or used for a database login.	*Oracle Database Global Data Services Concepts and Administration Guide*
GSMCATUSER	The account used by Global Service Manager to connect to the Global Data Services catalog.	*Oracle Database Global Data Services Concepts and Administration Guide*
GSMUSER	The account used by Global Service Manager to connect to the database.	*Oracle Database Global Data Services Concepts and Administration Guide*
HR	The account that owns the Human Resources schema included in the Oracle Sample Schemas.	*Oracle Database Sample Schemas*
LBACSYS	The Oracle Label Security administrator account. Starting with Oracle Database 18c, the LBACSYS user account is created as a schema-only account.	*Oracle Label Security Administrator's Guide*
MDDATA	The schema used by Oracle Spatial and Graph for storing geocoder and router data.	*Oracle Spatial and Graph Developer's Guide*
MDSYS	The Oracle Spatial and Graph administrator account.	*Oracle Spatial and Graph Developer's Guide*
OUTLN	The account that supports plan stability. Plan stability enables you to maintain the same execution plans for the same SQL statements. OUTLN acts as a role to centrally manage metadata associated with stored outlines.	None

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Table 12-1 (Cont.) Partial List of Oracle Database System Privileges Accounts Locked After Installation

User Name	Description	For More Information
ORACLE_OCM	This account contains the instrumentation for configuration collection used by the Oracle Configuration Manager.	None
REMOTE_SCHEDULER_AGENT	The account to disable remote jobs on a database. This account is created during the remote scheduler agent configuration. You can disable the capability of a database to run remote jobs by dropping this user.	*Oracle Database Administrator's Guide*
SYS	The account used to perform database administration tasks.	*Oracle Database Administrator's Guide*
SYSTEM	Another account used to perform database administration tasks.	*Oracle Database Administrator's Guide*
SYSBACKUP	The account used to perform backup and recovery tasks.	*Oracle Database Administrator's Guide*
SYSKM	The account used to perform encryption key management.	*Oracle Database Administrator's Guide*
SYSDG	The account used to administer and monitor Oracle Data Guard.	*Oracle Database Administrator's Guide*
SYSRAC	The account used to administer Oracle Real Application Clusters (RAC).	*Oracle Database Administrator's Guide*
SYS$UMF	The account used to administer Remote Management Framework, including the remote Automatic Workload Repository (AWR).	*Oracle Database Performance Tuning Guide*
WMSYS	The account used to store the metadata information for Oracle Workspace Manager.	*Oracle Database Workspace Manager Developer's Guide*
XDB	The account used for storing Oracle XML DB data and metadata.	*Oracle XML DB Developer's Guide*
XS$NULL	The internal account that represents the absence of a database schema user in a session, and indicates an application user session is in use. XS$NULL cannot be authenticated to a database, nor can it own any database schema objects, or possess any database privileges.	*Oracle Database Real Application Security Administrator's and Developer's Guide*

Except for the accounts provided with the Oracle Sample Schemas, most of these database accounts are locked by default and created without passwords as schema only. This prevents malicious users from logging into these accounts using the default password set during catalog creation. To find the status of an account, query the `AUTHENTICATION_TYPE` column of the `DBA_USERS` data dictionary view. If `AUTHENTICATION_TYPE` is schema only, then the status is `NONE`.

Many of these accounts are automatically created when you run standard scripts such as the various `cat*.sql` scripts. To find user accounts that are created and maintained by Oracle, query the `USERNAME` and `ORACLE_MAINTAINED` columns of the `ALL_USERS` data dictionary view. If the output for `ORACLE_MAINTAINED` is `Y`, then you must not modify the user account except by running the script that was used to create it.

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To secure your database, use passwords that satisfy the Oracle recommended password requirements, even the passwords for predefined user accounts. Oracle Database provides a set of predefined user accounts. Create passwords in a secure fashion. If you have default passwords, change these passwords to secure passwords.

Related Topics

- *Oracle Database Security Guide*
- *Oracle Database Sample Schemas*

Guidelines for Changing System Privileges Account Passwords

Follow these rules for changing Oracle Database system privileges account passwords.

Before you use a locked account, you must unlock it and reset its password. Passwords for all Oracle system administration accounts except SYS, SYSTEM, and DBSNMP are revoked after installation. If you created a starter database during the installation, Oracle Database Configuration Assistant displays a screen with your database information and the Password Management button. Use the Password Management button to unlock only the user names you use.

For more information about how to create a secure password, see:

Oracle Database Security Guide

Locking and Unlocking User Accounts

To temporarily deny access to the database for a particular user account, you can lock the user account. If the user then attempts to connect, then the database displays an error message and does not allow the connection. You can unlock the user account when you want to permit database access again for that user. You can use Oracle Enterprise Manager Database Express (EM Express) to lock and unlock user accounts.

To lock or unlock a user account:

1. In EM Express, go to the Users page.
2. Click the desired user account.
3. From the **Actions** menu, select **Alter Account**.

   The Alter Account page appears.
4. Do one of the following:
   - To lock the account, enable the **Account Locked** option, and then click **OK**.
   - To unlock the account, disable the **Account Locked** option, and then click **OK**.

Using SQL*Plus to Unlock Accounts and Reset Passwords

Use this SQL*Plus procedure to unlock and reset user account passwords.

1. Log in as the Oracle Database software owner user.
2. Set the ORACLE_HOME and ORACLE_SID environment variables.

   Bourne, Bash or Korn shell:

   ```
   $ ORACLE_SID=orcl
   $ export ORACLE_SID
   ```


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```
$ ORACLE_HOME=/u01/app/oracle/product/19.0.0/dbhome_1
$ export ORACLE_HOME
```

C shell:

```
% setenv ORACLE_SID orcl
% setenv ORACLE_HOME /u01/app/oracle/product/19.0.0/dbhome_1
```

3. Start SQL*Plus and log in as the SYS user, connecting as SYSDBA:

```
$ $ORACLE_HOME/bin/sqlplus
SQL> CONNECT SYS as SYSDBA
Enter password: sys_password
```

4. To unlock an account:

```
ALTER USER account ACCOUNT UNLOCK;
```

5. To reset the password:

```
ALTER USER user_name IDENTIFIED BY new_password;
```

> **Note**
>
> If you unlock an account but do not reset the password, then the password remains expired. The first time someone connects as that user, they must change the user's password.

Related Topics

- *Oracle Database Administrator's Guide*

Recommended Postinstallation Tasks

Oracle recommends that you complete these tasks after installation.

- Creating a Backup of the root.sh Script
  Oracle recommends that you back up the `root.sh` script after you complete an installation.
- Setting Language and Locale Preferences for Client Connections
  Configure client applications connecting to an Oracle Database according to your locale preferences and your I/O device character set.
- Recompile Invalid Objects in the Database
  After you install, patch, or upgrade a database, recompile invalid objects on the CDB and PDBs with a recompilation driver script.
- About Installing Oracle Autonomous Health Framework
  Install the latest version of Oracle Autonomous Health Framework to perform proactive heath checks and collect diagnostics data for the Oracle software stack.

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Creating a Backup of the root.sh Script

Oracle recommends that you back up the `root.sh` script after you complete an installation.

If you install other products in the same Oracle home directory subsequent to this installation, then Oracle Universal Installer updates the contents of the existing `root.sh` script during the installation. If you require information contained in the original `root.sh` script, then you can recover it from the backed up `root.sh` file.

Setting Language and Locale Preferences for Client Connections

Configure client applications connecting to an Oracle Database according to your locale preferences and your I/O device character set.

You must configure client applications connecting to an Oracle Database according to your locale preferences and your I/O device character set. If your applications do not have their own specific methods to configure locale preferences, then the method you use to configure an Oracle database client connection depends on the access API you use to connect to the database. Check your application documentation, before you configure locale preferences for your applications.

For applications that connect to Oracle Databases using Oracle Call Interface (OCI) use NLS_LANG and other client settings with names that start with `NLS_` to set the locale conventions and client character set for Oracle Database sessions. It is important that you set the character set part of the NLS_LANG value properly. The character set you set must correspond to the character set used by your I/O devices, which in case of Microsoft Windows is either the ANSI Code Page (for GUI applications), such as WE8MSWIN1252, or the OEM Code Page (for Console mode applications), such as US8PC437. By doing this, the OCI API is notified about the character set of data that it receives from the application. OCI can then convert this data correctly to and from the database character set.

NLS_LANG and the other NLS settings can be specified either as environment variables or as Windows Registry settings. Environment variable values take precedence over Registry values.

Oracle Universal Installer sets a default value for the NLS_LANG setting in Registry when it creates a new Oracle home on Microsoft Windows. The NLS_LANG value is based on the language of the Windows user interface, which is the language of Windows menu items and dialog box labels.

> ⚠ **Caution**
>
> Failure to set the client character set correctly can cause data loss.

Java applications that connect to Oracle Databases by using Oracle JDBC do not use NLS_LANG. Instead, Oracle JDBC maps the default locale of the Java VM in which the application runs to the Oracle Database language and territory settings. Oracle JDBC then configures the connected database session using these settings. Because Java works internally in Unicode, the client character set is always set to Unicode. Unless an application explicitly changes it, the default locale of the Java VM is set based on the locale of the user operating system on which the Java VM runs. Check your Java VM documentation for information about configuring the Java VM default locale.

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> **Note**
>
> In 3-tier architecture deployments, application servers that are database clients can have settings in their configuration files that specify the NLS_LANG value or the Java VM locale. Check the documentation accompanying these servers.

> **See Also**
>
> *Oracle Database Globalization Support Guide* for more information about configuring user locale preferences

Recompile Invalid Objects in the Database

After you install, patch, or upgrade a database, recompile invalid objects on the CDB and PDBs with a recompilation driver script.

By default, AutoUpgrade performs a recompilation of invalid Oracle objects, which is controlled by the configuraiton file run_utlrp local parameter (default: *prefix*`.run_utlrp=yes`). In addition, Oracle provides the recompilation scripts `utlrp.sql`, `utlprp.sql`, and `utlprpom.sql`. These scripts are located in the *Oracle_home*`/rdbms/admin` directory.

> **Note**
>
> Starting with AutoUpgrade 23.1, when you run the AutoUpgrade utility, AutoUpgrade runs the `utlprpom.sql` script, and does not run `utlrp.sql`. When AutoUpgrade is used for upgrades to Oracle Database 18c (RU 18.8) and later releases, AutoUpgrade only recompiles invalid objects owned by Oracle-maintained schemas. Because database upgrades do not need to touch user objects, AutoUpgrade maintains this policy when it recompiles invalid objects.

After installing a database, recompile all invalid objects;

1. Change directory to *Oracle_home*`/rdbms/admin`. For example

   ```
   $ cd $ORACLE_HOME/rdbms/admin
   ```

2. Use the `catcon.pl` script in the Oracle home to run `utlrp.sql`. For example:

   ```
   $ORACLE_HOME/perl/bin/perl catcon.pl --n 1 --e --b utlrp --d '''.''' 
   utlrp.sql
   ```

   Note the following conditions of this use case:

   - `--n` parameter: is set to 1, so the script runs each PDB recompilation in sequence.
   - `--e` parameter: turns echo on.
   - `--b` parameter: Sets the log file base name. It is set to `utlrp`.

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Expect a time delay for the serial recompilation of PDBs to complete. Depending on the number of PDBs that you are upgrading, the recompilation can extend significantly beyond the time required for the upgrade scripts to complete.

The `utlrp.sql` script automatically recompiles invalid objects in either serial or parallel recompilation, based on both the number of invalid objects, and on the number of CPUs available. CPUs are calculated using the number of CPUs (*cpu_count*) multiplied by the number of threads for each CPU (*parallel_threads_per_cpu*). On Oracle Real Application Clusters (Oracle RAC), this number is added across all Oracle RAC nodes.

After patching or upgrading a database, there is more than one approach you can use to recompile invalid Oracle-owned and user-owned objects:

Recompile all invalid objects (the invalid objects in both Oracle and user schemas) by using `utlrp.sql` or `utlprp.sql`.

If time is a factor and the type of invalid objects is predominately application owned, then you can recompile Oracle-owned invalid objects first, and defer recompiling application-owned invalid objects to a later time. To recompile invalid objects in Oracle schemas, use `utlprpom.sql`. To recompile the remaining invalid objects, use `utlrp.sql` or `utlprp.sql`.

> **Note**
>
> When you use either `utlprp.sql` or `utlprpom.sql`, note that both scripts require you to define the degree of parallelism that the script should use, or determine the number of parallel recompile jobs to use.

The script uses syntax as follows, where *`base`* is the base name you want to have given to log files, *`N`* is the number of PDBs on which you want to run recompilation jobs in parallel (degrees of parallelism), *`script.sql`* is the Oracle recompilation script you chose to use, and *`P`* is the number of PDBs on which you want to run in parallel:

```
$ORACLE_HOME/perl/bin/perl $ORACLE_HOME/rdbms/admin/catcon.pl -b base -
d $ORACLE_HOME/rdbms/admin
          -n N -l /tmp script.sql '--pP'
```

Suppose you are running recompilation in a CDB using the log file base name `recomp`, with a degrees of parallelism setting of 3 jobs per PDB container, the script you choose to use is `utlprp.sql`, and you want to recompile across at most 10 PDBs at a time. In that case, the syntax you use to run the recompile operation is similar to the following,

```
$ORACLE_HOME/perl/bin/perl $ORACLE_HOME/rdbms/admin/catcon.pl -b recomp -
d $ORACLE_HOME/rdbms/admin -n 10 -l /tmp utlprp.sql '--p3'
```

Related Topics

- Syntax and Parameters for catcon.pl

About Installing Oracle Autonomous Health Framework

Install the latest version of Oracle Autonomous Health Framework to perform proactive heath checks and collect diagnostics data for the Oracle software stack.

Oracle Autonomous Health Framework includes the functionality from Oracle ORAchk, Oracle EXAchk, and Oracle Trace File Analyzer (TFA). Oracle Autonomous Health Framework

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extends health check coverage to the entire Oracle software stack, based on critical and reoccurring problems. Oracle Autonomous Health Framework proactively scans for known problems with Oracle products and deployments, including the following:

- Standalone Oracle Database
- Oracle Grid Infrastructure
- Oracle Real Application Clusters
- Maximum Availability Architecture (MAA) Validation
- Upgrade Readiness Validations
- Oracle GoldenGate

Oracle Autonomous Health Framework is pre-installed with Oracle Database. However, Oracle recommends that you update to the latest version of Oracle Autonomous Health Framework by downloading and installing it from My Oracle Support Note 2550798.1.

https://support.oracle.com/epmos/faces/DocContentDisplay?id=2550798.1&parent=DOCUMENTATION&sourceId=USERGUIDE

About Changes in Default SGA Permissions for Oracle Database

Starting with Oracle Database 12c Release 2 (12.2.0.1), by default, permissions to read and write to the System Global Area (SGA) are limited to the Oracle software installation owner.

In previous releases, both the Oracle installation owner account and members of the OSDBA group had access to shared memory. The change in Oracle Database 12c Release 2 (12.2) and later releases to restrict access by default to the Oracle installation owner account provides greater security than previous configurations. However, this change may prevent DBAs who do not have access to the Oracle installation owner account from administering the database.

The Oracle Database initialization parameter `ALLOW_GROUP_ACCESS_TO_SGA` determines if the Oracle Database installation owner account (`oracle` in Oracle documentation examples) is the only user who can read and write to the database System Global Area (SGA), or if members of the OSDBA group can read the SGA. In Oracle Database 12c Release 2 (12.2) and later releases, the default value for this parameter is FALSE, so that only the Oracle Database installation owner has read and write permissions to the SGA. Group access to the SGA is removed by default. This change affects all Linux and UNIX platforms.

If members of the OSDBA group require read access to the SGA, then you can change the initialization parameter `ALLOW_GROUP_ACCESS_TO_SGA` setting from FALSE to TRUE. Oracle strongly recommends that you accept the default permissions that limit access to the SGA to the `oracle` user account.

Related Topics

- *Oracle Database Reference*

Checking Installed Oracle Database Contents and Directory Location

Use these steps to check the contents and directory location of an Oracle Database installation:

1. Go to `$ORACLE_HOME/oui/bin`.

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2. Start Oracle Universal Installer.

```
$ ./runInstaller
```

3. Click **Installed Products** to display the Inventory dialog box on the Welcome screen.
4. Select an Oracle Database product from the list to check the installed contents.
5. Click **Details** to find additional information about an installed product.
6. Click **Close** to close the Inventory dialog box.
7. Click **Cancel** to close Oracle Universal Installer, and then click **Yes** to confirm.

Enabling and Disabling Oracle Database Options After Installation

The `chopt` tool changes your database options after installation.

When you install Oracle Database, some options are enabled and others are disabled. To enable or disable a particular database feature for an Oracle home, shut down the database and use the `chopt` tool.

- Chopt Tool
  Use the `chopt` tool after installation to add or remove Oracle Database options.

Chopt Tool

Use the `chopt` tool after installation to add or remove Oracle Database options.

Purpose

The `chopt` tool is a command-line utility that enables and disables database options.

> **Note**
>
> If you install or clone an Oracle Database image, then all Oracle Database options are enabled by default.

Prerequisites

You must complete installation before you can use the `chopt` tool.

File Path

The tool is located in the *`ORACLE_HOME`*`/bin` directory

Syntax

`chopt` [`enable` | `disable`] *db_option*

Options

Command Option	Description
`olap`	Oracle OLAP

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Command Option	Description
`partitioning`	Oracle Partitioning
`rat`	Oracle Real Application Testing

> **Note**
>
> - When you enable or disable OLAP, you must run the `SYS.XOQ_VALIDATE` and `SYS.APS_VALIDATE` procedures to update the database registry. When you disable OLAP, its status in the database registry should be OPTION OFF and when you enable OLAP, its status in the database registry should be VALID.
> - The Oracle Advanced Analytics (OAA) feature is enabled by default for Oracle Database. You cannot disable it using the `chopt` tool.

Examples

To use the `chopt` tool to modify your Oracle Database, you must shut down the database before you run the `chopt` tool, and then start up the database after you add or remove database options.

Example 12-1 Enabling Oracle Real Application Testing Using chopt

The following example shows how to use the `chopt` tool to enable the Oracle Real Application Testing option in an Oracle Database called Sales:

```
cd $ORACLE_HOME/bin
srvctl stop database -d Sales
chopt enable rat
srvctl start database -d Sales
```

Starting Oracle Enterprise Manager Database Express

Use these steps to log in to Oracle Enterprise Manager Database Express (EM Express).

To start Oracle Enterprise Manager Database Express, use the EM Express URL provided by Oracle Database Configuration Assistant (Oracle DBCA) during the database installation and creation. For information about logging in to Oracle Enterprise Manager Database Express see *Oracle Database 2 Day DBA*.

If Oracle DBCA did not provide the EM Express URL during the database installation and creation, or if you need to change the EM Express port later on, then see *Oracle Database 2 Day DBA*.

Related Topics

- *Oracle Database 2 Day DBA*
- *Configuring the HTTPS Port for EM Express*

Creating a Fast Recovery Area

During an Oracle Restart installation, you can create only one disk group. During an Oracle Clusterware installation, you can create multiple disk groups. If you plan to add an Oracle

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Database for a standalone server or an Oracle RAC database, then you should create the fast recovery area for database files.

- 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. Enabling rapid backups for recent data can reduce requests to system administrators to retrieve backup tapes for recovery operations.
- Creating the Fast Recovery Area Disk Group
  Procedure to create the fast recovery area disk group.

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. Enabling rapid backups for recent data can reduce requests to system administrators to retrieve backup tapes for recovery operations.

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. When you enable fast recovery in the `init.ora` file, Oracle Database writes all RMAN backups, archive logs, control file automatic backups, and database copies to the fast recovery area. RMAN automatically manages files in the fast recovery area by deleting obsolete backups and archiving files no longer required for recovery.

Oracle recommends that you create a fast recovery area disk group. Oracle Clusterware files and Oracle Database files can be placed on the same disk group, and you can also place fast recovery files in the same disk group. However, Oracle recommends that you create a separate fast recovery disk group to reduce storage device contention.

The fast recovery area is enabled by setting the `DB_RECOVERY_FILE_DEST` parameter. The size of the fast recovery area is set with `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 is 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 a fast recovery area disk group on disks with 150 GB of storage, shared by 3 different databases. You can set the size of the fast recovery for each database depending on the importance of each database. For example, if database1 is your least important database, database2 is of greater importance, and database3 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 database1, 50 GB for database2, and 70 GB for database3.

Creating the Fast Recovery Area Disk Group

Procedure to create the fast recovery area disk group.

1. Go to the Oracle Grid Infrastructure home `bin` directory, and start Oracle ASM Configuration Assistant (ASMCA).

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For example:

```
$ cd /u01/app/oracle/product/19.0.0/grid/bin
$ ./asmca
```

ASMCA opens the home window.

2. Click **Disk Groups** in the left panel to open the Disk Groups tab.
3. Click **Create** to create a new disk group.

   The Create Disk Groups window opens.
4. Provide configuration information for the fast recovery area as prompted:

   In the Disk Group Name field, enter a descriptive name for the fast recovery area group. For example: `FRA`.

   In the Redundancy section, select the level of redundancy you want to use. For example: `Normal`

   In the Select Member Disks field, select eligible disks you want to add to the fast recovery area, and click **OK**.
5. When the Fast Recovery Area disk group creation is complete, click **Exit** and click **Yes** to confirm closing the ASMCA application.

Cloning an Oracle Database Home

Cloning an Oracle home involves creating a copy of the Oracle home and then configuring it for a new environment.

If you are performing multiple Oracle Database installations, then you may want to use cloning to create each Oracle home, because copying files from an existing Oracle Database installation takes less time than creating a new version of them. This method is also useful if the Oracle home that you are cloning has had patches applied to it. When you clone the Oracle home, the new Oracle home has the patch updates.

Perform these steps to clone an Oracle home.

> **Note**
>
> During cloning, Oracle Universal Installer (OUI) prompts you to run scripts that require root privileges.

1. Verify that the installation of Oracle Database that you want clone is successful.

   You can do this by reviewing the `installActionsdate_time.log` file for the installation session, which is typically located in the `/u01/app/oracle/oraInventory/logs` directory.

   If you install patches, then check their status using the following:

   ```
   $ cd $ORACLE_HOME/OPatch
   ```


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Include $ORACLE_HOME/OPatch in $PATH

```
$ opatch lsinventory
```

2. Stop all processes related to the Oracle home.
3. Create a ZIP or TAR file with the Oracle home (but not the Oracle base) directory.

   For example, if the source Oracle installation is in the path /u01/app/oracle/product/19.0.0/dbhome_1, then you zip the dbhome_1 directory by using the following command:

   ```
   # zip -r dbhome_1.zip /u01/app/oracle/product/19.0.0/dbhome_1
   ```

   You can also use the TAR command. For example:

   ```
   # tar -cvf dbhome_1.tar /u01/app/oracle/product/19.0.0/dbhome_1
   ```

   Do not include the admin, fast_recovery_area, and oradata directories that are under the Oracle base directory. These directories are created in the target installation later, when you create a new database there.
4. Copy the ZIP or TAR file to the root directory of the target computer. If you use File Transfer Protocol (FTP), then transfer the ZIP or TAR file in binary mode only.
5. Extract the ZIP or TAR file content using the following command:

   ```
   # unzip -d / dbhome_1.zip
   # tar -xvf dbhome_1.tar
   ```

6. If necessary, change the ownership of the Oracle Database home to the Oracle Database installation owner user (oracle) belonging to the Oracle Inventory group (oinstall).

   ```
   # chown -R oracle:oinstall /u01/app/oracle/product/19.0.0/dbhome_1
   ```

7. On the target computer, change the directory to the unzipped Oracle home directory, and remove all the .ora (*.ora) files present in the unzipped $ORACLE_HOME/network/admin directory.
8. Delete unnecessary files from the unzipped Oracle home directory.

   The unzipped Oracle home directory contains files that are relevant only to the source Oracle home. The following example shows how to remove these unnecessary files from the unzipped Oracle home directory:

   Remove the .ora files from the network/admin directory, and remove the old database entries from the dbs directory.

   ```
   # cd $ORACLE_HOME
   # rm -rf network/admin/*.ora
   # rm dbs/old_database_entries
   ```

9. From the $ORACLE_HOME/clone/bin directory, run the clone.pl file for the unzipped Oracle home.

   Use the following syntax (you can also include one or more of the extended Oracle Database groups in the syntax):

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```
$ORACLE_HOME/perl/bin/perl $ORACLE_HOME/clone/bin/clone.pl
ORACLE_BASE="target_oracle_base" ORACLE_HOME="target_oracle_home"
OSDBA_GROUP=OSDBA_privileged_group
OSOPER_GROUP=OSOPER_privileged_group
OSBACKUPDBA_GROUP=OSBACKUPDBA_privileged_group
OSDGDBA_GROUP=OSDGDBA_privileged_group
OSKMDBA_GROUP=OSKMDBA_privileged_group
OSRACDBA_GROUP=OSRACDBA_privileged_group -defaultHomeName
```

For example:

```
$ORACLE_HOME/perl/bin/perl $ORACLE_HOME/clone/bin/clone.pl
ORACLE_BASE="/u01/app/oracle" ORACLE_HOME="/u01/app/oracle/product/19.0.0/
dbhome_1"
OSDBA_GROUP=dba OSOPER_GROUP=oper OSBACKUPDBA_GROUP=backupdba
OSDGDBA_GROUP=dgdba OSKMDBA_GROUP=kmdba OSRACDBA_GROUP=racdba -
defaultHomeName
```

Note

- In this command, if you do not provide the parameters for the operating system groups, then `clone.pl` uses the operating system group values from the source home.
- Run the `$ORACLE_HOME/perl/bin/perl $ORACLE_HOME/clone/bin/clone.pl -help` command for more information about the command option flags.
- The `clone.pl` script is deprecated in Oracle Database 19c and can be removed in a future release. Hence, Oracle recommends that you use the software-only installation option, available in the database installer, instead of `clone.pl` to clone your database.

OUI starts, and then records the cloning actions in the `cloneActionstimestamp.log` file. This log file is typically located in `/u01/app/oracle/oraInventory/logs` directory.

10. Use the following commands to run Net Configuration Assistant to configure the connection information for the new database:

```
$ cd $ORACLE_HOME/bin
$ ./netca
```

11. Use the following commands to run Database Configuration Assistant to create a new Oracle Database for the newly-cloned oracle home:

```
$ cd $ORACLE_HOME/bin
$ ./dbca
```

Related Topics

- *Oracle Clusterware Administration and Deployment Guide*
- *Oracle Database Administrator's Guide*

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Removing Oracle Database Software

These topics describe how to remove Oracle software and configuration files.

Use the `deinstall` command that is included in Oracle homes to remove Oracle software. Oracle does not support the removal of individual products or components.

> **⚠ Caution**
>
> If you have a standalone database on a node in a cluster, and if you have multiple databases with the same global database name (GDN), then you cannot use the `deinstall` command to remove one database only.

- About Oracle Deinstallation Options
  You can stop and remove Oracle Database software and components in an Oracle Database home with the `deinstall` command.
- Oracle Deinstallation (Deinstall)
  You can run the `deinstall` command from an Oracle home directory after installation.
- Deinstallation Examples for Oracle Database
  Use these examples to help you understand how to run the `deinstall` command.
- Downgrading Oracle Restart
  Use this procedure to deconfigure and downgrade Oracle Restart, or to troubleshoot Oracle Restart installation errors.
- Removing an RPM-based Oracle Database Installation
  Use this procedure to remove and deinstall a database installed using the `yum` command.
- Deinstalling Previous Release Grid Home
  Use this procedure to deinstall the previous release Grid home.

About Oracle Deinstallation Options

You can stop and remove Oracle Database software and components in an Oracle Database home with the `deinstall` command.

You can remove the following software using `deinstall` :

- Oracle Database
- Oracle Grid Infrastructure, which includes Oracle Clusterware and Oracle Automatic Storage Management (Oracle ASM)
- Oracle Real Application Clusters (Oracle RAC)
- Oracle Database Client

The `deinstall` command is available in Oracle home directories after installation. It is located in the `$ORACLE_HOME/deinstall` directory.

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`deinstall` creates a response file by using information in the Oracle home and using the information you provide. You can use a response file that you generated previously by running the `deinstall` command using the `-checkonly` option. You can also edit the response file template.

If you run `deinstall` to remove an Oracle Grid Infrastructure installation, then the deinstaller prompts you to run the `deinstall` command as the `root` user. For Oracle Grid Infrastructure for a cluster, the script is `rootcrs.sh`, and for Oracle Grid Infrastructure for a standalone server (Oracle Restart), the script is `roothas.sh`.

> **Note**
>
> - You must run the `deinstall` command from the same release to remove Oracle software. Do not run the `deinstall` command from a later release to remove Oracle software from an earlier release. For example, do not run the `deinstall` command from the 19c Oracle home to remove Oracle software from an existing 11.2.0.4 Oracle home.
> - Starting with Oracle Database 12c Release 1 (12.1.0.2), the `roothas.sh` script replaces the `roothas.pl` script in the Oracle Grid Infrastructure home for Oracle Restart, and the `rootcrs.sh` script replaces the `rootcrs.pl` script in the Grid home for Oracle Grid Infrastructure for a cluster.

If the software in the Oracle home is not running (for example, after an unsuccessful installation), then `deinstall` cannot determine the configuration, and you must provide all the configuration details either interactively or in a response file.

In addition, before you run `deinstall` 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).
- If Grid Naming Service (GNS) is in use, then notify your DNS administrator to delete the subdomain entry from the DNS.

Files Deleted by deinstall

When you run `deinstall`, if the central inventory (`oraInventory`) contains no other registered homes besides the home that you are deconfiguring and removing, then `deinstall` removes the following files and directory contents in the Oracle base directory of the Oracle Database installation owner:

- `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

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base that is owned by the user account that owns the Oracle software, then `deinstall` deletes this data.

> **⚠ Caution**
>
> `deinstall` deletes Oracle Database configuration files, user data, and fast recovery area (FRA) files even if they are located outside of the Oracle base directory path.

Oracle Deinstallation (Deinstall)

You can run the `deinstall` command from an Oracle home directory after installation.

Purpose

`deinstall` stops Oracle software, and removes Oracle software and configuration files on the operating system for a specific Oracle home.

Syntax

The `deinstall` command uses the following syntax:

```
(./deinstall [-silent] [-checkonly] [-paramfile complete path of input
response file]
[-params name1=value name2=value . . .]
[-o complete path of directory for saving files]
[-tmpdir complete path of temporary directory to use]
[-logdir complete path of log directory to use] [-local] [-
skipLocalHomeDeletion] [-skipRemoteHomeDeletion] [-help]
```

Parameters

Parameter	Description
`-silent`	Use this flag to run `deinstall` 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. You can generate a response file to use or modify by running `deinstall` with the `-checkonly` flag. `deinstall` then discovers information from the Oracle home to deinstall and deconfigure. It generates the response file that you can then use with the `-silent` option. You can also modify the template file `deinstall.rsp.tmpl`, located in the `$ORACLE_HOME/deinstall/response` directory.

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Parameter	Description
`-checkonly`	Use this flag to check the status of the Oracle software home configuration. Running `deinstall` with the `-checkonly` flag does not remove the Oracle configuration. The `-checkonly` flag generates a response file that you can then use with the `deinstall` command and `-silent` option.
`-paramfile` *complete path of input response file*	Use this flag to run `deinstall` 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. The default location of the response file is `$ORACLE_HOME/deinstall/response`.
`-params` [*name1=value name2=value name3=value . . .*]	Use this flag with a response file to override one or more values to change in a response file you have created.
`-o` *complete path of directory for saving response files*	Use this flag to provide a path other than the default location where the response file (`deinstall.rsp.tmpl`) is saved. The default location of the response file is `$ORACLE_HOME/deinstall/response` .
`-tmpdir` *complete path of temporary directory to use*	Use this flag to specify a non-default location where `deinstall` writes the temporary files for the deinstallation.
`-logdir` *complete path of log directory to use*	Use this flag to specify a non-default location where `deinstall` writes the log files for the deinstallation.
`-local`	Use this flag on a multinode environment to deinstall Oracle software in a cluster. When you run `deinstall` with this flag, it deconfigures and deinstalls the Oracle software on the local node (the node where `deinstall` is run). On remote nodes, it deconfigures Oracle software, but does not deinstall the Oracle software.
`-skipLocalHomeDeletion`	Use this flag in Oracle Grid Infrastructure installations on a multinode environment to deconfigure a local Grid home without deleting the Grid home.
`-skipRemoteHomeDeletion`	Use this flag in Oracle Grid Infrastructure installations on a multinode environment to deconfigure a remote Grid home without deleting the Grid home.
`-help`	Use this option to obtain additional information about the command option flags.

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Deinstallation Examples for Oracle Database

Use these examples to help you understand how to run the `deinstall` command.

Run `deinstall` from the `$ORACLE_HOME/deinstall` directory. The deinstallation starts without prompting you for the Oracle home path.

```
$ ./deinstall
```

You can generate a deinstallation response file by running `deinstall` with the `-checkonly` flag. Alternatively, you can use the response file template located at `$ORACLE_HOME/deinstall/response/deinstall.rsp.tmpl`. If you have a response file, then use the optional flag `-paramfile` to provide a path to the response file.

In the following example, the `deinstall` command is in the path `/u01/app/oracle/product/19.0.0/dbhome_1/deinstall`. It uses a response file called `my_db_paramfile.tmpl` in the software owner location `/home/usr/oracle`:

```
$ cd /u01/app/oracle/product/19.0.0/dbhome_1/deinstall
$ ./deinstall -paramfile /home/usr/oracle/my_db_paramfile.tmpl
```

To remove the Oracle Grid Infrastructure home, use the `deinstall` command in the Oracle Grid Infrastructure home.

In this example, the Oracle Grid Infrastructure home is `/u01/app/oracle/product/19.0.0/grid`

```
$ cd  /u01/app/oracle/product/19.0.0/grid/deinstall
$ ./deinstall -paramfile /home/usr/oracle/my_grid_paramfile.tmpl
```

Downgrading Oracle Restart

Use this procedure to deconfigure and downgrade Oracle Restart, or to troubleshoot Oracle Restart installation errors.

Running `roothas.sh` with the command flags `-deconfig -force` enables you to deconfigure Oracle Restart without removing the installed binaries. This feature is useful if you encounter an error during an Oracle Grid Infrastructure for a standalone server installation. For example, when you run the `root.sh` command, and find a missing operating system package. By running `roothas.sh -deconfig -force`, you can deconfigure Oracle Restart, correct the cause of the error, and then run `root.sh` again.

1. As the `oracle` user, create a backup of the SPFILE to a PFILE.

   ```
   CREATE PFILE='/u01/app/oracle/product/19.0.0/dbhome_1/dbs/test_init.ora'
   FROM SPFILE='/u01/oracle/dbs/test_spfile.ora';
   ```

2. List all the Oracle Databases on the server with their version, unique name of the database, and Oracle home information.

   ```
   $ srvctl config database -home
   ```


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3. Downgrade Oracle Database. Refer to *Oracle Database Upgrade Guide* for more information about required pre-downgrade tasks, downgrade tasks, post-downgrade tasks, and compatibility information.

   > **Note**
   >
   > Downgrade Oracle Database only if the Oracle Database version is higher than the Oracle Restart version to which you are downgrading Oracle Restart.

4. As the `oracle` user, downgrade the Oracle Restart resources corresponding to the Oracle Database, only if you have downgraded your Oracle Database.

   ```
   $ srvctl downgrade database -d db_unique_name -oraclehome $ORACLE_HOME -t
   to_version
   ```

5. Inspect the Oracle Restart configuration of each database, service, and listener.

   ```
   $ srvctl config database -db db_unique_name
   $ srvctl config service -db db_unique_name
   $ srvctl config listener -listener listener_name
   ```

   Make a note of the configuration information and use this information when adding the components back to Oracle Restart.

6. Stop all databases and listeners that are running before you deconfigure or downgrade Oracle Restart.

   ```
   $ srvctl stop database -db db_unique_name
   $ srvctl stop listener [-listener listener_name]
   ```

7. As the `root` user, run `roothas.sh` with the `-deconfig -force` flags to deconfigure Oracle Restart.

   ```
   # /u01/app/oracle/product/19.0.0/grid/crs/install/roothas.sh -deconfig -
   force
   ```

8. As the `grid` user, update the Oracle central inventory (`oraInventory`).

   ```
   $ /u01/app/oracle/product/19.0.0/grid/oui/bin/runInstaller -updateNodeList
   -silent ORACLE_HOME=upgraded_Grid_home -local CRS=false
   ```

9. As the `root` user, run `roothas.sh` with the `-unlock` flag to unlock the previous release Oracle Restart home.

   ```
   # /u01/app/oracle/product/18.0.0/grid/crs/install/roothas.sh -unlock -
   dstcrshome previous_release_Grid_home
   ```

10. As the `grid` user, reconfigure the previous release Oracle Restart home using the `gridSetup.sh` command.

    ```
    $ /u01/app/oracle/product/18.0.0/grid/gridSetup.sh
    ```

11. As the `oracle` user, add the components back to Oracle Restart with the same attributes that you noted down before deconfiguring Oracle Restart.

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a. Add Oracle Database to the Oracle Restart configuration.

```
$ srvctl add database -db db_unique_name -oraclehome Oracle_home
```

b. Add the listener to the Oracle Restart configuration.

```
$ srvctl add listener -listener listener_name -oraclehome Oracle_home
```

For the `-oraclehome` parameter, provide the Oracle home path from which the listener was running before the downgrade.

c. Add each service to the database, using the `srvctl add service` command.

```
$ srvctl add service -db db_unique_name -service service_name_list
```

Related Topics

- *Oracle Database Upgrade Guide*

Removing an RPM-based Oracle Database Installation

Use this procedure to remove and deinstall a database installed using the `yum` command.

1. Log in as `root`.
2. Run the following command to remove the RPM-based database installation:

```
# yum -y remove oracle-database-ee-19c
```

The `yum` command detects the default configured components in the Oracle home such as the database (ORCLCDB) and the listener (LISTENER) and removes these components for you. Apart from the default database (ORCLCDB) and the listener (LISTENER), if the `yum` command detects other configured components in the Oracle home such as additional databases or listeners, then it stops the deinstallation process. A message is displayed that instructs you to remove these configured components manually. To remove these configured components:

1. Login as the Oracle Database installation owner user (`oracle`).
2. To remove any database associated with your installation, use Oracle Database Configuration Assistant (Oracle DBCA).

```
$ cd $ORACLE_HOME/bin
$ ./dbca
```

3. To remove any listeners associated with your installation, run Oracle Net Configuration Assistant (Oracle NETCA).

```
$ cd $ORACLE_HOME/bin
$ ./netca
```


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4. Log in as `root` and run the `yum` command again to remove the rpm-based database installation.

   ```
   # yum -y remove oracle-database-ee-19c
   ```

Related Topics

- Deleting a Database Using Oracle DBCA
- Using Oracle Net Configuration Assistant

Deinstalling Previous Release Grid Home

Use this procedure to deinstall the previous release Grid home.

For upgrades from previous releases, if you want to deinstall the previous release Grid home, then perform the following steps:

1. Log in as the `root` user.
2. Manually change the permissions of the previous release Grid home.

   ```
   # chmod -R 775 /u01/app/oracle/product/18.0.0/grid
   # chown -R oracle:oinstall /u01/app/oracle/product/18.0.0/grid
   # chown oracle /u01/app/oracle/product/18.0.0
   ```

   In this example:

   - `/u01/app/oracle/product/18.0.0/grid` is the previous release Oracle Grid Infrastructure for a standalone server home
   - `oracle` is the Oracle Grid Infrastructure installation owner user
   - `oinstall` is the name of the Oracle Inventory group (OINSTALL group)
   - `/u01/app/oracle/product/18.0.0` is the parent directory of the previous Grid home.
3. Log in as the Oracle Grid Infrastructure software owner user (`oracle`) and run the `deinstall` command.

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A

Completing Preinstallation Tasks Manually

You can complete the preinstallation configuration tasks manually.

Oracle recommends that you use Oracle Universal Installer and Configuration Verification Utility (CVU) fixup scripts to complete minimal configuration settings. If you cannot use fixup scripts, then complete minimum system settings manually.

- Configuring Kernel Parameters for Linux
  These topics explain how to configure kernel parameters manually for Linux if you cannot complete them using the fixup scripts.
- Configuring Default Thread Limits Value for SUSE Linux
  If you are on SUSE Linux Enterprise Server 12 SP2 or later, or SUSE Linux Enterprise Server 15 or later, then set the `DefaultTasksMax` parameter value to `65535`.
- Configuring Storage Device Path Persistence Manually
  You can maintain storage file path persistence by creating a rules file.

Configuring Kernel Parameters for Linux

These topics explain how to configure kernel parameters manually for Linux if you cannot complete them using the fixup scripts.

- Minimum Parameter Settings for Installation
  Use this table to set parameters manually if you cannot use the fixup scripts.
- Changing Kernel Parameter Values
  Use these instructions to display and change the kernel parameter values if they are different from the minimum recommended value.
- Configuring Additional Kernel Settings for SUSE Linux
  Additional kernel parameter settings configuration is required on SUSE Linux Enterprise Server systems.
- Setting UDP and TCP Kernel Parameters Manually
  If you do not use a Fixup script or CVU to set ephemeral ports, then follow these guidelines to ensure smooth and high performance experience with least errors or issues.

Minimum Parameter Settings for Installation

Use this table to set parameters manually if you cannot use the fixup scripts.

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Note

- Unless otherwise specified, the kernel parameter and shell limit values shown in the following table are minimum values only. For production database systems, Oracle recommends that you tune these values to optimize the performance of the system. See the operating system documentation for more information about tuning kernel parameters.
- The values in this table are minimum values for manual configuration. If you used the Oracle Database Preinstallation RPM to complete your preinstallation configuration tasks, then the RPM configures these kernel parameters for you. The Preinstallation RPM can set higher values for these kernel parameters. Do not reduce a higher or different value configured by the Preinstallation RPM or by your system administrator solely to match the minimum value in this table.
- If the current value for any parameter is greater than the value listed in this table, then the Fixup scripts do not change the value of that parameter.

Table A-1 Minimum Operating System Resource Parameter Settings

Parameter	Value	File

`semmsl`
`semmns`
`semopm`
`semmni`
	250
	32000
	100
	128
		`/proc/sys/kernel/sem`

`shmall`	Greater than or equal to the value of `shmmax`, in pages.	`/proc/sys/kernel/shmall`
`shmmax`	Half the size of physical memory in bytes See My Oracle Support Note 567506.1 for additional information about configuring shmmax.	`/proc/sys/kernel/shmmax`
`shmmni`	4096	`/proc/sys/kernel/shmmni`
`panic_on_oops`	1	`/proc/sys/kernel/panic_on_oops`
`file-max`	6815744	`/proc/sys/fs/file-max`
`aio-max-nr`	1048576 Note: This value limits concurrent outstanding requests and should be set to avoid I/O subsystem failures.	`/proc/sys/fs/aio-max-nr`
`ip_local_port_range`	Minimum: 9000 Maximum: 65500	`/proc/sys/net/ipv4/ip_local_port_range`
`rmem_default`	262144	`/proc/sys/net/core/rmem_default`
`rmem_max`	4194304	`/proc/sys/net/core/rmem_max`
`wmem_default`	262144	`/proc/sys/net/core/wmem_default`

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Table A-1 (Cont.) Minimum Operating System Resource Parameter Settings

Parameter	Value	File
wmem_max	1048576	/proc/sys/net/core/wmem_max

Related Topics

- Setting UDP and TCP Kernel Parameters Manually
  If you do not use a Fixup script or CVU to set ephemeral ports, then follow these guidelines to ensure smooth and high performance experience with least errors or issues.

Changing Kernel Parameter Values

Use these instructions to display and change the kernel parameter values if they are different from the minimum recommended value.

Use the following commands to display the current values of the kernel parameters:

Table A-2 Commands to Display Kernel Parameter Values

Parameter	Command
semmsl, semmns, semopm, and semmni	# /sbin/sysctl -a | grep sem This command displays the value of the semaphore parameters in the order listed.
shmall, shmmax, and shmmni	# /sbin/sysctl -a | grep shm This command displays the details of the shared memory segment sizes.
file-max	# /sbin/sysctl -a | grep file-max This command displays the maximum number of file handles.
ip_local_port_range	# /sbin/sysctl -a | grep ip_local_port_range This command displays a range of port numbers.
rmem_default	# /sbin/sysctl -a | grep rmem_default
rmem_max	# /sbin/sysctl -a | grep rmem_max
wmem_default	# /sbin/sysctl -a | grep wmem_default
wmem_max	# /sbin/sysctl -a | grep wmem_max
aio-max-nr	# /sbin/sysctl -a | grep aio-max-nr

If you used the Oracle Database Preinstallation RPM to complete you preinstallation configuration tasks, then the Oracle Database Preinstallation RPM sets these kernel parameters for you. However, if you did not use the Oracle Database Preinstallation RPM or the kernel parameters are different from the minimum recommended value, then to change these kernel parameter values:

1. Using any text editor, create or edit the /etc/sysctl.d/97-oracle-database-sysctl.conf file, and add or edit lines similar to:

```
fs.aio-max-nr = 1048576
fs.file-max = 6815744
kernel.shmall = 2097152
```


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```
kernel.shmmax = 4294967295
kernel.shmmni = 4096
kernel.sem = 250 32000 100 128
net.ipv4.ip_local_port_range = 9000 65500
net.core.rmem_default = 262144
net.core.rmem_max = 4194304
net.core.wmem_default = 262144
net.core.wmem_max = 1048576
```

By specifying the values in the `/etc/sysctl.d/97-oracle-database-sysctl.conf` file, the values persist on system restarts.

2. To change the current values of the kernel parameters:

```
# /sbin/sysctl --system
```

Review the output. If the values are incorrect, edit the `/etc/sysctl.d/97-oracle-database-sysctl.conf` file, then enter this command again.

3. Confirm that the values are set correctly:

```
# /sbin/sysctl -a
```

4. Restart the computer, or run `sysctl --system` to make the changes in the `/etc/sysctl.d/97-oracle-database-sysctl.conf` file available in the active kernel memory.

Guidelines for Setting Kernel Parameter Values

- In an Oracle RAC cluster, a node may experience higher utilization of I/O-related resources when workloads are transferred from other nodes. Consider increasing `fs.file-max` and `fs.aio-max-nr` on each node to support these scenarios, as the minimum values may not be sufficient for very large workloads.
- If you used the Oracle Database Preinstallation RPM, then your kernel parameter settings reside in the `/etc/sysctl.d/99-oracle-database-preinstall-19c-sysctl.conf` file.
- Include lines only for the kernel parameter values to change. For the semaphore parameters (`kernel.sem`), you must specify all four values. If any of the current values are larger than the minimum value, then specify the larger value.
- The `/etc/sysctl.conf` file has been deprecated.
- Avoid setting kernel parameter values in multiple files under `/etc/sysctl.d/`. The file with a lexically later name under `/etc/sysctl.d/` takes precedence, followed by `/etc/sysctl.conf`. Oracle recommends that you use the Oracle Database Preinstallation RPM which, among other preinstallation tasks, also sets the kernel parameter values for your database installation.

> **See Also**
>
> `sysctl.conf(5)` and `sysctl.d(5)` man pages for more information

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Configuring Additional Kernel Settings for SUSE Linux

Additional kernel parameter settings configuration is required on SUSE Linux Enterprise Server systems.

Perform these steps on SUSE Linux Enterprise Server systems only:

1. Enter the following command to enable the system to read the `/etc/sysctl.conf` file when it restarts:

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

2. Enter the GID of the oinstall group as the value for the parameter `/proc/sys/vm/hugetlb_shm_group`.

   For example, where the oinstall group GID is `501`:

   ```
   # echo 501 > /proc/sys/vm/hugetlb_shm_group
   ```

   Use `vi` to add the following text to `/etc/sysctl.conf`, and enable the `boot.sysctl` script to run on system restart:

   ```
   vm.hugetlb_shm_group=501
   ```

   > **Note**
   >
   > Only one group can be defined as the `vm.hugetlb_shm_group`.

Setting UDP and TCP Kernel Parameters Manually

If you do not use a Fixup script or CVU to set ephemeral ports, then follow these guidelines to ensure smooth and high performance experience with least errors or issues.

- Choose lower and higher numbers that are even/odd not both odd or both even.
- Ensure that the lower range is set to 9000 or higher to avoid *well known ports* and those commonly registered for use by Oracle and other vendors or servers.
- Set the port range high enough to include reserved ports for any applications you may intend to use and large enough ephemeral ports for the anticipated server workload.

For example, with IPv4, use the following command to check your current range for ephemeral ports:

```
$ cat /proc/sys/net/ipv4/ip_local_port_range
32768 61001
```

In the preceding example, the lowest port is set to 32768 and the highest port to 61001.

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If necessary, update the UDP and TCP ephemeral port range to a range high enough for anticipated system workloads, and to ensure that the ephemeral port range starts at 9000 and above. For example:

```
# echo 9000 65535 > /proc/sys/net/ipv4/ip_local_port_range
```

Oracle recommends that you make these settings permanent. For example, as `root`, use a text editor to open `/etc/sysctl.d/97-oracle-database-sysctl.conf`, and add or change to the following: `net.ipv4.ip_local_port_range = 9000 65535`, and then restart the network:

```
$ sudo systemctl restart NetworkManager.service
```

Refer to your Linux distribution system administration documentation for information about automating ephemeral port range alteration on system restarts.

Configuring Default Thread Limits Value for SUSE Linux

If you are on SUSE Linux Enterprise Server 12 SP2 or later, or SUSE Linux Enterprise Server 15 or later, then set the `DefaultTasksMax` parameter value to `65535`.

Increase the default thread limits, `DefaultTasksMax` value from `512` to `65535` to avoid running into service failures.

1. View the contents of `/etc/systemd/system.conf` to know the current `DefaultTasksMax` value. Alternatively, run the following command:

   ```
   $ systemctl show --property DefaultTasksMax
   ```

2. If your `DefaultTasksMax` value is not `65535`, then uncomment the line in `/etc/systemd/system.conf` and set the value to `65535`.
3. To enable the new settings, reboot your system or run the following command:

   ```
   $ systemctl daemon-reload
   ```

Configuring Storage Device Path Persistence Manually

You can maintain storage file path persistence by creating a rules file.

By default, the device file naming scheme `udev` dynamically creates device file names when the server is started, and assigns ownership of them to root. If `udev` applies default settings, then it changes Oracle device file names and owners for the disks, making the disks inaccessible when the server is restarted. For example, a voting disk on a device named `/dev/sdd` owned by the user `grid` may be on a device named `/dev/sdf` owned by root after restarting the server.

If you do not use Oracle ASMLib, then you must create a custom rules file. Linux vendors customize their `udev` configurations and use different orders for reading rules files. For example, on some Linux distributions when `udev` is started, it sequentially carries out rules (configuration directives) defined in rules files. These files are in the path `/etc/udev/rules.d/`. Rules files are read in lexical order. For example, rules in the file `10-wacom.rules` are parsed and carried out before rules in the rules file `90-ib.rules`.

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When specifying the device information in the udev rules file, ensure that the OWNER, GROUP, and MODE are specified before all other characteristics in the order shown. For example, to include the characteristic ACTION on the UDEV line, specify ACTION after OWNER, GROUP, and MODE.

Where rules files describe the same devices, on the supported Linux kernel versions, the last file read is the one that is applied.

- Configuring Device Persistence Manually for Oracle ASM
  Complete these tasks to create device path persistence manually for Oracle ASM.

Configuring Device Persistence Manually for Oracle ASM

Complete these tasks to create device path persistence manually for Oracle ASM.

1. On existing systems (single instance or clustered), to obtain current mount paths, run the command `scsi_id` (`/sbin/scsi_id`) on storage devices on a server to obtain their unique device identifiers. When you run the command `scsi_id` with the `-s` argument, the device path and name you provide should be relative to the `sysfs` directory `/sys` (for example, `/block/device`) when referring to `/sys/block/device`.

   For example, as the `root` user:

   ```
   # /sbin/scsi_id -g -s /block/sdb/sdb1
   360a98000686f6959684a453333524174

   # /sbin/scsi_id -g -s /block/sde/sde1
   360a98000686f6959684a453333524179
   ```

   Record the unique SCSI identifiers, so you can provide them when required.

   > **Note**
   >
   > The command `scsi_id` should return the same device identifier value for a given device, regardless of which node the command is run from.

2. Configure SCSI devices as trusted devices, by editing the `/etc/scsi_id.config` file and adding `options=-g` to the file.

   ```
   # cat > /etc/scsi_id.config
   vendor="ATA",options=-p 0x80
   options=-g
   ```

3. Using a text editor, create a UDEV rules file for the Oracle ASM devices, setting permissions to 0660 for the installation owner and the operating system group you have designated the OSDBA group, whose members are granted access privileges to Oracle ASM. For example, on Oracle Linux, to create a role-based configuration `rules.d` file where the installation owner is `grid` and the OSDBA group for `asmdba`, enter commands similar to the following:

   ```
   # vi /etc/udev/rules.d/99-oracle-asmdevices.rules

   KERNEL=="sdb1, OWNER="grid", GROUP="asmdba", MODE="0660",
   BUS=="scsi", PROGRAM=="/sbin/scsi_id", RESULT=="14f70656e66696c00000000"
   ```


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```
KERNEL=="sdc1", OWNER="grid", GROUP="asmdba", MODE="0660",
BUS=="scsi", PROGRAM=="/sbin/scsi_id", RESULT=="14f70656e66696c00000001"
KERNEL=="sdd1", OWNER="grid", GROUP="asmdba", MODE="0660",
BUS=="scsi", PROGRAM=="/sbin/scsi_id", RESULT=="14f70656e66696c00000002"
```

4. On clustered systems, copy the `rules.d` file to all other nodes on the cluster. For example:

   ```
   # sftp 99-oracle-asmdevices.rules root@node2:/etc/udev/rules.d/99-oracle-
   asmdevices.rules
   ```

5. Run the `partprobe` command using the syntax `/sbin/partprobe` *`devicename`*.

   For example:

   ```
   # /sbin/partprobe /dev/sdc1
   # /sbin/partprobe /dev/sdd1
   # /sbin/partprobe /dev/sde1
   # /sbin/partprobe /dev/sdf1
   ```

6. Run the command `udevtest` (`/sbin/udevtest`) to test the UDEV rules configuration you have created. The output should indicate that the devices are available and the rules are applied as expected. For example, for `/dev/ssd1`:

   ```
   # udevtest /block/sdd/sdd1
   main: looking at device '/block/sdd/sdd1' from subsystem 'block'
   udev_rules_get_name: add symlink
   'disk/by-id/scsi-360a98000686f6959684a453333524174-part1'
   udev_rules_get_name: add symlink
   'disk/by-path/ip-192.168.1.1:3260-iscsi-iqn.1992-08.com.netapp:sn.887085-
   part1'
   udev_node_mknod: preserve file '/dev/.tmp-8-17', because it has correct
   dev_t
   run_program: '/lib/udev/vol_id --export /dev/.tmp-8-17'
   run_program: '/lib/udev/vol_id' returned with status 4
   run_program: '/sbin/scsi_id'
   run_program: '/sbin/scsi_id' (stdout) '360a98000686f6959684a453333524174'
   run_program: '/sbin/scsi_id' returned with status 0
   udev_rules_get_name: rule applied, 'sdd1' becomes 'data1'
   udev_device_event: device '/block/sdd/sdd1' validate currently present
   symlinks
   udev_node_add: creating device node '/dev/data1', major = '8', minor =
   '17',
   mode = '0640', uid = '0', gid = '500'
   udev_node_add: creating symlink
   '/dev/disk/by-id/scsi-360a98000686f6959684a453333524174-part1' to '../../
   data1'
   udev_node_add: creating symlink
   '/dev/disk/by-path/ip-192.168.1.1:3260-iscsi-
   iqn.1992-08.com.netapp:sn.84187085
   -part1' to '../../data1'
   main: run: 'socket:/org/kernel/udev/monitor'
   main: run: '/lib/udev/udev_run_devd'
   main: run: 'socket:/org/freedesktop/hal/udev_event'
   main: run: '/sbin/pam_console_apply /dev/data1
   /dev/disk/by-id/scsi-360a98000686f6959684a453333524174-part1
   /dev/disk/by-path/ip-192.168.1.1:3260-iscsi-
   ```


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```
iqn.1992-08.com.netapp:sn.84187085-
part1'
```

In the example output, note that applying the rules renames OCR device `/dev/sdd1` to `/dev/data1`.

7. Load the rules and restart the UDEV service. For example:
   - Oracle Linux and Red Hat Enterprise Linux

     ```
     # udevadm control --reload-rules && udevadm trigger
     ```

   - SUSE Linux Enterprise Server

     ```
     # /etc/init.d boot.udev restart
     ```

Verify that the device permissions and ownerships are set correctly.

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B

Response Files

Review the following topics to install and configure Oracle Database, Oracle Grid Infrastructure, and other Oracle products using response files.

- How Response Files Work
  Response files can assist you with installing an Oracle product multiple times on multiple computers.
- Reasons for Using Silent Mode or Response File Mode
  Review this section for use cases for running the installer in silent mode or response file mode.
- Using Response Files
  Review this information to use response files.
- Preparing Response Files
  Review this information to prepare response files for use during silent mode or response file mode installations.
- Running Oracle Universal Installer Using a Response File
  After creating the response file, run Oracle Universal Installer at the command line, specifying the response file you created, to perform the installation.
- Running Configuration Assistants Using Response Files
  You can run configuration assistants in response file or silent mode to configure and start Oracle software after it is installed on the system. To run configuration assistants in response file or silent mode, you must copy and edit a response file template.
- Postinstallation Configuration Using Response File Created During Installation
  Use response files to configure Oracle software after installation. You can use the same response file created during installation to also complete postinstallation configuration.
- Postinstallation Configuration Using the ConfigToolAllCommands Script
  You can create and run a response file configuration after installing Oracle software. The `configToolAllCommands` script requires users to create a second response file, of a different format than the one used for installing the product.

How Response Files Work

Response files can assist you with installing an Oracle product multiple times on multiple computers.

When you start Oracle Universal Installer (OUI), you can use a response file to automate the installation and configuration of Oracle software, either fully or partially. OUI 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

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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, provide the Oracle home path for the `ORACLE_HOME` environment variable:

```
ORACLE_HOME=/u01/app/oracle/product/19.0.0/dbhome_1
```

Reasons for Using Silent Mode or Response File Mode

Review this section for use cases for running the installer in silent mode or response file mode.

Mode	Uses
Silent	Use silent mode for the following installations: • Complete an unattended installation, which you schedule using operating system utilities such as `at`. • Complete several similar installations on multiple systems without user interaction. • Install the software on a system that does not have X Window System software installed on it. The installer displays progress information on the terminal that you used to start it, but it does not display any of the installer screens.
Response file	Use response file mode to complete similar Oracle software installations on more than one system, providing default answers to some, but not all of the installer prompts.

Using Response Files

Review this information to use response files.

Use the following 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.

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3. Run the root scripts as prompted by Oracle Universal Installer.
4. If you completed a software-only installation, then run Net Configuration Assistant and Oracle DBCA in silent or response file mode to create the database listener and an Oracle Database instance respectively.

Preparing Response Files

Review this information to prepare response files for use during silent mode or response file mode installations.

- Editing a Response File Template
  Oracle provides response file templates for each product and each configuration tool.
- Recording Response Files
  You can use OUI in interactive mode to record response files, which you can then edit and use to complete silent mode or response file mode installations. This method is useful for Advanced or software-only installations.

Editing a Response File Template

Oracle provides response file templates for each product and each configuration tool.

About Response File Templates

For Oracle Database, the response file templates are located in the `$ORACLE_HOME/install/response` directory. For Oracle Grid Infrastructure, the response file templates are located in the *`Grid_home`*`/install/response` directory.

Where, *Grid_home* is the Oracle Grid Infrastructure home directory path.

> **Note**
>
> If you copied the software to a hard disk, then the response files are located in the `$ORACLE_HOME/install/response` directory.

All response file templates contain comment entries, sample formats, examples, and other useful instructions. Read the response file instructions to understand how to specify values for the response file variables, so that you can customize your installation.

The following table lists the response files provided with this software:

Table B-1 Response Files for Oracle Database and Oracle Grid Infrastructure

Response File	Description
`db_install.rsp`	Silent installation of Oracle Database.
`dbca.rsp`	Silent creation and configuration of Oracle Database using Oracle DBCA.
`netca.rsp`	Silent configuration of Oracle Net using Oracle NETCA.
`gridsetup.rsp`	Silent configuration of Oracle Grid Infrastructure installations.

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> **⚠ 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, and permissions on the response file should be changed to 600. 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:

   For example, for Oracle Database:

   ```
   $ cp $ORACLE_HOME/install/response/db_install.rsp local_directory
   ```

2. Open the response file in a text editor:

   ```
   $ vi /local_directory/db_install.rsp
   ```

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. Also, ensure that your response file name has the `.rsp` suffix.

4. Secure the response file by changing the permissions on the file to 600:

   ```
   $ chmod 600 /local_dir/db_install.rsp
   ```

   Ensure that only the Oracle software owner user can view or modify response files or consider deleting them after the installation succeeds.

   > **ⓘ Note**
   >
   > - A fully-specified response file for an Oracle Database installation contains the passwords for database administrative accounts and for a user who is a member of the OSDBA group (required for automated backups).
   > - If passwords are not specified in the response file or on the command-line, the installer prompts for the applicable passwords during installation.

Recording Response Files

You can use OUI in interactive mode to record response files, which you can then edit and use to complete silent mode or response file mode installations. This method is useful for Advanced or software-only installations.

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.

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When you record the response file, you can either complete the installation, or you can exit from the installer on the Summary page, before OUI starts to set up the software to the system.

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.

> **Note**
>
> OUI does not save passwords while recording the response file.

To record a response file:

1. Complete preinstallation tasks as for a standard 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. Ensure that the Oracle software owner user (typically `oracle`) has permissions to create or write to the Oracle home path that you specify when you run the installer.
3. 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 window, specify a file name and location for the new response file. Click **Save** to write the responses you entered to the response file.
   b. Click **Finish** to continue with the installation.

      Click **Cancel** if you do not want to continue with the installation. The installation stops, but the recorded response file is retained.

   > **Note**
   >
   > Ensure that your response file name has the `.rsp` suffix.
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.

Running Oracle Universal Installer Using a Response File

After creating the response file, run Oracle Universal Installer at the command line, specifying the response file you created, to perform the installation.

Run Oracle Universal Installer at the command line, specifying the response file you created. The Oracle Universal Installer executables, `runInstaller` and `gridSetup.sh`, provide several options. For help information on the full set of these options, run the `gridSetup.sh` or `runInstaller` command with the `-help` option. For example:

- For Oracle Database:

```
$ $ORACLE_HOME/runInstaller -help
```


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- For Oracle Grid Infrastructure:

```
$ /u01/app/oracle/product/19.0.0/grid/gridSetup.sh -help
```

The help information appears in a window after some time.

To run the installer using a response file:

1. Complete the preinstallation tasks for a normal installation.
2. Log in as the software installation owner user.
3. If you are completing a response file mode installation, then set the operating system `DISPLAY` environment variable for the user running the installation.

> **Note**
>
> You do not have to set the `DISPLAY` environment variable if you are completing a silent mode installation.

4. To start the installer in silent or response file mode, enter a command similar to the following:
   - For Oracle Database:

```
$ $ORACLE_HOME/runInstaller [-silent] \
 -responseFile responsefilename
```

   - For Oracle Grid Infrastructure:

```
$ /u01/app/oracle/product/19.0.0/grid/gridSetup.sh [-silent] \
 -responseFile responsefilename
```

> **Note**
>
> Do not specify a relative path to the response file. If you specify a relative path, then the installer fails.

   In this example:
   - `-silent` runs the installer in silent mode.
   - *responsefilename* is the full path and file name of the installation response file that you configured.
5. If this is the first time you are installing Oracle software on your system, then Oracle Universal Installer prompts you to run the `orainstRoot.sh` script.

   Log in as the `root` user and run the `orainstRoot.sh` script:

```
$ su root
password:
# /u01/app/oraInventory/orainstRoot.sh
```


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> **Note**
>
> You do not have to manually create the `oraInst.loc` file. Running the `orainstRoot.sh` script is sufficient as it specifies the location of the Oracle Inventory directory.

6. When the installation completes, log in as the `root` user and run the `root.sh` script. For example:

```
$ su root
password:
# $ORACLE_HOME/root.sh
```

Running Configuration Assistants Using Response Files

You can run configuration assistants in response file or silent mode to configure and start Oracle software after it is installed on the system. To run configuration assistants in response file or silent mode, you must copy and edit a response file template.

> **Note**
>
> If you copied the software to a hard disk, then the response file template is located in the `$ORACLE_HOME/install/response` directory.

- Running Net Configuration Assistant Using Response Files
  You can run NETCA in silent mode to configure and start an Oracle Net Listener on the system, and configure naming methods and Oracle Net service names.
- Running Oracle DBCA Using Response Files
  You can run Oracle Database Configuration Assistant (Oracle DBCA) in response file mode to configure and start an Oracle database on the system.

Running Net Configuration Assistant Using Response Files

You can run NETCA in silent mode to configure and start an Oracle Net Listener on the system, and configure naming methods and Oracle Net service names.

To run Oracle Net Configuration Assistant (NETCA) in silent mode, you must copy and edit a response file template. Oracle provides a response file template named `netca.rsp` in the `$ORACLE_HOME/assistants/netca` directory.

To run Net Configuration Assistant using a response file:

1. Copy the `netca.rsp` response file template from the response file directory to a directory on your system:

   ```
   $ cp $ORACLE_HOME/assistants/netca/netca.rsp local_directory
   ```

2. Open the response file in a text editor:

   ```
   $ vi /local_directory/netca.rsp
   ```

3. Follow the instructions in the file to edit it.

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> **Note**
>
> Net Configuration Assistant fails if you do not correctly configure the response file.

4. Log in as the Oracle software owner 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 Net Configuration Assistant in silent mode:

   ```
   $ $ORACLE_HOME/bin/netca -silent -responsefile /local_directory/netca.rsp
   ```

   In this command:

   - The `/silent` option indicates to run Net Configuration Assistant in silent mode.
   - *local_directory* is the full path of the directory where you copied the `netca.rsp` response file template.

Running Oracle DBCA Using Response Files

You can run Oracle Database Configuration Assistant (Oracle DBCA) in response file mode to configure and start an Oracle database on the system.

To run Oracle DBCA in response file mode, you must copy and edit a response file template. Oracle provides a response file template named `dbca.rsp` in the `ORACLE_HOME/assistants/dbca` directory. To run Oracle DBCA in response file mode, you must use the `-responseFile` flag in combination with the `-silent` flag. You must also use a graphical display and set the `DISPLAY` environment variable.

To run Oracle DBCA in response file mode:

1. Copy the `dbca.rsp` response file template from the response file directory to a directory on your system:

   ```
   $ cp /directory_path/assistants/dbca/dbca.rsp local_directory
   ```

   In this example, *directory_path* is the path of the directory where you have copied the installation binaries.

   As an alternative to editing the response file template, you can also create a database by specifying all required information as command line options when you run Oracle DBCA. For information about the list of options supported, enter the following command:

   ```
   $ $ORACLE_HOME/bin/dbca -help
   ```

2. Open the response file in a text editor:

   ```
   $ vi /local_dir/dbca.rsp
   ```

3. Follow the instructions in the file to edit the file.

> **Note**
>
> Oracle DBCA fails if you do not correctly configure the response file.

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4. Log in as the Oracle software owner user, and set the `ORACLE_HOME` environment variable to specify the correct Oracle home directory.
5. To run Oracle DBCA in response file mode, set the `DISPLAY` environment variable.
6. Use the following command syntax to run Oracle DBCA in silent or response file mode using a response file:

   ```
   $ORACLE_HOME/bin/dbca [-silent] -createDatabase -responseFile /local_dir/
   dbca.rsp
   ```

   In this example:

   - `-silent` option indicates that Oracle DBCA runs in silent mode.
   - *`local_dir`* is the full path of the directory where you copied the `dbca.rsp` response file template.

   During configuration, Oracle DBCA displays a window that contains the status messages and a progress bar.

Postinstallation Configuration Using Response File Created During Installation

Use response files to configure Oracle software after installation. You can use the same response file created during installation to also complete postinstallation configuration.

- Using the Installation Response File for Postinstallation Configuration
  Starting with Oracle Database 12c release 2 (12.2), you can use the response file created during installation to also complete postinstallation configuration.
- Running Postinstallation Configuration Using Response File
  You can use a response file to complete postinstallation tasks on one or more servers simultaneously.

Using the Installation Response File for Postinstallation Configuration

Starting with Oracle Database 12c release 2 (12.2), you can use the response file created during installation to also complete postinstallation configuration.

Run the installer with the `-executeConfigTools` option to configure configuration assistants after installing Oracle Grid Infrastructure or Oracle Database. You can use the response file located at `$ORACLE_HOME/install/response/`*`product_timestamp.rsp`* to obtain the passwords required to run the configuration tools.

> **Note**
>
> If passwords are not specified in the response file or on the command-line, the installer prompts for the applicable passwords during installation.

Oracle strongly recommends that you maintain security with a password response file:

- Permissions on the response file should be set to 600.
- The owner of the response file should be the installation owner user, with the group set to the central inventory (`oraInventory`) group.

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Example B-1 Response File Passwords for Oracle Grid Infrastructure (`grid` user)

```
grid.install.crs.config.ipmi.bmcPassword=password
grid.install.asm.SYSASMPassword=password
grid.install.asm.monitorPassword=password
grid.install.config.emAdminPassword=password
```

If you do not have a BMC card, or you do not want to enable IPMI, then leave the `ipmi.bmcPassword` input field blank.

If you do not want to enable Oracle Enterprise Manager for management, then leave the `emAdminPassword` password field blank.

Example B-2 Response File Passwords for Oracle Grid Infrastructure for a Standalone Server (`oracle` user)

```
oracle.install.asm.SYSASMPassword=password
oracle.install.asm.monitorPassword=password
oracle.install.config.emAdminPassword=password
```

If you do not want to enable Oracle Enterprise Manager for management, then leave the `emAdminPassword` password field blank.

Example B-3 Response File Passwords for Oracle Database (`oracle` user)

This example illustrates the passwords to specify for use with the database configuration assistants.

```
oracle.install.db.config.starterdb.password.SYS=password
oracle.install.db.config.starterdb.password.SYSTEM=password
oracle.install.db.config.starterdb.password.DBSNMP=password
oracle.install.db.config.starterdb.password.PDBADMIN=password
oracle.install.db.config.starterdb.emAdminPassword=password
oracle.install.db.config.asm.ASMSNMPPassword=password
```

You can also specify `oracle.install.db.config.starterdb.password.ALL=`*password* to use the same password for all database users.

The database configuration assistants require the SYS, SYSTEM, and DBSNMP passwords for use with Oracle DBCA. You must specify the following passwords, depending on your system configuration:

- If the database uses Oracle Automatic Storage Management (Oracle ASM) for storage, then you must specify a password for the `ASMSNMPPassword` variable. If you are not using Oracle ASM, then leave the value for this password variable blank.
- If you create a multitenant container database (CDB) with one or more pluggable databases (PDBs), then you must specify a password for the `PDBADMIN` variable. If you are not using Oracle ASM, then leave the value for this password variable blank.

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Running Postinstallation Configuration Using Response File

You can use a response file to complete postinstallation tasks on one or more servers simultaneously.

Complete this procedure to run configuration assistants with the `executeConfigTools` command and a response file.

1. Edit the response file and specify the required passwords for your configuration. You can use the response file created during installation, located at `$ORACLE_HOME/install/response/`*product_timestamp.rsp*. For example:

   For Oracle Database (`oracle` user)

   ```
   oracle.install.asm.SYSASMPassword=password
   oracle.install.config.emAdminPassword=password
   ```

   For Oracle Grid Infrastructure (`grid` user)

   ```
   grid.install.asm.SYSASMPassword=password
   grid.install.config.emAdminPassword=password
   ```

2. Change directory to the Oracle home containing the installation software. For example:

   For Oracle Grid Infrastructure:

   ```
   cd Grid_home
   ```

   Where, *Grid_home* is the path to the Oracle Grid Infrastructure home directory `/u01/app/oracle/product/19.0.0/grid`

   For Oracle Database:

   ```
   cd $ORACLE_HOME
   ```

3. Run the configuration script using the following syntax:

   For Oracle Grid Infrastructure:

   ```
   $ ./gridSetup.sh -executeConfigTools -responseFile Grid_home/install/response/product_timestamp.rsp
   ```

   For Oracle Database:

   ```
   $ ./runInstaller -executeConfigTools -responseFile $ORACLE_HOME/install/response/product_timestamp.rsp
   ```

   For Oracle Database, you can also run the response file located in the directory `$ORACLE_HOME/inventory/response/`:

   ```
   $ ./runInstaller -executeConfigTools -responseFile $ORACLE_HOME/inventory/response/db_install.rsp
   ```


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The postinstallation configuration tool runs the installer in the graphical user interface mode, displaying the progress of the postinstallation configuration. Specify the `[-silent]` option to run the postinstallation configuration in the silent mode.

For example, for Oracle Grid Infrastructure:

```
$ ./gridSetup.sh -executeConfigTools -responseFile /u01/app/oracle/product/
19.0.0/grid/response/grid_2016-01-09_01-03-36PM.rsp [-silent]
```

For Oracle Database:

```
$ ./runInstaller -executeConfigTools -responseFile /u01/app/oracle/product/
19.0.0/dbhome_1/inventory/response/db_2016-01-09_01-03-36PM.rsp [-silent]
```

Postinstallation Configuration Using the ConfigToolAllCommands Script

You can create and run a response file configuration after installing Oracle software. The `configToolAllCommands` script requires users to create a second response file, of a different format than the one used for installing the product.

Starting with Oracle Database 12c Release 2 (12.2), the `configToolAllCommands` script is deprecated and may be desupported in a future release.

- 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 during a graphical user interface installation.
- Creating a Password Response File
  You can create a password response file and use it with configuration assistants to perform silent installation.
- Running Postinstallation Configuration Using a Password Response File
  Complete this procedure to run configuration assistants with the `configToolAllCommands` script.

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 during a graphical user interface installation.

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 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 the password file in a secure location. In addition, if you have to 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 has the following syntax options:

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- `oracle.crs` for Oracle Grid Infrastructure components or `oracle.server` for Oracle Database components that the configuration assistants configure
- *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.crs|S_ASMPASSWORD=PassWord
```

> **Note**
>
> If passwords are not specified in the response file or on the command-line, the installer prompts for the applicable passwords during installation.

The database configuration assistants require the SYS, SYSTEM, and DBSNMP passwords for use with Oracle DBCA. You may need to specify the following additional passwords, depending on your system configuration:

- If the database is using Oracle Automatic Storage Management (Oracle ASM) for storage, then specify a password for the `S_ASMSNMPPASSWORD` variable. If you are not using Oracle ASM, then leave the value for this password variable blank.
- If you create a multitenant container database (CDB) with one or more pluggable databases (PDBs), then specify a password for the `S_PDBADMINPASSWORD` variable. If you are not using Oracle ASM, then leave the value for this password variable blank.

Oracle strongly recommends that you maintain security with a password response file:

- Permissions on the response file should be set to 600.
- The owner of the response file should be the installation owner user, with the group set to the central inventory (`oraInventory`) group.

Creating a Password Response File

You can create a password response file and use it with configuration assistants to perform silent installation.

> **Note**
>
> If passwords are not specified in the response file or on the command-line, the installer prompts for the applicable passwords during installation.

Perform the following steps to create a password response file:

1. Create a response file that has a name of the format *filename*`.properties`, for example:

   ```
   $ touch pwdrsp.properties
   ```


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2. Open the file with a text editor, and cut and paste the sample password file contents, as shown in the examples, modifying as needed.
3. Change permissions to secure the password response file. For example:

```
$ ls -al pwdrsp.properties
-rw------- 1 oracle oinstall 0 Apr 30 17:30 pwdrsp.properties
```

Example B-4 Password response file for Oracle Grid Infrastructure (`grid` user)

```
grid.crs|S_ASMPASSWORD=password
grid.crs|S_OMSPASSWORD=password
grid.crs|S_BMCPASSWORD=password
grid.crs|S_ASMMONITORPASSWORD=password
```

If you do not have a BMC card, or you do not want to enable IPMI, then leave the `S_BMCPASSWORD` input field blank.

Example B-5 Password response file for Oracle Grid Infrastructure for a Standalone Server (`oracle` user)

```
oracle.crs|S_ASMPASSWORD=password
oracle.crs|S_OMSPASSWORD=password
oracle.crs|S_ASMMONITORPASSWORD=password
```

Example B-6 Password response file for Oracle Database (`oracle` user)

This example provides a template for a password response file to use with the database configuration assistants.

```
oracle.server|S_SYSPASSWORD=password
oracle.server|S_SYSTEMPASSWORD=password
oracle.server|S_EMADMINPASSWORD=password
oracle.server|S_DBSNMPPASSWORD=password
oracle.server|S_ASMSNMPPASSWORD=password
oracle.server|S_PDBADMINPASSWORD=password
```

If you do not want to enable Oracle Enterprise Manager for management, then leave those password fields blank.

Running Postinstallation Configuration Using a Password Response File

Complete this procedure to run configuration assistants with the `configToolAllCommands` script.

1. Create a password response file as described in *Creating a Password File*.
2. Change directory to `$ORACLE_HOME/cfgtoollogs`.
3. Run the configuration script using the following syntax:

```
configToolAllCommands RESPONSE_FILE=/path/name.properties
```


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For example:

```
$ ./configToolAllCommands RESPONSE_FILE=/home/oracle/pwdrsp.properties
```

Related Topics

- Creating a Password Response File
  You can create a password response file and use it with configuration assistants to perform silent installation.

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C

Optimal Flexible Architecture

Oracle Optimal Flexible Architecture (OFA) rules are a set of configuration guidelines created to ensure well-organized Oracle installations, which simplifies administration, support and maintenance.

- About the Optimal Flexible Architecture Standard
  Oracle Optimal Flexible Architecture (OFA) rules help you to organize database software and configure databases to allow multiple databases, of different versions, owned by different users to coexist.
- About Multiple Oracle Homes Support
  Oracle Database supports multiple Oracle homes. You can install this release or earlier releases of the software more than once on the same system, in different Oracle home directories.
- About the Oracle Inventory Directory and Installation
  The directory that you designate as the Oracle Inventory directory (oraInventory) stores an inventory of all software installed on the system.
- Oracle Base Directory Naming Convention
  The Oracle Base directory is the database home directory for Oracle Database installation owners, and the log file location for Oracle Grid Infrastructure owners.
- Oracle Home Directory Naming Convention
  By default, Oracle Universal Installer configures Oracle home directories using these Oracle Optimal Flexible Architecture conventions.
- Optimal Flexible Architecture File Path Examples
  Review examples of hierarchical file mappings of an Optimal Flexible Architecture-compliant installation.

About the Optimal Flexible Architecture Standard

Oracle Optimal Flexible Architecture (OFA) rules help you to organize database software and configure databases to allow multiple databases, of different versions, owned by different users to coexist.

In earlier Oracle Database releases, the OFA rules provided optimal system performance by isolating fragmentation and minimizing contention. In current releases, OFA rules provide consistency in database management and support, and simplifies expanding or adding databases, or adding additional hardware.

By default, Oracle Universal Installer places Oracle Database components in directory locations and with permissions in compliance with OFA rules. Oracle recommends that you configure all Oracle components in accordance with OFA guidelines.

Oracle recommends that you accept the OFA default. Following OFA rules is especially of value if the database is large, or if you plan to have multiple databases.

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> **Note**
>
> OFA assists in identification of an ORACLE_BASE with its Automatic Diagnostic Repository (ADR) diagnostic data to properly collect incidents.

About Multiple Oracle Homes Support

Oracle Database supports multiple Oracle homes. You can install this release or earlier releases of the software more than once on the same system, in different Oracle home directories.

Careful selection of mount point names can make Oracle software easier to administer. Configuring multiple Oracle homes in compliance with Optimal Flexible Architecture (OFA) rules provides the following advantages:

- You can install this release, or earlier releases of the software, more than once on the same system, in different Oracle home directories. However, you cannot install products from one release of Oracle Database into an Oracle home directory of a different release.
- Multiple databases, of different versions, owned by different users can coexist concurrently.
- To install Oracle Database software in multiple Oracle homes, you must extract the image file in each Oracle home, and then run the setup wizard from the respective Oracle home.
- You must install a new Oracle Database release in a new Oracle home that is separate from earlier releases of Oracle Database.

  You cannot install multiple releases in one Oracle home. Oracle recommends that you create a separate Oracle Database Oracle home for each release, in accordance with the Optimal Flexible Architecture (OFA) guidelines.
- In production, the Oracle Database server software release is the release number in the format of major and RU release number. For example, with the release number 19.3.0.0.0, the major release is 19 and the RU release number is 3.
- Later Oracle Database releases can access earlier Oracle Database releases. However, this access is only for upgrades. For example, Oracle Database 19c can access an Oracle Database 18c if the 18c database is started up in upgrade mode.
- Structured organization of directories and files, and consistent naming for database files simplify database administration.
- Login home directories are not at risk when database administrators add, move, or delete Oracle home directories.
- For information about release support timelines, refer to My Oracle Support Doc ID 742060.1

Related Topics

- My Oracle Support Note 742060.1

About the Oracle Inventory Directory and Installation

The directory that you designate as the Oracle Inventory directory (oraInventory) stores an inventory of all software installed on the system.

All Oracle software installation owners on a server are granted the OINSTALL privileges to read and write to this directory. If you have previous Oracle software installations on a server,

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then additional Oracle software installations detect this directory from the `/etc/oraInst.loc` file, and continue to use that Oracle Inventory. Ensure that the group designated as the OINSTALL group is available as a primary group for all planned Oracle software installation owners.

If you are installing Oracle software for the first time, then OUI creates an Oracle base and central inventory, and creates an Oracle inventory using information in the following priority:

- In the path indicated in the `ORACLE_BASE` environment variable set for the installation owner user account
- In an Optimal Flexible Architecture (OFA) path (u[01–99]`/app/`*owner* where *owner* is the name of the user account running the installation), and that user account has permissions to write to that path
- In the user home directory, in the path `/app/`*owner*, where *owner* is the name of the user account running the installation

For example:

If you are performing an Oracle Database installation, and you set `ORACLE_BASE` for user `oracle` to the path `/u01/app/oracle` before installation, and grant 755 permissions to `oracle` for that path, then Oracle Universal Installer creates the Oracle Inventory directory one level above the ORACLE_BASE in the path `ORACLE_BASE/../oraInventory`, so the Oracle Inventory path is `/u01/app/oraInventory`. Oracle Universal Installer installs the software in the `ORACLE_BASE` path. If you are performing an Oracle Grid Infrastructure for a Cluster installation, then the Grid installation path is changed to `root` ownership after installation, and the Grid home software location should be in a different path from the Grid user Oracle base.

If you create the OFA path `/u01`, and grant `oracle` 755 permissions to write to that path, then the Oracle Inventory directory is created in the path `/u01/app/oraInventory`, and Oracle Universal Installer creates the path `/u01/app/oracle`, and configures the `ORACLE_BASE` environment variable for the Oracle user to that path. If you are performing an Oracle Database installation, then the Oracle home is installed under the Oracle base. However, if you are installing Oracle Grid Infrastructure for a cluster, then be aware that ownership of the path for the Grid home is changed to `root` after installation and the Grid base and Grid home should be in different locations, such as `/u01/app/19.0.0/grid` for the Grid home path, and `/u01/app/grid` for the Grid base. For example:

`/u01/app/oraInventory`, owned by `grid:oinstall`
`/u01/app/oracle`, owned by `oracle:oinstall`
`/u01/app/oracle/product/19.0.0/dbhome_1/`, owned by `oracle:oinistall`
`/u01/app/grid`, owned by `grid:oinstall`
`/u01/app/19.0.0/grid`, owned by `root`

If you have neither set ORACLE_BASE, nor created an OFA-compliant path, then the Oracle Inventory directory is placed in the home directory of the user that is performing the installation, and the Oracle software is installed in the path `/app/`*owner*, where *owner* is the Oracle software installation owner. For example:

```
/home/oracle/oraInventory
/home/oracle/app/oracle/product/19.0.0/dbhome_1
```


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Oracle Base Directory Naming Convention

The Oracle Base directory is the database home directory for Oracle Database installation owners, and the log file location for Oracle Grid Infrastructure owners.

Name Oracle base directories using the syntax */pm/h/u*, where *pm* is a string mount point name, *h* is selected from a small set of standard directory names, and *u* is the name of the owner of the directory.

You can use the same Oracle base directory for multiple installations. If different operating system users install Oracle software on the same system, then you must create a separate Oracle base directory for each installation owner. For ease of administration, Oracle recommends that you create a unique owner for each Oracle software installation owner, to separate log files.

Because all Oracle installation owners write to the central Oracle inventory file, and that file mountpoint is in the same mount point path as the initial Oracle installation, Oracle recommends that you use the same */pm/h* path for all Oracle installation owners.

Table C-1 Examples of OFA-Compliant Oracle Base Directory Names

Example	Description
`/u01/app/oracle`	Oracle Database Oracle base, where the Oracle Database software installation owner name is `oracle`. The Oracle Database binary home is located underneath the Oracle base path.
`/u01/app/grid`	Oracle Grid Infrastructure Oracle base, where the Oracle Grid Infrastructure software installation owner name is `grid`. **Caution**: The Oracle Grid Infrastructure Oracle base should not contain the Oracle Grid Infrastructure binaries for an Oracle Grid Infrastructure installation. Permissions for the file path to the Oracle Grid Infrastructure binary home are changed to `root` during installation.

> **Note**
>
> Oracle home or Oracle base cannot be `symlinks`, nor can any of their parent directories, all the way to up to the `root` directory.

Oracle Home Directory Naming Convention

By default, Oracle Universal Installer configures Oracle home directories using these Oracle Optimal Flexible Architecture conventions.

The directory pattern syntax for Oracle homes is */pm/s/u*/product/*v*/*type*_[*n*]. The following table describes the variables used in this syntax:

Variable	Description
pm	A mount point name.
s	A standard directory name.

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Variable	Description
u	The name of the owner of the directory.
v	The version of the software.
type	The type of installation. For example: Database (`dbhome`), Client (`client`), or Oracle Grid Infrastructure (`grid`)
n	An optional counter, which enables you to install the same product more than once in the same Oracle base directory. For example: Database 1 and Database 2 (`dbhome_1`, `dbhome_2`)

For example, the following path is typical for the first installation of Oracle Database on this system:

```
/u01/app/oracle/product/19.0.0/dbhome_1
```

> **Note**
>
> Oracle home or Oracle base cannot be `symlinks`, nor can any of their parent directories, all the way to up to the `root` directory.

Optimal Flexible Architecture File Path Examples

Review examples of hierarchical file mappings of an Optimal Flexible Architecture-compliant installation.

```
/u02/u03 /u04
```

> **Note**
>
> - The Grid homes are examples of Grid homes used for an Oracle Grid Infrastructure for a standalone server deployment (Oracle Restart), or a Grid home used for an Oracle Grid Infrastructure for a cluster deployment (Oracle Clusterware). You can have either an Oracle Restart deployment, or an Oracle Clusterware deployment. You cannot have both options deployed at the same time.
> - Oracle Automatic Storage Management (Oracle ASM) is included as part of an Oracle Grid Infrastructure installation. Oracle recommends that you use Oracle ASM to provide greater redundancy and throughput.

> **Caution**
>
> Refrain from placing any private or application files under the Optimal Flexible Architecture file directories such as Oracle base, Oracle home, and OraInventory.

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Table C-2 Optimal Flexible Architecture Hierarchical File Path Examples

Directory	Description
`/`	Root directory
`/u01/`	User data mount point 1
`/u01/app/`	Subtree for application software
`/u01/app/oraInventory`	Central OraInventory directory, which maintains information about Oracle installations on a server. Members of the group designated as the OINSTALL group have permissions to write to the central inventory. All Oracle software installation owners must have the OINSTALL group as their primary group, and be able to write to this group.
`/u01/app/oracle/`	Oracle base directory for user `oracle`. There can be many Oracle Database installations on a server, and many Oracle Database software installation owners. Oracle software homes that an Oracle installation owner owns should be located in the Oracle base directory for the Oracle software installation owner, unless that Oracle software is Oracle Grid Infrastructure deployed for a cluster.
`/u01/app/grid`	Oracle base directory for user `grid`. The Oracle home (Grid home) for Oracle Grid Infrastructure installation is located outside of the Grid user. There can be only one Grid home on a server, and only one Grid software installation owner. The Grid home contains log files and other administrative files.
`/u01/app/oracle/admin/`	Subtree for database administration files
`/u01/app/oracle/admin/TAR`	Subtree for support log files
`/u01/app/oracle/admin/db_sales/`	Admin subtree for database named “sales”
`/u01/app/oracle/admin/db_dwh/`	Admin subtree for database named “dwh”

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Table C-2 (Cont.) Optimal Flexible Architecture Hierarchical File Path Examples

Directory	Description
`/u01/app/oracle/fast_recovery_area/`	Subtree for recovery files
`/u01/app/oracle/fast_recovery_area/db_sales`	Recovery files for database named “sales”
`/u01/app/oracle/fast_recovery_area/db_dwh`	Recovery files for database named “dwh”

`/u02/app/oracle/oradata`
`/u03/app/oracle/oradata`
`/u04/app/oracle/oradata`
	Oracle data file directories

`/u01/app/oracle/product/`	Common path for Oracle software products other than Oracle Grid Infrastructure for a cluster
`/u01/app/oracle/product/19.0.0/dbhome_1`	Oracle home directory for Oracle Database 1, owned by Oracle Database installation owner account `oracle`
`/u01/app/oracle/product/19.0.0/dbhome_2`	Oracle home directory for Oracle Database 2, owned by Oracle Database installation owner account `oracle`
`/u01/app/oracle2/product/19.0.0/dbhome_2`	Oracle home directory for Oracle Database 2, owned by Oracle Database installation owner account `oracle2`

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Table C-2 (Cont.) Optimal Flexible Architecture Hierarchical File Path Examples

Directory	Description
`/u01/app/oracle/product/19.0.0/grid`	Oracle home directory for Oracle Grid Infrastructure for a standalone server, owned by Oracle Database and Oracle Grid Infrastructure installation owner `oracle`.
`/u01/app/19.0.0/grid`	Oracle home directory for Oracle Grid Infrastructure for a cluster (Grid home), owned by user `grid` before installation, and owned by `root` after installation.
`/u01/app/oracle/product/19.0.0/client_1`	Oracle home directory for Oracle Database Client 1, owned by Oracle Database installation owner account `oracle`

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D

Configuring Read-Only Oracle Homes

Understand how read-only Oracle homes work and how you can configure read-only Oracle homes.

- Evolution of Oracle Homes
  Learn about read-only Oracle home concepts like Oracle base home, Oracle base config, and orabasetab.
- Enabling a Read-Only Oracle Home
  Configure your Oracle home as a read-only Oracle home after you have performed a software-only Oracle Database installation.
- Copying demo Directories to Oracle Base Home
  In a read-only mode ORACLE_HOME, you must copy the `demo` directories listed in this topic from ORACLE_HOME to ORACLE_BASE_HOME.
- Determining if an Oracle Home is Read-Only
  Run the `orabasehome` command to determine if your Oracle home is a read/write or read-only Oracle home.
- File Path and Directory Changes in Read-Only Oracle Homes
  Examples of hierarchical file mappings in a read-only Oracle home as compared to a read/write Oracle home.

Evolution of Oracle Homes

Learn about read-only Oracle home concepts like Oracle base home, Oracle base config, and orabasetab.

- About Read-Only Oracle Homes
  Starting with Oracle Database 18c, you can configure an Oracle home in read-only mode. A read-only Oracle home does not imply that the file system and the Oracle home is in read-only mode. The file system and mount point should always be in read/write mode.
- About Oracle Base Homes
  Both, in a read-only ORACLE_HOME and read/write ORACLE_HOME, the user-specific files, instance-specific files, and log files reside in a location known as the ORACLE_BASE_HOME.
- About Oracle Base Config
  Both, in a read-only ORACLE_HOME and read/write ORACLE_HOME, the configuration files reside in a location known as ORACLE_BASE_CONFIG.
- About orabasetab
  The `orabasetab` file is used to define fundamental directories based on $ORACLE_HOME, ORACLE_BASE, ORACLE_BASE_HOME and ORACLE_BASE_CONFIG.

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About Read-Only Oracle Homes

Starting with Oracle Database 18c, you can configure an Oracle home in read-only mode. A read-only Oracle home does not imply that the file system and the Oracle home is in read-only mode. The file system and mount point should always be in read/write mode.

A read-only Oracle home simplifies provisioning by implementing separation of installation and configuration.

In a read-only Oracle home, the configuration data and log files reside outside of the read-only Oracle home. See, File Path and Directory Changes in Read-Only Oracle Homes.

Apart from the traditional ORACLE_BASE and ORACLE_HOME directories, the following directories contain files that used to be in ORACLE_HOME:

- ORACLE_BASE_HOME
- ORACLE_BASE_CONFIG

Ensure that you enable read-only Oracle home before you create the database or listener.

When you run the `roohctl` script to enable a read-only Oracle home, the Oracle home file system will continue to be a read/write file system.

> **Note**
>
> This feature does not affect how database administrators monitor, diagnose, and tune their system performance.

About Oracle Base Homes

Both, in a read-only ORACLE_HOME and read/write ORACLE_HOME, the user-specific files, instance-specific files, and log files reside in a location known as the ORACLE_BASE_HOME.

In a read/write ORACLE_HOME, the ORACLE_BASE_HOME path is the same as the ORACLE_HOME directory. However, in a read-only ORACLE_HOME, the ORACLE_BASE_HOME directory is not co-located with ORACLE_HOME but is located at ORACLE_BASE/homes/HOME_NAME.

Where, HOME_NAME is the internal name for ORACLE_HOME.

For example, the networking directories `network/admin`, `network/trace`, and `network/log` are located in the ORACLE_BASE_HOME directory. In a read/write ORACLE_HOME the networking directories appear to be in ORACLE_HOME because ORACLE_BASE_HOME is co-located with ORACLE_HOME, whereas in a read-only ORACLE_HOME the networking directories are located in ORACLE_BASE/homes/HOME_NAME.

To print the ORACLE_BASE_HOME path, run the `orabasehome` command from the `$ORACLE_HOME/bin` directory:

```
$ setenv ORACLE_HOME /u01/app/oracle/product/19.0.0/dbhome_1
$ cd $ORACLE_HOME/bin
$ ./orabasehome
```


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For example:

```
$ ./orabasehome
/u01/app/oracle/homes/OraDB19Home1
```

Where, `/u01/app/oracle` is ORACLE_BASE and `OraDB19Home1` is HOME_NAME

About Oracle Base Config

Both, in a read-only ORACLE_HOME and read/write ORACLE_HOME, the configuration files reside in a location known as ORACLE_BASE_CONFIG.

In a read/write ORACLE_HOME, the ORACLE_BASE_CONFIG path is the same as the ORACLE_HOME path because it is located at $ORACLE_HOME. However, in a read-only ORACLE_HOME, the ORACLE_BASE_CONFIG path is the same as ORACLE_BASE.

`ORACLE_BASE_CONFIG/dbs` contains the configuration files for ORACLE_HOME. Each file in the `dbs` directory contains $ORACLE_SID so that the directory can be shared by many different ORACLE_SIDs.

To print the ORACLE_BASE_CONFIG path, run the `orabaseconfig` command from the `$ORACLE_HOME/bin` directory:

```
$ setenv ORACLE_HOME /u01/app/oracle/product/19.0.0/dbhome_1
$ cd $ORACLE_HOME/bin
$ ./orabaseconfig
```

For example:

```
$ ./orabaseconfig
/u01/app/oracle
```

Where, `/u01/app/oracle` is ORACLE_BASE.

About orabasetab

The `orabasetab` file is used to define fundamental directories based on $ORACLE_HOME, ORACLE_BASE, ORACLE_BASE_HOME and ORACLE_BASE_CONFIG.

The `orabasetab` file resides in `ORACLE_HOME/install/orabasetab`. To determine if an ORACLE_HOME is read-only or read/write, you can check for the presence of the `orabasetab` file. The `orabasetab` file also defines the ORACLE_BASE and the HOME_NAME of the Oracle home. HOME_NAME is the internal name for ORACLE_HOME.

The last line in the `orabasetab` file, which starts with $ORACLE_HOME, defines the directories for $ORACLE_HOME. The last line consists of four fields, each separate by a colon delimiter`(:)`.

1. The first field matches the current $ORACLE_HOME.
2. The second field defines the ORACLE_BASE for the current ORACLE_HOME.
3. The third field defines the HOME_NAME which is used in constructing the ORACLE_BASE_HOME path in a read-only ORACLE_HOME.

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4. The fourth field displays `N` in a read/write ORACLE_HOME and `Y` in a read-only ORACLE_HOME.

In a read-only ORACLE_HOME, the ORACLE_BASE_HOME path is `ORACLE_BASE/homes/HOME_NAME` and ORACLE_BASE_CONFIG is the same as ORACLE_BASE.

In a read/write ORACLE_HOME, ORACLE_HOME, ORACLE_BASE_HOME and ORACLE_BASE_CONFIG are all the same.

Viewing an orabasetab File

1. Log in as the Oracle installation owner user account (`oracle`).
2. Go to the `$ORACLE_HOME/install` directory.

```
$ cd /u01/app/oracle/product/19.0.0/dbhome_1/install
```

3. View the contents of the `orabasetab` file.

```
$ cat orabasetab
/u01/app/oracle/product/19.0.0/dbhome_1:/u01/app/oracle:OraDB19Home1:Y:
```

In this example, a `Y` in the fourth field at the end of the line indicates you have a read-only Oracle home.

Enabling a Read-Only Oracle Home

Configure your Oracle home as a read-only Oracle home after you have performed a software-only Oracle Database installation.

To enable a read-only Oracle home:

1. Perform a software-only Oracle Database installation.
2. Run the `roohctl -enable` script.
3. Run Oracle Database Configuration Assistant (Oracle DBCA) to create a database.

> **Note**
>
> Ensure that you enable read-only Oracle home before you create the database or listener.

Software-Only Database Installation

1. Log in as the Oracle installation owner user account (`oracle`) that you want to own the software binaries.
2. Download the Oracle Database installation image files (`db_home.zip`) to a directory of your choice. For example, you can download the image files to the `/tmp` directory.
3. Create the Oracle home directory and extract the image files that you have downloaded in to this Oracle home directory. For example:

```
$ mkdir -p /u01/app/oracle/product/19.0.0/dbhome_1
$ chown oracle:oinstall /u01/app/oracle/product/19.0.0/dbhome_1
```


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```
$ cd /u01/app/oracle/product/19.0.0/dbhome_1
$ unzip -q /tmp/db_home.zip
```

> **Note**
>
> Ensure that the Oracle home directory path you create is in compliance with the Oracle Optimal Flexible Architecture recommendations. Also, unzip the installation image files only in this Oracle home directory that you created.

4. From the Oracle home directory, run the `runInstaller` command to start the Oracle Database installer.
5. In the Select Configuration Option screen, select **Set Up Software Only.**
6. Select your installation type. Installation screens vary depending on the installation option you select. Respond to the configuration prompts as needed.

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

Run the roohctl Script

1. Go to the `bin` directory

   ```
   $ cd /u01/app/oracle/product/19.0.0/dbhome_1/bin
   ```

2. Run the `roohctl` script to enable read-only Oracle home.

   ```
   $ ./roohctl -enable
   ```

3. On Oracle Real Application Clusters (Oracle RAC) installations, run the preceding `roohctl` script on every node of the cluster. Alternatively, run the `roohctl` script with the `nodelist` option and provide the list of cluster nodes:

   ```
   $ ./roohctl –enable –nodelist comma_separated_list_of_nodes
   ```

Run Oracle Database Configuration Assistant

1. Ensure that you are still in the `bin` directory and run Oracle DBCA.

   ```
   $ ./dbca
   ```

2. In the Select Database Operation screen, select **Create a Database.**
3. The configuration screens vary depending on the options you select. Respond to the prompts as needed.

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> **Note**
>
> Click **Help** if you have any questions about the information you are asked to submit during database creation.

Related Topics

- Running Oracle Database Setup Wizard to Install Oracle Database
  Extract the database image files and use the `runInstaller` command to start the installation.
- *Oracle Database 2 Day DBA*

Copying demo Directories to Oracle Base Home

In a read-only mode ORACLE_HOME, you must copy the `demo` directories listed in this topic from ORACLE_HOME to ORACLE_BASE_HOME.

Oracle Database contains various `demo` directories that include a variety of examples and product demonstrations that you can use to learn about the products, options, and features of Oracle Database. In a read-only mode ORACLE_HOME, you cannot use these `demo` directories in ORACLE_HOME because writes are performed to these `demo` directories when they are used.

Many of the demo directories are not available by default. You must install Oracle Database Examples to view and use the examples and product demonstrations.

Copy the respective `demo` directory to the corresponding location in ORACLE_BASE_HOME. Now, you can use this copy of the `demo` directory.

You must copy the following `demo` directories from ORACLE_HOME to ORACLE_BASE_HOME:

- `jdbc/demo`
- `odbc/demo`
- `ord/http/demo`
- `precomp/demo`
- `rdbms/demo`
- `sqlj/demo`
- `sqlplus/demo`
- `xdk/demo`

You must also create symbolic links for the `odbc/demo`, `precomp/demo`, `rdbms/demo`, and `xdk/demo` `demo` directories. See the "Creating Symbolic Links" section in this topic.

Copying demo Directories

For example, to copy the `rdbms/demo` directory from ORACLE_HOME to ORACLE_BASE_HOME, perform the following:

1. Login as the Oracle software owner user (`oracle`).

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2. Check if the `rdbms/demo` directory is copied to ORACLE_BASE_HOME.

```
$ ls -l -d $(orabasehome)/rdbms/demo
```

3. If the `rdbms/demo` directory has not been copied, then create it and copy it.

```
$ mkdir -p $(orabasehome)/rdbms
$ cp -r $ORACLE_HOME/rdbms/demo $(orabasehome)/rdbms/demo
```

Similarly, copy all the demo directories listed earlier from ORACLE_HOME to ORACLE_BASE_HOME.

Creating Symbolic Links

You must create symbolic links for the `odbc/demo`, `precomp/demo`, `rdbms/demo`, and `xdk/demo` demo directories.

For `rdbms/demo`, replace `$ORACLE_HOME/rdbms/demo` with a symbolic link to the copy.

1. Ensure that the symbolic link does not already exist.

```
$ ls -l -d $ORACLE_HOME/rdbms/demo
```

2. If `$ORACLE_HOME/rdbms/demo` is still the original `demo` directory, rename it and replace it with the symbolic link.

```
$ cd $ORACLE_HOME/rdbms
$ mv demo demo.installed
$ ln -s $(orabasehome)/rdbms/demo $ORACLE_HOME/rdbms/demo
```

For `odbc/demo`, replace `$ORACLE_HOME/odbc/demo` with a symbolic link to the copy.

1. Ensure that the symbolic link does not already exist.

```
$ ls -l -d $ORACLE_HOME/odbc/demo
```

2. If `$ORACLE_HOME/odbc/demo` is still the original `demo` directory, rename it and replace it with the symbolic link.

```
$ cd $ORACLE_HOME/odbc
$ mv demo demo.installed
$ ln -s $(orabasehome)/odbc/demo $ORACLE_HOME/odbc/demo
```

For `precomp/demo`, replace `$ORACLE_HOME/precomp/demo` with a symbolic link to the copy.

1. Ensure that the symbolic link does not already exist.

```
$ ls -l -d $ORACLE_HOME/precomp/demo
```

2. If `$ORACLE_HOME/precomp/demo` is still the original `demo` directory, rename it and replace it with the symbolic link.

```
$ cd $ORACLE_HOME/precomp
$ mv demo demo.installed
$ ln -s $(orabasehome)/precomp/demo $ORACLE_HOME/precomp/demo
```


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The xdk/demo directory requires a symbolic link at $ORACLE_HOME/xdk/include pointing to $(orabasehome)/xdk/include after you copy the xdk/demo directory.

1. Ensure that the symbolic link does not already exist:

   ```
   $ ls -l -d $ORACLE_HOME/xdk/include
   ```

2. If the symbolic link does not exist, then, run the following command:

   ```
   $ ln -s $ORACLE_HOME/xdk/include $(orabasehome)/xdk/include
   ```

> **Note**
>
> In the plsql/demo directory, ncmpdemo.sql is unusable in read-only mode.

Copying the init.ora File

Copy the init.ora file from ORACLE_HOME to ORACLE_BASE_HOME.

1. Login as the Oracle software owner user (oracle).
2. Check if the init.ora file exists in ORACLE_BASE_HOME.

   ```
   $ ls $(orabasehome)/init.ora
   ```

   If an init.ora file exists in ORACLE_BASE_HOME, then update this init.ora file to be in-sync with the $ORACLE_HOME/init.ora file.
3. If the init.ora file does not exist in ORACLE_BASE_HOME, then copy it from ORACLE_HOME.

   ```
   $ cp $ORACLE_HOME/init.ora $(orabasehome)/init.ora
   ```

Related Topics

- *Oracle Database Examples Installation Guide*

Determining if an Oracle Home is Read-Only

Run the orabasehome command to determine if your Oracle home is a read/write or read-only Oracle home.

If the output of the orabasehome command is the same as $ORACLE_HOME, then your Oracle home is in read/write mode. If the output displays the path ORACLE_BASE/homes/HOME_NAME, then your Oracle home is in read-only mode.

1. Set the ORACLE_HOME environment variable:

   Bourne, Bash or Korn shell:

   ```
   $ ORACLE_HOME=/u01/app/oracle/product/19.0.0/dbhome_1
   $ export ORACLE_HOME
   ```


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C shell:

```
% setenv ORACLE_HOME /u01/app/oracle/product/19.0.0/dbhome_1
```

2. Go to the `bin` directory and run the `orabasehome` command:

```
$ cd $ORACLE_HOME/bin
$ ./orabasehome
/u01/app/oracle/homes/OraDB19Home1
```

In this example, the Oracle home is in read-only mode.

File Path and Directory Changes in Read-Only Oracle Homes

Examples of hierarchical file mappings in a read-only Oracle home as compared to a read/write Oracle home.

This example shows an Optimal Flexible Architecture-compliant Oracle Database installation, for the user `oracle`, with the ORACLE_HOME, ORACLE_BASE, ORACLE_BASE_HOME, and ORACLE_BASE_CONFIG logical locations. The database files are mounted on `/u01` and the HOME_NAME is `OraDB19Home1`.

This example also shows the changes in the Oracle Database software defined paths of configuration files, log files, and other directories in a read-only Oracle home when compared to a read/write Oracle home.

Table D-1 read/write and Read-Only Oracle Home File Path Examples

Directory	Read/Write Oracle Home File Path	Read-Only Oracle Home File Path
ORACLE_HOME	`/u01/app/oracle/product/19.0.0/dbhome_1`	`/u01/app/oracle/product/19.0.0/dbhome_1`
ORACLE_BASE	`/u01/app/oracle/`	`/u01/app/oracle/`
ORACLE_BASE_HOME	ORACLE_HOME (or) `/u01/app/oracle/product/19.0.0/dbhome_1`	ORACLE_BASE/homes/HOME_NAME (or) `/u01/app/oracle/homes/OraDB19Home1`
ORACLE_BASE_CONFIG	ORACLE_HOME (or) `/u01/app/oracle/product/19.0.0/dbhome_1`	ORACLE_BASE (or) `/u01/app/oracle/`
`network`	ORACLE_HOME/network (or) `/u01/app/oracle/product/19.0.0/dbhome_1/network`	ORACLE_BASE_HOME/network (or) `/u01/app/oracle/homes/OraDB19Home1/network`

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Table D-1 (Cont.) read/write and Read-Only Oracle Home File Path Examples

Directory	Read/Write Oracle Home File Path	Read-Only Oracle Home File Path
`dbs`	ORACLE_HOME/dbs (or) `/u01/app/oracle/product/19.0.0/dbhome_1/dbs`	ORACLE_BASE/dbs (or) `/u01/app/oracle/dbs`

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E

Oracle Memory Speed CLI Commands

`omsfscmds` is a command line utility for administering Oracle Memory Speed (OMS). To use `omsfscmds`, ensure that the OMS daemon is running.

Example E-1 Running omsfscmds

Set the $ORACLE SID to the same SID as the daemon and run `omsfscmds`.

```
$ $ORACLE_HOME/bin/omsfscmds
OMS>
```

- mkfs and forcemkfs Command Reference
  Use `mkfs` and `forcemkfs` to format the OMS uber file placed in a PMEM DAX mount point.
- mount, unmount and lsmount Command Reference
  Use `mount`, `umount` and, `lsmount` to manage and query the Oracle Memory Speed file system mount points.
- df Command Reference
  Use `df` to determine the total space, used space, and free space in a mounted Oracle Memory Speed (OMS) file system.
- cp Command Reference
  Use the copy command `cp` to copy files.
- ls and lls Command Reference
  Use `ls` to list files in the Oracle Memory Speed (OMS) mount point, and `lls` to list files in the OMS mount point with additional information for each file.
- rm Command Reference
  Use the `rm` command to delete a file from an Oracle Memory Speed (OMS) mount point.
- cd and pwd Command Reference
  Use the current directory `cd` command to set the current working Oracle Memory Speed (OMS) mount point. Use the present working directory `pwd` command to display the current OMS mount point set by the previous `cd` command.
- lsom and lsof Command Reference
  Use the `ls` of mount point `lsom` command to list the Oracle process identifiers of all processes that have opened files in an Oracle Memory Speed (OMS) mount point.
- Daemon Control Command Reference
  Use the `daemon` command to control the OMS daemon process.
- Diagnostics and Tracing
  The `dump` command has many sub options to print diagnostic information.

mkfs and forcemkfs Command Reference

Use `mkfs` and `forcemkfs` to format the OMS uber file placed in a PMEM DAX mount point.

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Syntax

```
mkfs PMEM_device blksz
forcemkfs PMEM_device blksz
```

In this example, *PMEM_device* is the uber file.

Both `mkfs` and `forcemks` accept an optional block size *blksz* argument. Currently, 4 KB is the only supported block size. `mkfs` and `forcemkfs` will not format an uber file that is mounted as an OMS file system.

Usage Notes

The uber file size must be an exact multiple of 2 MB. `mkfs` checks if the uber file includes a preexisting OMS file system. If `mkfs` finds a preexisting OMS file system, `mkfs` will print an error.

`forcemkfs` does not check for a preexisting OMS file system in the uber file and proceeds with laying out a new OMS file system in the uber file.

> ⚠ **Caution**
>
> After you run `forcemkfs`, the data in the uber file cannot be restored.

mount, unmount and lsmount Command Reference

Use `mount`, `umount` and, `lsmount` to manage and query the Oracle Memory Speed file system mount points.

Syntax

```
mount Device mount_path
umount mount_path
lsmount
```

Usage Notes

`mount` creates a mount point for the uber file referred to as *Device* in the command syntax. `mount` does not allow a previously mounted uber file to be mounted again. `mount` supports a maximum of two mount points. The directory for the mount point must exist in the underlying POSIX file system and should not have write permissions.

`umount` unmounts a previously mounted OMS file system.

`lsmount` lists all the mount points.

df Command Reference

Use `df` to determine the total space, used space, and free space in a mounted Oracle Memory Speed (OMS) file system.

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Syntax

```
df mount_path
```

Example

```
OMS> df /oracle/omsfs_1
Free (KB) : 10265748
Used (KB) : 218928
Total (KB): 10484676
OMS>
```

Usage Notes

The OMS file system mounted at `/oracle/omsfs_1` has a total available space of 10 GB. Out of this 10 GB total space, 213 MB is in use and approximately 9.8 GB is free space.

cp Command Reference

Use the copy command `cp` to copy files.

Syntax

```
cp src_filepath dst_filepath
```

Usage Notes

You can copy the files from a POSIX mount point to an Oracle Memory Speed (OMS) mount point, an OMS mount point to a POSIX mount point, within a single OMS mount point, or between OMS mount points associated with the same SID.

You must use absolute paths for files residing in the OMS file system. The `cp` command is enabled only when the Oracle instance is down. Oracle recommends that you use SQL commands to copy files into and out of the OMS file system using the instance.

ls and lls Command Reference

Use `ls` to list files in the Oracle Memory Speed (OMS) mount point, and `lls` to list files in the OMS mount point with additional information for each file.

Syntax

```
ls mount_path
lls mount_path
```

Usage Notes

`lls` reports an accurate accounting of the total bytes allocated for the files. However, `ls` may not always report an accurate accounting of the total bytes allocated for the files.

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Example

```
ls /oracle/omsfs_1
OMS:ls: dirpath fixed to /oracle/omsfs_1/
OMS:ls: Files in /oracle/omsfs_1/:
OMS:ls: [blobno] blobname
OMS:ls cb: [4] /control01.ctl
OMS:ls cb: [5] /df1.dbf
OMS:ls cb: [6] /tempfile
OMS:lst: Total bytes allocated: 212640K
OMS> lls /oracle/omsfs_1
OMS:ls: dirpath fixed to /oracle/omsfs_1/
OMS:lls: Files in /oracle/omsfs_1/:
OMS:lls cb: : Blob Name : /control01.ctl
OMS:lls cb: : Blob Num : 4
OMS:lls cb: : Size : 8011776
OMS:lls cb: : BlockSize : 4096
OMS:lls cb: : DB ID: : 0
OMS:lls cb: : Dir ID: : 0
OMS:lls cb: : Blob Name : /df1.dbf
OMS:lls cb: : Blob Num : 5
OMS:lls cb: : Size : 104865792
OMS:lls cb: : BlockSize : 4096
OMS:lls cb: : DB ID: : 0
OMS:lls cb: : Dir ID: : 0
OMS:lls cb: : Blob Name : /tempfile
OMS:lls cb: : Blob Num : 6
OMS:lls cb: : Size : 104865792
OMS:lls cb: : BlockSize : 4096
OMS:lls cb: : DB ID: : 0
OMS:lls cb: : Dir ID: : 0
OMS:lst: Total bytes allocated: 212640K
OMS>
```

rm Command Reference

Use the `rm` command to delete a file from an Oracle Memory Speed (OMS) mount point.

Syntax

```
rm filepath
```

Usage Notes

The file path must be an absolute path to an OMS file. `rm` is enabled only when the Oracle instance is down. If you delete critical files, then it may cause the instance start-up to fail.

> ⚠ **Caution**
>
> You cannot restore the files you delete.

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cd and pwd Command Reference

Use the current directory `cd` command to set the current working Oracle Memory Speed (OMS) mount point. Use the present working directory `pwd` command to display the current OMS mount point set by the previous `cd` command.

Syntax

```
cd dirpath
pwd
```

Usage Notes

`cd` allows you to use other commands such as `ls` without an explicit argument.

Example

```
OMS> pwd
pwd: /
OMS> cd /oracle/omsfs_1
cd /oracle/omsfs_1 succeeded.
OMS> pwd
pwd: /oracle/omsfs_1
OMS> ls
OMS:ls: Files in /oracle/omsfs_1/:
OMS:ls: [blobno] blobname
OMS:ls cb: [4] /control01.ctl
OMS:ls cb: [5] /df1.dbf
OMS:ls cb: [6] /tempfile
OMS:lst: Total bytes allocated: 212640K
OMS>
```

lsom and lsof Command Reference

Use the `ls` of mount point `lsom` command to list the Oracle process identifiers of all processes that have opened files in an Oracle Memory Speed (OMS) mount point.

Syntax

```
dump lsom mount_point dump_file_name
dump lsof absolute_file dump_file_name
```

Usage Notes

Use the `ls` of file `lsof` to list the Oracle process identifiers of all processes that have the specified file open.

Browse the alert log to determine the OS pid of the process from the Oracle pid. `lsom` and `lsof` are available only when the Oracle instance is up-and-running.

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Examples

```
OMS> dump lsom /oracle/omsfs_1 /tmp/lsom
OMS> exit
$ cat /tmp/lsom
18 /control01.ctl
18 /df1.dbf
18 /tempfile
19 /df1.dbf
20 /df1.dbf
21 /df1.dbf
22 /df1.dbf
23 /df1.dbf
24 /df1.dbf
25 /df1.dbf
26 /df1.dbf
27 /df1.dbf
28 /df1.dbf
29 /df1.dbf
31 /control01.ctl
30 /control01.ctl
30 /df1.dbf
32 /tempfile
43 /control01.ctl
8 /control01.ctl
47 /control01.ctl
```

```
OMS> dump lsof /oracle/omsfs_2/control02.ctl /tmp/lsof
OMS> exit
$ cat /tmp/lsof
18 /control02.ctl
31 /control02.ctl
30 /control02.ctl
43 /control02.ctl
8 /control02.ctl
47 /control02.ctl
```

Daemon Control Command Reference

Use the `daemon` command to control the OMS daemon process.

Syntax

```
daemon exit
trace lvl
```

Usage Notes

The `exit` option marks the shared memory segment deleted and requests the daemon process to cleanly exit.

The `trace` option sets the verbosity of tracing to the daemon trace file. The verbosity levels are low, medium, and high. The default tracing verbosity is medium.

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The daemon trace file is located at `$ORACLE_BASE/diag/oms/$ORACLE_SID_oms_*.trc`.

Related Topics

- About the OMS Daemon
  OMS is a user-space file system. The OMS daemon handles management and CLI operations for OMS.

Diagnostics and Tracing

The `dump` command has many sub options to print diagnostic information.

The `trace` command allows you to trace the internal modules of Oracle Memory Speed (OMS). Contact Oracle technical support to use these options.

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F

Managing Oracle Database Port Numbers

Review default port numbers. If needed, use these steps to change assigned ports after installation.

- About Managing Ports
  During installation, Oracle Universal Installer assigns port numbers to components from a set of default port numbers.
- Oracle Database Component Port Numbers and Protocols
  This table lists the port numbers and protocols configured for Oracle Database components during a single-instance installation. By default, the first port in the range is assigned to the component, if it is available.

About Managing Ports

During installation, Oracle Universal Installer assigns port numbers to components from a set of default port numbers.

Many Oracle Database components and services use ports. As an administrator, it is important to know the port numbers used by these services, and to ensure that the same port number is not used by two services on your host. Enter the following command to identify the ports currently used on your computer:

```
$/bin/netstat -a
```

Most port numbers are assigned during installation. Every component and service has an allotted port range, which is the set of port numbers Oracle Database attempts to use when assigning a port. Oracle Database starts with the lowest number in the range and performs the following checks:

- Is the port used by another Oracle Database installation on the host?

  The installation may be up or down at the time. Oracle Database can still detect if the port is used.
- Is the port used by a process that is currently running?

  This can be any process on the host, even a non-Oracle Database process.
- Is the port listed in the `/etc/services` file?

If the answer to any of the preceding questions is yes, then Oracle Database moves to the next highest port in the allotted port range, and continues checking until it finds a free port.

Oracle Database Component Port Numbers and Protocols

This table lists the port numbers and protocols configured for Oracle Database components during a single-instance installation. By default, the first port in the range is assigned to the component, if it is available.

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Table F-1 Protocols and Default Port Numbers for Oracle Database Components

Component	Description	Default Port Number	Port Range	Protocol
Oracle Net Services Listener	Enables Oracle client connections to the database over the Oracle Net Services protocol. You can configure it during installation. To reconfigure this port, use Net Configuration Assistant.	1521	Port number changes to the next available port. Modifiable manually to any available port.	TCP
Oracle Connection Manager	Listening port for Oracle client connections to Oracle Connection Manager. It is not configured during installation, but can be configured manually by editing the `cman.ora` parameter file. This file is located under the `/network/admin` directory.	1630	1630	TCP
Oracle XML DB	The Oracle XML DB HTTP port is used if web-based applications must access an Oracle database from an HTTP listener. You must configure this port manually.	0	Configured Manually	HTTP
Oracle XML DB	The Oracle XML DB FTP is used when applications must access an Oracle database from an FTP listener. You must configure this port manually.	0	Configured Manually	FTP

Related Topics

- Using HTTP(S) on a Standard Port
- Using FTP on the Standard Port
- *Oracle Real Application Clusters Installation Guide for Linux and UNIX*

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