Oracle® Clusterware

Administration and Deployment Guide

11*g* Release 2 (11.2)

E10717-03

August 2009

ORACLE®

Oracle Clusterware Administration and Deployment Guide, 11*g* Release 2 (11.2)

E10717-03

Primary Author: Richard Strohm

Contributing Authors: Ahmed Abbas, Ram Avudaiappan, Mark Bauer, Eric Belden, Gajanan Bhat, Jonathan Creighton, Mark Fuller, John Grout, Andrey Gusev, Winston Huang, Sameer Joshi, Sana Karam, Roland Knapp, Erich Kreisler, Raj Kumar, Karen Li, Barb Lundhild, Bill Manry, Saar Maoz, Markus Michalewicz, Anil Nair, Philip Newlan, Kevin Reardon, Dipak Saggi, Viv Schupmann, K.P. Singh, Duane Smith, Janet Stern, Su Tang, Juan Tellez, Douglas Williams

Contents

3 Cloning Oracle Clusterware to Create a Cluster

4 Adding and Deleting Cluster Nodes

5 Making Applications Highly Available Using Oracle Clusterware

A Cluster Verification Utility Reference

B Oracle Clusterware Resource Reference

C OLSNODES Command Reference

D Oracle Interface Configuration Tool (OIFCFG) Command Reference

E CRSCTL Utility Reference

Preface

The *Oracle Clusterware Administration and Deployment Guide* describes the Oracle Clusterware architecture and provides an overview of this product. This book also describes administrative and deployment topics for Oracle Clusterware.

Information in this manual applies to Oracle Clusterware as it runs on all platforms unless otherwise noted. In addition, the content of this manual supplements administrative and deployment topics for Oracle single-instance databases that appear in other Oracle documentation. Where necessary, this manual refers to platform-specific documentation. This Preface contains these topics:

Audience

The *Oracle Clusterware Administration and Deployment Guide* is intended for database administrators, network administrators, and system administrators who perform the following tasks:

- Install and configure Oracle Real Application Clusters (Oracle RAC) databases
- Administer and manage Oracle RAC databases
- Manage and troubleshoot clusters and networks that use Oracle RAC

Documentation Accessibility

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

Accessibility of Code Examples in Documentation

Screen readers may not always correctly read the code examples in this document. The conventions for writing code require that closing braces should appear on an otherwise empty line; however, some screen readers may not always read a line of text that consists solely of a bracket or brace.

Accessibility of Links to External Web Sites in Documentation

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

Deaf/Hard of Hearing Access to Oracle Support Services

To reach Oracle Support Services, use a telecommunications relay service (TRS) to call Oracle Support at 1.800.223.1711. An Oracle Support Services engineer will handle technical issues and provide customer support according to the Oracle service request process. Information about TRS is available at `http://www.fcc.gov/cgb/consumerfacts/trs.html`, and a list of phone numbers is available at `http://www.fcc.gov/cgb/dro/trsphonebk.html`.

Related Documents

For more information, see the Oracle resources listed in this section.

- Platform-specific Oracle Clusterware and Oracle RAC installation guides

  Each platform-specific Oracle Database 11*g* installation media contains a copy of an Oracle Clusterware and Oracle RAC platform-specific installation and configuration guide in HTML and PDF formats. These installation books contain the preinstallation, installation, and postinstallation information for the various UNIX, Linux, and Windows platforms on which Oracle Clusterware and Oracle RAC operate.

- *Oracle Database 2 Day + Real Application Clusters Guide*

  This task-oriented guide helps you understand the basic steps required to install, configure, and administer Oracle Clusterware and Oracle Real Application Clusters on a two-node system using Red Hat Linux system.

- *Oracle Real Application Clusters Administration and Deployment Guide*

  This is an essential companion book that describes Oracle Clusterware components such as the voting disks and the Oracle Cluster Registry.

- *Oracle Database 2 Day DBA*
- *Oracle Database Administrator's Guide*
- *Oracle Database Net Services Administrator's Guide*
- *Oracle Database Platform Guide for Microsoft Windows*
- *Oracle Database Administrator's Reference 11g Release 1 (11.1) for UNIX Operating Systems: AIX Systems, HP-UX, Linux, and the Solaris Operating System (SPARC)*

Database error messages descriptions are available online or by way of a Tahiti documentation search.

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.

What's New in Oracle Clusterware Administration and Deployment?

This section describes administration and deployment features for Oracle Clusterware in Oracle Database 11*g* release 2 (11.2).

> **See Also:** *Oracle Database New Features Guide* for a complete description of the features in Oracle Database 11*g* release 2 (11.2)

- **Oracle Real Application Clusters One Node (Oracle RAC One Node)**

  Oracle Database 11*g* release 2 (11.2) introduces a new option, Oracle Real Application Clusters One Node (Oracle RAC One Node). Oracle RAC One Node is a single instance of Oracle Real Application Clusters (Oracle RAC) that runs on one node in a cluster. This option adds to the flexibility that Oracle offers for database consolidation. You can consolidate many databases into one cluster with minimal overhead while also providing the high availability benefits of failover protection, online rolling patch application, and rolling upgrades for the operating system and Oracle Clusterware.

  You can limit the CPU utilization of individual database instances within the cluster through Resource Manager Instance Caging and dynamically change this limit if needed. With Oracle RAC One Node, there is no limit to server scalability and if applications grow to require more resources than a single node can supply, then you can easily upgrade your applications online to Oracle RAC. If the node that is running Oracle RAC One Node becomes overloaded, then you can migrate the instance to another node in the cluster using the Omotion online migration utility with no downtime for application users.

  Oracle RAC One Node is supported on all platforms on which Oracle RAC is certified. With Oracle RAC and Oracle RAC One Node, you can standardize your deployments across a data center while achieving the required level of scalability and high availability for your applications.

  Similar to Oracle RAC, Oracle RAC One Node will be certified on Oracle Virtual Machine (Oracle VM). Oracle VM is a no-cost, next-generation server virtualization and management solution that simplifies enterprise applications deployment, management, and support. Using Oracle RAC or Oracle RAC One Node with Oracle VM increases the benefits of Oracle VM with the high availability and scalability of Oracle RAC.

  If your Oracle VM is sized too small, then you can migrate the Oracle RAC One Node instance to another Oracle VM node in your cluster using Omotion, and then resize your Oracle VM. When you move the Oracle RAC One Node instance

back to the newly resized Oracle VM node, you can dynamically increase any limits programmed with Resource Manger Instance Caging.

Alternatively, you can create a larger Oracle VM and use Omotion to migrate to the new Oracle VM and then dynamically resize the Oracle instance, depending on the resources available in the cluster. Since Oracle clients use the Single Client Access Name (SCAN) to connect to the database, they can locate the service independently of the node on which it is running.

See Also: Oracle Technology Network for more information at

`http://otn.oracle.com/rac`

- **Oracle Restart**

  Oracle Restart provides automatic restart of Oracle Database and listeners.

  For standalone servers, Oracle Restart monitors and automatically restarts Oracle processes, such as **Oracle Automatic Storage Management (Oracle ASM)**, Oracle Database, and listeners, on the server. Oracle Restart and Oracle ASM provide the grid infrastructure for a standalone server.

  See Also: *Oracle Database Administrator's Guide* for more information about Oracle Restart

- **Improved Oracle Clusterware resource modeling**

  Oracle Clusterware can manage different types of applications and processes, including third-party applications. You can create dependencies among the applications and processes and manage them as one entity.

  Oracle Clusterware uses different entities to manage your applications and processes, including resources, resource types, servers, and server pools. In addition to revised application programming interfaces (APIs), Oracle has created a new set of APIs to manage these entities.

  See Also:

  - "Policy-Based Cluster and Capacity Management" on page 2-11 for more information about servers and server pools
  - "The Oracle Clusterware Agent Framework" on page 5-1 for more information about resources and resource types
  - Appendix F, "Oracle Clusterware C Application Program Interfaces" for more information about APIs

- **Policy-based cluster and capacity management**

  Server capacity management is improved through logical separation of a **cluster** into **server pool**s. You can determine where and how resources run in the cluster using a cardinality-based approach. Subsequently, nodes become anonymous, eliminating the need to identify the nodes when placing resources on them.

  Server pools are assigned various levels of importance. When a failure occurs, Oracle Clusterware efficiently reallocates and reassigns capacity for applications to another, less important server pool within the cluster based on user-defined policies. This feature enables faster resource failover and dynamic capacity assignment.

Clusters can host resources (defined as applications and databases) in server pools, which are isolated with respect to their resource consumption by the user-defined policies. For example, you can choose to run all human resources applications, accounting applications, and email applications in separate server pools.

> **See Also:** "Policy-Based Cluster and Capacity Management" on page 2-11 for more information

- **Role-separated management**

  Role-separated management enables multiple applications and databases to share the same cluster and hardware resources, but ensures that different administration groups do not interfere with each other.

  > **See Also:** "Role-separated Management" on page 2-18 for more information

- **Cluster time synchronization service**

  Cluster time synchronization service synchronizes the system time on all nodes in a cluster when vendor time synchronization software (such as NTP on UNIX and Window Time Service) is not installed. Synchronized system time across the cluster is a prerequisite to successfully run an Oracle cluster, improving the reliability of the entire Oracle cluster environment.

  > **See Also:** "Cluster Time Management" on page 2-1 for more information

- **Oracle Cluster Registry and voting disks can be stored using Oracle Automatic Storage Management**

  OCR and voting disks can be stored in Oracle Automatic Storage Management (Oracle ASM). The Oracle ASM partnership and status table (PST) is replicated on multiple disks and is extended to store OCR. Consequently, OCR can tolerate the loss of the same number of disks as are in the underlying **disk group** and be relocated in response to disk failures.

  Oracle ASM reserves several blocks at a fixed location on every Oracle ASM disk for storing the voting disk. Should the disk holding the voting disk fail, Oracle ASM selects another disk on which to store this data.

  Storing OCR and the voting disk on Oracle ASM eliminates the need for third-party cluster volume managers and eliminates the complexity of managing disk partitions for OCR and voting disks in Oracle Clusterware installations.

  Note: The `dd` commands used to back up and recover voting disks in previous versions of Oracle Clusterware are not supported in Oracle Clusterware 11*g* release 2 (11.2).

  > **See Also:** Chapter 2, "Administering Oracle Clusterware" for more information about OCR and voting disks

- **Oracle Automatic Storage Management Cluster File System**

  The Oracle Automatic Storage Management Cluster File System (Oracle ACFS) extends Oracle ASM by providing a robust, general purpose extent-based and journaling file system for files other than Oracle database files. Oracle ACFS

provides support for files such as Oracle binaries, report files, trace files, alert logs, and other application data files. With the addition of Oracle ACFS, Oracle ASM becomes a complete storage management solution for both Oracle database and non-database files.

Additionally, Oracle ACFS

- Supports large files with 64-bit file and file system data structure sizes leading to exabyte-capable file and file system capacities.
- Uses extent-based storage allocation for improved performance.
- Uses a log-based metadata transaction engine for file system integrity and fast recovery.
- Can be exported to remote clients through industry standard protocols such as Network File System and Common Internet File System.

Oracle ACFS eliminates the need for third-party cluster file system solutions, while streamlining, automating, and simplifying all file type management in both a single node and Oracle Real Application Clusters (Oracle RAC) and Grid computing environments.

Oracle ACFS supports dynamic file system expansion and contraction without downtime. It is also highly available, leveraging the Oracle ASM mirroring and striping features in addition to hardware RAID functionality.

> **See Also:** *Oracle Database Storage Administrator's Guide* for more information about Oracle ACFS

- **Oracle Clusterware out-of-place upgrade**

  You can install a new version of Oracle Clusterware into a separate home. Installing Oracle Clusterware in a separate home before the upgrade reduces planned outage time required for cluster upgrades, which assists in meeting availability service level agreements. After the Oracle Clusterware software is installed, you can then upgrade the cluster by stopping the previous version of the Oracle Clusterware software and starting the new version node by node (known as a rolling upgrade).

  > **See Also:** *Oracle Grid Infrastructure Installation Guide* for more information about out-of-place upgrades

- **Enhanced Cluster Verification Utility**

  Enhancements to the Cluster Verification Utility (CVU) include the following checks on the cluster:

  - Before and after node addition
  - Before and after node deletion
  - Before and after storage addition
  - Before and after storage deletion
  - After network modification
  - Oracle ASM integrity

  In addition to command-line commands, these checks are done through the Oracle Universal Installer, Database Configuration Assistant, and Oracle Enterprise Manager. These enhancements facilitate implementation and configuration of

cluster environments and provide assistance in diagnosing problems in a cluster environment, improving configuration and installation.

See Also:

- Appendix A, "Cluster Verification Utility Reference" for more information about CVU commands
- *Oracle Grid Infrastructure Installation Guide* for more information about CVU checks done during installation

- **Enhanced Integration of Cluster Verification Utility and Oracle Universal Installer**

  This feature fully integrates the CVU with Oracle Universal Installer so that multi-node checks are done automatically. This ensures that any problems with cluster setup are detected and corrected before installing Oracle software.

  The CVU validates cluster components and verifies the cluster readiness at different stages of Oracle RAC deployment, such as installation of Oracle Clusterware and Oracle RAC databases, and configuration of Oracle RAC databases. It also helps validate the successful completion of a specific stage of Oracle RAC deployment.

  See Also: *Oracle Grid Infrastructure Installation Guide* for more information about CVU checks done during installation

- **Patch application with Oracle Enterprise Manager Database Control**

  Patches can be applied to single-instance databases, Oracle RAC databases, and Oracle Clusterware using Oracle Enterprise Manager Database Control.

  See Also: *Oracle Database 2 Day + Real Application Clusters Guide* for more information

- **Grid Plug and Play**

  Grid Plug and Play enables you to move your data center toward a dynamic grid infrastructure. This enables you to consolidate applications and lower the costs of managing applications, while providing a highly available environment that can easily scale when the workload requires. There are many modifications in Oracle RAC 11*g* release 2 (11.2) to support the easy addition of servers in a cluster and therefore a more dynamic grid.

  In the past, adding or removing servers in a cluster required extensive manual preparation. With this release, Grid Plug and Play reduces the costs of installing, configuring, and managing server nodes by automating the following tasks:

  – Adding an Oracle RAC database instance

  – Negotiating appropriate network identities for itself

  – Acquiring additional information it needs to operate from a configuration profile

  – Configuring or reconfiguring itself using profile data, making host names and addresses resolvable on the network

  Additionally, the number of steps necessary to add and remove nodes is reduced.

  Oracle Enterprise Manager immediately reflects Grid Plug and Play-enabled changes.

- **Oracle Enterprise Manager support for Oracle ACFS**

  This feature provides a comprehensive management solution that extends Oracle ASM technology to support general purpose files not directly supported by ASM, and in both single-instance Oracle Database and Oracle Clusterware configurations. It also enhances existing Oracle Enterprise Manager support for Oracle ASM, and adds new features to support the Oracle ASM Dynamic Volume Manager (ADVM) and Oracle ASM Cluster File System technology (ACFS).

  Oracle Automatic Storage Management Cluster File System (Oracle ACFS) is a scalable file system and storage management design that extends Oracle ASM technology. It supports all application data in both single host and cluster configurations and leverages existing Oracle ASM functionality to achieve the following:

  – Dynamic file system resizing
  – Maximized performance through Oracle ASM's automatic distribution
  – Balancing and striping of the file system across all available disks
  – Storage reliability through Oracle ASM's mirroring and parity protection

  Oracle ACFS provides a multiplatform storage management solution to access clusterwide, non-database customer files.

  See Also: *Oracle Database Storage Administrator's Guide* for more information about Oracle ACFS

- **Oracle Enterprise Manager-based Oracle Clusterware resource management**

  You can use Oracle Enterprise Manager to manage Oracle Clusterware resources. You can create and configure resources in Oracle Clusterware and also monitor and manage resources after they are deployed in the cluster.

  See Also: "Adding Resources Using Oracle Enterprise Manager" on page 5-19

- **Zero downtime for patching Oracle Clusterware**

  Patching Oracle Clusterware and Oracle RAC can be completed without taking the entire cluster down. This also allows for out-of-place upgrades to the cluster software and Oracle Database, reducing the planned maintenance downtime required in an Oracle RAC environment.

- **Improvements to provisioning of Oracle Clusterware and Oracle RAC**

  This feature offers a simplified solution for provisioning Oracle RAC systems. Oracle Enterprise Manager Database Control enables you to extend Oracle RAC clusters by automating the provisioning tasks on the new nodes.

1

Introduction to Oracle Clusterware

This chapter includes the following topics:

- What is Oracle Clusterware?
- Overview of Oracle Clusterware Platform-Specific Software Components
- Overview of Installing Oracle Clusterware
- Overview of Managing Oracle Clusterware Environments
- Overview of Cloning and Extending Oracle Clusterware in Grid Environments
- Overview of the Oracle Clusterware High Availability Framework and APIs

What is Oracle Clusterware?

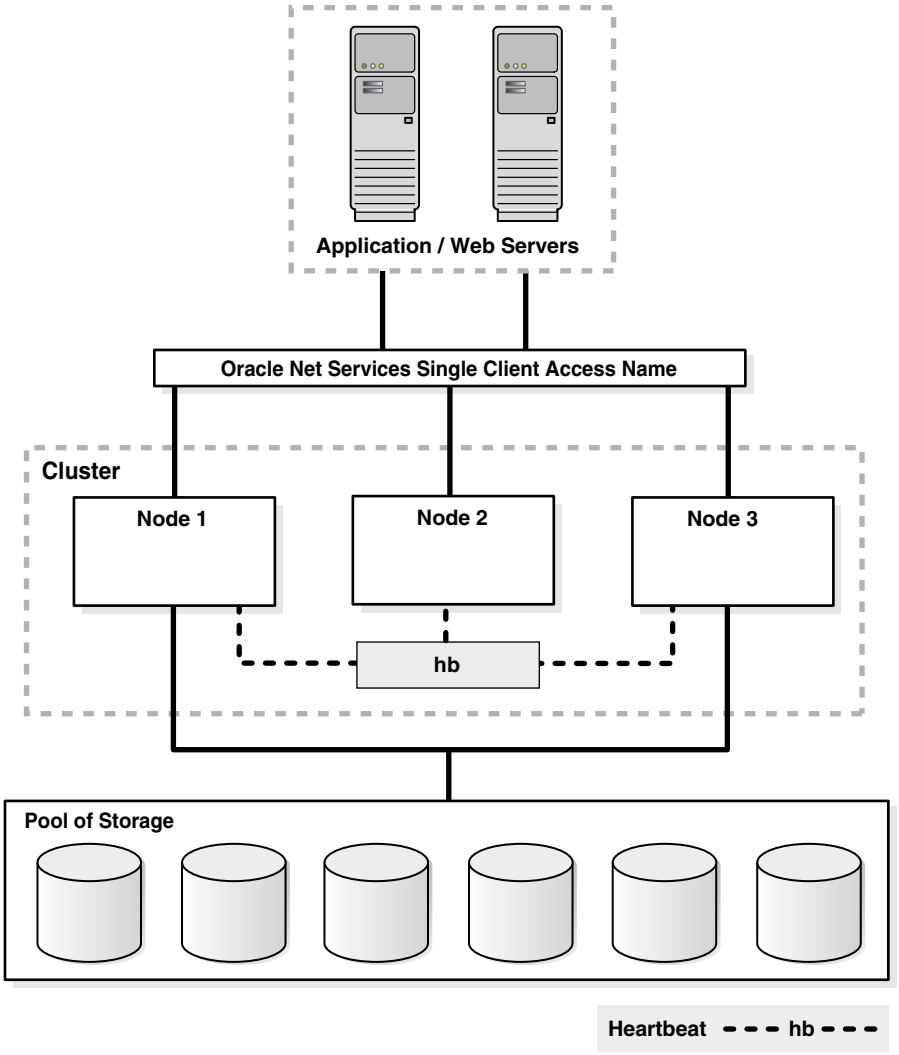
Oracle Clusterware enables servers to communicate with each other, so that they appear to function as a collective unit. This combination of servers is commonly known as a cluster. Although the servers are standalone servers, each server has additional processes that communicate with other servers. In this way the separate servers appear as if they are one system to applications and end users.

Oracle Clusterware provides the infrastructure necessary to run Oracle Real Application Clusters (Oracle RAC). Oracle Clusterware also manages **resource**s, such as virtual IP (VIP) addresses, databases, listeners, services, and so on. These resources are generally named `ora.`*`resource_name`*`.`*`host_name`*. Oracle does not support editing these resources except under the explicit direction of Oracle support. Additionally, Oracle Clusterware can help you manage your applications.

> **See Also:** Chapter 2, "Administering Oracle Clusterware" and Chapter 5, "Making Applications Highly Available Using Oracle Clusterware" for more information

Figure 1–1 shows a configuration that uses Oracle Clusterware to extend the basic single-instance Oracle Database architecture. In Figure 1–1, the cluster is running Oracle Database and is actively servicing applications and users. Using Oracle Clusterware, you can use the same high availability mechanisms to make your Oracle database and your custom applications highly available.

Figure 1–1 Oracle Clusterware Configuration



The benefits of using a cluster include:

- Scalability of applications
- Use of less expensive commodity hardware
- Ability to fail over
- Ability to increase capacity over time by adding servers
- Ability to program the startup of applications in a planned order that ensures dependent processes are started
- Ability to monitor processes and restart them if they stop

You can program Oracle Clusterware to manage the availability of user applications and Oracle databases. In an Oracle RAC environment, Oracle Clusterware manages all of the resources automatically. All of the applications and processes that Oracle Clusterware manages are either **cluster resource**s or **local resource**s.

Creating a cluster with Oracle Clusterware provides the ability to:

- Eliminate unplanned downtime due to hardware or software malfunctions

- Reduce or eliminate planned downtime for software maintenance
- Increase throughput for cluster-aware applications by enabling the applications to run on all of the nodes in a cluster
- Increase throughput on demand for cluster-aware applications, by adding servers to a cluster to increase cluster resources
- Reduce the total cost of ownership for the infrastructure by providing a scalable system with low-cost commodity hardware

Oracle Clusterware is required for using Oracle RAC; it is the only clusterware that you need for platforms on which Oracle RAC operates. Although Oracle RAC continues to support many third-party clusterware products on specific platforms, you must also install and use Oracle Clusterware. Note that the servers on which you want to install and run Oracle Clusterware must use the same operating system.

Using Oracle Clusterware eliminates the need for proprietary vendor clusterware and provides the benefit of using only Oracle software. Oracle provides an entire software solution, including everything from disk management with Oracle Automatic Storage Management (Oracle ASM) to data management with Oracle Database and Oracle RAC. In addition, Oracle Database features, such as Oracle Services, provide advanced functionality when used with the underlying Oracle Clusterware high availability framework.

Oracle Clusterware has two stored components, besides the binaries: The voting disk files, which record node membership information, and the Oracle Cluster Registry (OCR), which records cluster configuration information. Voting disks and OCRs must reside on shared storage available to all cluster member nodes.

To use Oracle Clusterware, you must understand the hardware and software concepts and requirements as described in the following sections:

- Oracle Clusterware Hardware Concepts and Requirements
- Oracle Clusterware Operating System Concepts and Requirements
- Oracle Clusterware Software Concepts and Requirements
- Oracle Clusterware Network Configuration Concepts
- Upgrading Oracle Clusterware

Oracle Clusterware Hardware Concepts and Requirements

Note: Many hardware providers have validated cluster configurations that provide a single part number for a cluster. If you are new to clustering, then use the information in this section to simplify your hardware procurement efforts when you purchase hardware to create a cluster.

A cluster comprises one or more servers. The hardware in a server in a cluster (or cluster member or node) is similar to a standalone server. However, a server that is part of a cluster, otherwise known as a node or a cluster member, requires a second network. This second network is referred to as the interconnect. For this reason, cluster member nodes require at least two network interface cards: one for a public network and one for a private network. The interconnect network is a private network using a switch (or multiple switches) that only the nodes in the cluster can access.[1]

Note: Oracle does not support using crossover cables as Oracle Clusterware interconnects.

Cluster size is determined by the requirements of the workload running on the cluster and the number of nodes that you have configured in the cluster. If you are implementing a cluster for high availability, then configure redundancy for all of the components of the infrastructure as follows:

- At least two network interfaces for the public network, bonded to provide one address
- At least two network interfaces for the private interconnect network, also bonded to provide one address

The cluster requires cluster-aware storage[2] that is connected to each server in the cluster. This may also be referred to as a multihost device. Oracle Clusterware supports NFS, iSCSI, Direct Attached Storage (DAS), Storage Area Network (SAN) storage, and Network Attached Storage (NAS).

To provide redundancy for storage, generally provide at least two connections from each server to the cluster-aware storage. There may be more connections depending on your I/O requirements. It is important to consider the I/O requirements of the entire cluster when choosing your storage subsystem.

Most servers have at least one local disk that is internal to the server. Often, this disk is used for the operating system binaries; you can also use this disk for the Oracle software binaries. The benefit of each server having its own copy of the Oracle binaries is that it increases high availability, so that corruption to a one binary does not affect all of the nodes in the cluster simultaneously. It also allows rolling upgrades, which reduce downtime.

Oracle Clusterware Operating System Concepts and Requirements

Each server must have an operating system that is certified with the Oracle Clusterware version you are installing. Refer to the certification matrices available on My Oracle Support (formerly Oracle*MetaLink*) for details, which are available from the following URL:

`http://certify.oraclecorp.com/certifyv3/certify/cert_views.group_selection?p_html_source=0`

When the operating system is installed and working, you can then install Oracle Clusterware to create the cluster. Oracle Clusterware is installed independently of Oracle Database. Once Oracle Clusterware is installed, you can then install Oracle Database or Oracle RAC on any of the nodes in the cluster.

See Also: Your platform-specific Oracle database installation documentation

Oracle Clusterware Software Concepts and Requirements

Oracle Clusterware uses voting disk files to provide fencing and cluster node membership determination. The OCR provides cluster configuration information. You

[1] Oracle Clusterware supports up to 100 nodes in a cluster on configurations running Oracle Database 10*g* release 2 (10.2) and later releases.

[2] Cluster-aware storage may also be referred to as a multihost device.

can place the Oracle Clusterware files on either Oracle ASM or on shared common disk storage. If you configure Oracle Clusterware on storage that does not provide file redundancy, then Oracle recommends that you configure multiple locations for OCR and voting disks. The voting disks and OCR are described as follows:

- **Voting Disks**

  Oracle Clusterware uses voting disk files to determine which nodes are members of a cluster. You can configure voting disks on Oracle ASM, or you can configure voting disks on shared storage.

  If you configure voting disks on Oracle ASM, then you do not need to manually configure the voting disks. Depending on the redundancy of your disk group, an appropriate number of voting disks are created.

  If you do not configure voting disks on Oracle ASM, then for high availability, Oracle recommends that you have a minimum of three voting disks on physically separate storage. This avoids having a single point of failure. If you configure a single voting disk, then you must use external mirroring to provide redundancy.

  You should have at least three voting disks, unless you have a storage device, such as a disk array that provides external redundancy. Oracle recommends that you do not use more than five voting disks. The maximum number of voting disks that is supported is 15.

- **Oracle Cluster Registry**

  Oracle Clusterware uses the Oracle Cluster Registry (OCR) to store and manage information about the components that Oracle Clusterware controls, such as Oracle RAC databases, listeners, virtual IP addresses (VIPs), and services and any applications. The OCR stores configuration information in a series of key-value pairs in a tree structure. To ensure cluster high availability, Oracle recommends that you define multiple OCR locations (multiplex). In addition:

  – You can have up to five OCR locations

  – Each OCR location must reside on shared storage that is accessible by all of the nodes in the cluster

  – You can replace a failed OCR location online if it is not the only OCR location

  – You must update the OCR through supported utilities such as Oracle Enterprise Manager, the Server Control Utility (SRVCTL), the OCR configuration utility (OCRCONFIG), or the Database Configuration Assistant (DBCA)

    See Also: Chapter 2, "Administering Oracle Clusterware" for more information about voting disks and the OCR

Oracle Clusterware Network Configuration Concepts

Oracle Clusterware enables a dynamic grid infrastructure through the self-management of the network requirements for the cluster. Oracle Clusterware 11*g* release 2 (11.2) supports the use of DHCP for all private interconnect addresses, as well as for most of the VIP addresses. DHCP provides dynamic configuration of the host's IP address, but it does not provide an optimal method of producing names that are useful to external clients.

When you are using Oracle RAC, all of the clients must be able to reach the database. This means that the VIP addresses must be resolved by the clients. This problem is solved by the addition of the Grid Naming Service (GNS) to the cluster. GNS is linked to the corporate Domain Name Service (DNS) so that clients can easily connect to the

cluster and the databases running there. Activating GNS in a cluster requires a DHCP service on the public network.

Implementing GNS

To implement GNS, you must collaborate with your network administrator to obtain an IP address on the public network for the GNS VIP. DNS uses the GNS VIP to forward requests to the cluster to GNS. The network administrator must delegate a subdomain in the network to the cluster. The subdomain forwards all requests for addresses in the subdomain to the GNS VIP.

GNS and the GNS VIP run on one node in the cluster. The GNS daemon listens, using default port 53, on this address for incoming requests. Oracle Clusterware manages the GNS and the GNS VIP to ensure that they are always available. If the server on which GNS is running fails, then Oracle Clusterware fails GNS over, along with the GNS VIP, to another node in the cluster.

With DHCP on the network, Oracle Clusterware obtains an IP address from the server along with other network information, such as what gateway to use, what DNS servers to use, what domain to use, and what NTP server to use. Oracle Clusterware initially obtains the necessary IP addresses during cluster configuration and it updates the Oracle Clusterware resources with the correct information obtained from the DHCP server.

Single Client Access Name (SCAN)

Oracle RAC 11*g* release 2 (11.2) introduces the **Single Client Access Name (SCAN)**. The SCAN is a single name that resolves to three IP addresses in the public network. When using GNS and DHCP, Oracle Clusterware configures the VIP addresses for the SCAN name that is provided during cluster configuration.

The node VIP and the three SCAN VIPs are obtained from the DHCP server when using GNS. If a new server joins the cluster, then Oracle Clusterware dynamically obtains the required VIP address from the DHCP server, updates the cluster resource, and makes the server accessible through GNS.

Example 1–1 shows the DNS entries that delegate a domain to the cluster.

Example 1–1 DNS Entries

```
# Delegate to gns on mycluster
mycluster.example.com NS myclustergns.example.com
#Let the world know to go to the GNS vip
myclustergns.example.com. 10.9.8.7
```

> **See Also:** *Oracle Grid Infrastructure Installation Guide* for details about establishing resolution through DNS

Configuring Addresses Manually

Alternatively, you can choose manual address configuration, in which you configure the following:

- One public host name for each node.
- One VIP address for each node.

  You must assign a VIP address to each node in the cluster. Each VIP address must be on the same subnet as the public IP address for the node and should be an address that is assigned a name in the DNS. Each VIP address must also be

unused and unpingable from within the network before you install Oracle Clusterware.

- Up to three SCAN addresses for the entire cluster.

Note: The SCAN must resolve to at least one address on the public network. For high availability and scalability, Oracle recommends that you configure the SCAN to resolve to three addresses.

See Also: Your platform-specific *Oracle Grid Infrastructure Installation Guide* installation documentation for information about requirements and configuring network addresses

Upgrading Oracle Clusterware

Oracle supports in-place and out-of-place upgrades. Both strategies facilitate rolling upgrades. For Oracle Clusterware 11*g* release 2 (11.2), in-place upgrades are supported for patches only. Patch bundles and one-off patches are supported for in-place upgrades but patch sets and major point releases are supported for out-of-place upgrades only.

An in-place upgrade replaces the Oracle Clusterware software with the newer version in the same Grid home. Out-of-place upgrade has both versions of the same software present on the nodes at the same time, in different Grid homes, but only one version is active.

Rolling upgrades avoid downtime and ensure continuous availability of Oracle Clusterware while the software is upgraded to the new version. When you upgrade to 11*g* release 2 (11.2), Oracle Clusterware and Oracle ASM binaries are installed as a single binary called the grid infrastructure. You can upgrade Oracle Clusterware in a rolling manner from Oracle Clusterware 10*g* and Oracle Clusterware 11*g*, however you can only upgrade Oracle ASM in a rolling manner from Oracle Database 11*g* release 1 (11.1).

See Also: *Oracle Grid Infrastructure Installation Guide* for more information about upgrading Oracle Clusterware

Overview of Oracle Clusterware Platform-Specific Software Components

When Oracle Clusterware operational, several platform-specific processes or services run on each node in the cluster. The UNIX, Linux, and Windows processes are described in the following sections:

- The Oracle Clusterware Stack
- Oracle Clusterware Processes on Linux and UNIX Systems

The Oracle Clusterware Stack

Oracle Clusterware consists of two separate stacks: an upper stack anchored by the Cluster Ready Services (CRS) daemon (`crsd`) and a lower stack anchored by the Oracle High Availability Services daemon (`ohasd`). These two stacks have several processes that facilitate cluster operations. The following sections describe these stacks in more detail:

- The Cluster Ready Services Stack
- The Oracle High Availability Services Stack

The Cluster Ready Services Stack

The list in this section describes the processes that comprise CRS. The list includes components that are processes on Linux and UNIX operating systems, or services on Windows.

- **Cluster Ready Services (CRS)**: The primary program for managing high availability operations in a cluster.

  The CRS daemon (`crsd`) manages cluster resources based on the configuration information that is stored in OCR for each resource. This includes start, stop, monitor, and failover operations. The `crsd` process generates events when the status of a resource changes. When you have Oracle RAC installed, the `crsd` process monitors the Oracle database instance, listener, and so on, and automatically restarts these components when a failure occurs.

- **Cluster Synchronization Services (CSS)**: Manages the cluster configuration by controlling which nodes are members of the cluster and by notifying members when a node joins or leaves the cluster. If you are using certified third-party clusterware, then CSS processes interfaces with your clusterware to manage node membership information.

  The `cssdagent` process monitors the cluster and provides I/O fencing. This service formerly was provided by Oracle Process Monitor Daemon (`oprocd`), also known as `OraFenceService` on Windows. A `cssdagent` failure results in Oracle Clusterware restarting the node.

- **Oracle ASM**: Provides disk management for Oracle Clusterware.

- **Cluster Time Synchronization Service (CTSS)**: Provides time management in a cluster for Oracle Clusterware.

- **Event Management (EVM)**: A background process that publishes events that Oracle Clusterware creates.

- **Oracle Notification Service (ONS)**: A publish and subscribe service for communicating Fast Application Notification (FAN) events.

- **Oracle Agent (oraagent)**: Extends clusterware to support Oracle-specific requirements and complex resources. Runs server callout scripts when FAN events occur. This process was known as RACG in Oracle Clusterware 11*g* release 1 (11.1).

- **Oracle Root Agent (orarootagent)**: A specialized `oraagent` process that helps `crsd` manage resources owned by root, such as the network, and the Grid virtual IP address.

The Cluster Synchronization Service (CSS), Event Management (EVM), and Oracle Notification Services (ONS) components communicate with other cluster component layers in the other instances in the same cluster database environment. These components are also the main communication links between Oracle Database, applications, and the Oracle Clusterware high availability components. In addition, these background processes monitor and manage database operations.

The Oracle High Availability Services Stack

The list in this section describes the processes that comprise the Oracle High Availability Services stack. The list includes components that are processes on Linux and UNIX operating systems, or services on Windows.

- **Grid Plug and Play (gpnpd)**: GPNPD provides access to the Grid Plug and Play profile, and coordinates updates to the profile among the nodes of the cluster to ensure that all of the nodes node have the most recent profile.

- **Grid Interprocess Communication (GIPC)**: A helper daemon for the communications infrastructure. Currently has no functionality; to be activated in a later release.
- **Multicast Domain Name Service (mDNS)**: Allows DNS requests. The mDNS process is a background process on Linux and UNIX, and a service on Windows.
- **Oracle Grid Naming Service (GNS)**: A gateway between the cluster mDNS and external DNS servers. The `gnsd` process performs name resolution within the cluster.

Table 1–1 lists the processes and services associated with Oracle Clusterware components. In Table 1–1, if a UNIX or a Linux system process has an (`r`) beside it, then the process runs as the `root` user.

Table 1–1 List of Processes and Services Associated with Oracle Clusterware Components

Oracle Clusterware Component	Linux/UNIX Process	Windows Services	Windows Processes
CRS	`crsd.bin` (r)	`OracleHAService`	`crsd.exe`
CSS	`ocssd.bin`, `cssdmonitor`, `cssdagent`	`OracleHAService`	`cssdagent.exe`, `cssdmonitor.exe` `ocssd.exe`
CTSS	`octssd.bin (r)`		
EVM	`evmd.bin`, `evmlogger.bin`	`OracleHAService`	`evmd.exe`
GIPC	`gipcd.bin`		
GNS	`gnsd` (r)		`gnsd.exe`
Grid Plug and Play	`gpnpd.bin`	`OracleHAService`	`gpnpd.exe`
Master Diskmon	`diskmon.bin`		
mDNS	`mdnsd.bin`	`mDNSResponder`	`mdns.exe`
Oracle agent	`oraagent.bin` (11.2), or `racgmain` and `racgimon` (11.1)		`oraagent.exe`
Oracle High Availability Services	`ohasd.bin` (r)	`OracleHAService`	`ohasd.exe`
ONS	`ons`		`ons.exe`
Oracle root agent	`orarootagent` (r)		

See Also: "Clusterware Log Files and the Unified Log Directory Structure" on page H-3 for information about the location of log files created for processes

Oracle Clusterware Processes on Linux and UNIX Systems

Oracle Clusterware processes on Linux and UNIX systems include the following:

- `crsd`: Performs high availability recovery and management operations such as maintaining the OCR and managing application resources. This grid infrastructure process runs as `root` and restarts automatically upon failure.

When you install Oracle Clusterware in a single-instance database environment for Oracle ASM and Oracle Restart, `ohasd` manages application resources and `crsd` is not used.

- `cssdagent`: Starts, stops, and checks the status of the CSS daemon, `ocssd`. In addition, the `cssdagent` and `cssdmonitor` provide the following services to guarantee data integrity:
  - Monitors the CSS daemon; if the CSS daemon stops, then it shuts down the node
  - Monitors the node scheduling to verify that the node is not hung, and shuts down the node on recovery from a hang.

  `oclskd`: (Oracle Clusterware Kill Daemon) CSS uses this daemon to stop processes associated with CSS group members for which stop requests have come in from other members on remote nodes.
- `ctssd`: Cluster time synchronization service daemon: Synchronizes the time on all of the nodes in a cluster to match the time setting on the master node but *not* to an external clock.

  When you install Oracle Clusterware, the **Cluster Time Synchronization Service** (CTSS) is installed as part of the software package. During installation, the Cluster Verification Utility (CVU) determines if the network time protocol (NTP) is in use on any nodes in the cluster. On Windows systems, CVU checks for NTP and Windows Time Service.

  If Oracle Clusterware finds that NTP is running or that NTP has been configured, then NTP is not affected by the CTSS installation. Instead, CTSS starts in observer mode (this condition is logged in the alert log for Oracle Clusterware). CTSS then monitors the cluster time and logs alert messages, if necessary, but CTSS does not modify the system time.

  If Oracle Clusterware detects that NTP is not running and is not configured, then CTSS designates one node as a clock reference, and synchronizes all of the other cluster member time and date settings to those of the clock reference.

  Oracle Clusterware considers an NTP installation to be misconfigured if one of the following is true:
  - NTP is not installed on some nodes of the cluster; CVU detects an NTP installation by a configuration file, such as `ntp.conf`
  - The primary and alternate clock references are different for all of the nodes of the cluster
  - The NTP processes are not running on all of the nodes of the cluster

  Only one type of time synchronization service can be active on the cluster.

  See Also: "Cluster Time Management" on page 2-1 for more information about CTSS
- `diskmon` (Disk Monitor daemon): Monitors and performs I/O fencing for HP Oracle Exadata Storage Server storage. Because Exadata storage can be added to any Oracle RAC node at any time, the `diskmon` daemon is always started when `ocssd` starts.
- `evmd` (Event manager daemon): Distributes and communicates some cluster events to all of the cluster members so that they are aware of changes in the cluster.

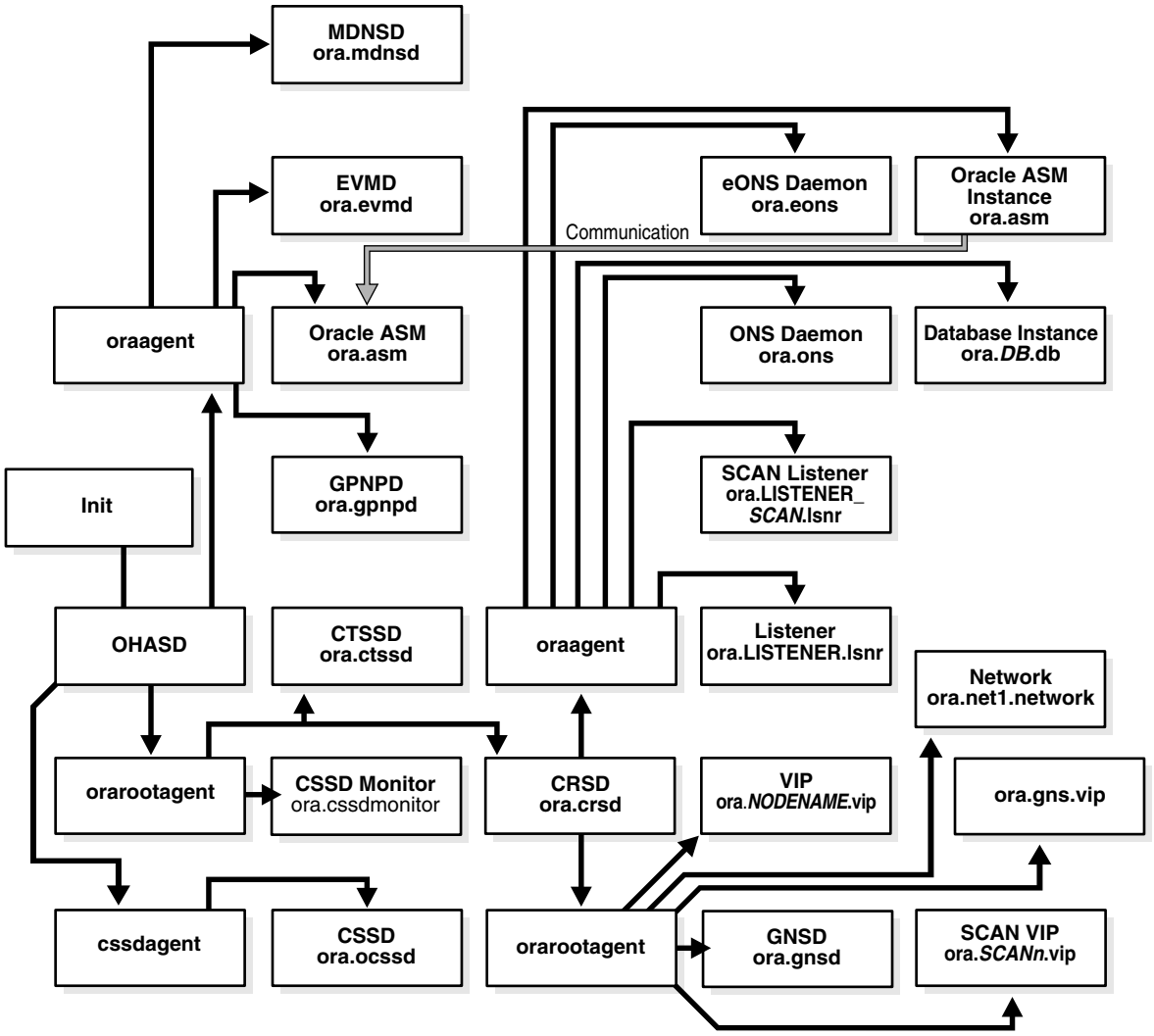
`evmlogger` (Event manager logger): This is started by EVMD at startup. This reads a configuration file to determine what events to subscribe to from EVMD and it runs user defined actions for those events. This facility maintains backward compatibility only.

- `gpnpd` (Grid Plug and Play daemon): Manages distribution and maintenance of the Grid Plug and Play profile containing cluster definition data.
- `mdnsd` (Multicast Domain Name Service daemon): Manages name resolution and service discovery within attached subnets.
- `ocssd` (Cluster Synchronization Service daemon): Manages cluster node membership and runs as the `oracle` user; failure of this process results in a node restart.
- `ohasd` (Oracle High Availability Services daemon): Starts Oracle Clusterware processes and also manages the OLR and acts as the OLR server, as shown in Figure 1–2.

  In a cluster, `ohasd` runs as `root`. However, in an Oracle Restart environment, where `ohasd` manages application resources, it runs as the `oracle` user.

Note: Oracle Clusterware on Linux platforms can have multiple threads that appear as separate processes with unique process identifiers.

Figure 1–2 Cluster Startup



Overview of Installing Oracle Clusterware

The following section introduces the installation processes for Oracle Clusterware:

- Oracle Clusterware Version Compatibility

> **Note:** Install Oracle Clusterware with the Oracle Universal Installer.

Oracle Clusterware Version Compatibility

You can install different releases of Oracle Clusterware, Oracle ASM, and Oracle Database on your cluster. Follow these guidelines when installing different releases of software on your cluster:

- You can only have one installation of Oracle Clusterware running in a cluster, and it must be installed into its own home (`Grid_home`). The release of Oracle Clusterware that you use must be equal to or higher than the Oracle ASM and Oracle RAC versions that are running in the cluster. You cannot install a version of

Oracle RAC that was released after the version of Oracle Clusterware that you run on the cluster. In other words:

- Oracle Clusterware 11*g* release 2 (11.2) supports Oracle ASM release 11.2 only, because Oracle ASM is in the grid infrastructure home, which also includes Oracle Clusterware.
- Oracle Clusterware release 11.2 supports Oracle Database 11*g* release 2 (11.2), release 1 (11.1), Oracle Database 10*g* release 2 (10.2), and release 1 (10.1)
- Oracle ASM release 11.2 requires Oracle Clusterware release 11.2 and supports Oracle Database 11*g* release 2 (11.2), release 1 (11.1), Oracle Database 10*g* release 2 (10.2), and release 1 (10.1)
- Oracle Database 11*g* release 2 (11.2) requires Oracle Clusterware 11*g* release 2 (11.2)

  For example:

  * If you have Oracle Clusterware 11*g* release 2 (11.2) installed as your clusterware, then you can have an Oracle Database 10*g* release 1 (10.1) single-instance database running on one node, and separate Oracle Real Application Clusters 10*g* release 1 (10.1), release 2 (10.2), and Oracle Real Application Clusters 11*g* release 1 (11.1) databases also running on the cluster. However, you cannot have Oracle Clusterware 10*g* release 2 (10.2) installed on your cluster, and install Oracle Real Application Clusters 11*g*. You can install Oracle Database 11*g* single-instance on a node in an Oracle Clusterware 10*g* release 2 (10.2) cluster.
  * When using different Oracle ASM and Oracle Database releases, the functionality of each is dependent on the functionality of the earlier software release. Thus, if you install Oracle Clusterware 11*g* and you later configure Oracle ASM, and you use Oracle Clusterware to support an existing Oracle Database 10*g* release 10.2.0.3 installation, then the Oracle ASM functionality is equivalent only to that available in the 10.2 release version. Set the compatible attributes of a disk group to the appropriate release of software in use.

  See Also: *Oracle Database Storage Administrator's Guide* for information about compatible attributes of disk groups

- There can be multiple Oracle homes for the Oracle database (both single instance and Oracle RAC) in the cluster. Note that the Oracle RAC databases must be running Oracle9*i* Database, or higher.
- You can use different users for the Oracle Clusterware and Oracle database homes if they belong to the same primary group.
- As of 11*g* release 2 (11.2), there can only be one installation of Oracle ASM running in a cluster. Oracle ASM is always the same version as Oracle Clusterware, which must be the same (or higher) release than that of the Oracle database.
- For Oracle RAC running Oracle9*i* you must run an Oracle9*i* cluster. For UNIX systems, that is HACMP, Serviceguard, Sun Cluster, or Veritas SF. For Windows and Linux systems, that is the Oracle Cluster Manager. To install Oracle RAC 10*g*, you must also install Oracle Clusterware.
- You cannot install Oracle9*i* RAC on an Oracle Database 10*g* cluster. If you have an Oracle9*i* RAC cluster, you can add Oracle RAC 10*g* to the cluster. However, when you install Oracle Clusterware 10*g*, you can no longer install any new Oracle9*i* RAC databases.

- Oracle recommends that you do not run different cluster software on the same servers unless they are certified to work together. However, if you are adding Oracle RAC to servers that are part of a cluster, either migrate to Oracle Clusterware or ensure that:
  - The clusterware you run is supported to run with Oracle RAC 11*g* release 2 (11.2).
  - You have installed the correct options for Oracle Clusterware and the other vendor clusterware to work together.

    See Also: *Oracle Grid Infrastructure Installation Guide* for more version compatibility information

Overview of Managing Oracle Clusterware Environments

The following list describes the tools and utilities for managing your Oracle Clusterware environment:

- **Oracle Enterprise Manager**: Oracle Enterprise Manager has both the Database Control and Grid Control GUI interfaces for managing both single instance and Oracle RAC database environments. It also has GUI interfaces to manage Oracle Clusterware and all components configured in the Oracle grid infrastructure installation. Oracle recommends that you use Oracle Enterprise Manager to perform administrative tasks, including applying patches.

  See Also: *Oracle Database 2 Day + Real Application Clusters Guide*, *Oracle Real Application Clusters Administration and Deployment Guide*, and Oracle Enterprise Manager online documentation for more information about administering Oracle Clusterware with Oracle Enterprise Manager

- **Cluster Verification Utility (CVU)**: CVU is a command-line utility that you use to verify a range of cluster and Oracle RAC specific components. Use CVU to verify shared storage devices, networking configurations, system requirements, and Oracle Clusterware, and operating system groups and users.

  Install and use CVU for both preinstallation and postinstallation checks of your cluster environment. CVU is especially useful during preinstallation and during installation of Oracle Clusterware and Oracle RAC components to ensure that your configuration meets the minimum installation requirements. Also use CVU to verify your configuration after completing administrative tasks, such as node additions and node deletions.

  See Also: Your platform-specific Oracle Clusterware and Oracle RAC installation guide for information about how to manually install CVU, and Appendix A, "Cluster Verification Utility Reference" for more information about using CVU

- **Server Control (SRVCTL)**: SRVCTL is a command-line interface that you can use to manage Oracle resources, such as databases, services, or listeners in the cluster.

  Note: You can only manage server pools that have names prefixed with `ora.*` by using SRVCTL.

See Also: Server Control Utility reference appendix in the *Oracle Real Application Clusters Administration and Deployment Guide*

- **Oracle Clusterware Control (CRSCTL)**: CRSCTL is a command-line tool that you can use to manage Oracle Clusterware. CRSCTL should be used for general Clusterware management and management of individual resources.

  Oracle Clusterware 11*g* release 2 (11.2) introduces cluster-aware commands with which you can perform operations from any node in the cluster on another node in the cluster, or on all nodes in the cluster, depending on the operation.

  You can use `crsctl` commands to monitor cluster resources (`crsctl status resource`) and to monitor and manage servers and server pools other than server pools that have names prefixed with `ora.*`, such as `crsctl status server`, `crsctl status serverpool`, `crsctl modify serverpool`, and `crsctl relocate server`. You can also manage Oracle High Availability Services on the entire cluster (`crsctl start | stop | enable | disable | config crs`), using the optional node-specific arguments `-n` or `-all`. You also can use CRSCTL to manage Oracle Clusterware on individual nodes (`crsctl start | stop | enable | disable | config crs`).

  See Also:

  - Chapter 2, "Administering Oracle Clusterware" for more information about using `crsctl` commands to manage Oracle Clusterware
  - Appendix E, "CRSCTL Utility Reference" for a complete list of CRSCTL commands

- **Oracle Interface Configuration Tool (OIFCFG)**: OIFCFG is a command-line tool for both single-instance Oracle databases and Oracle RAC environments. Use OIFCFG to allocate and deallocate network interfaces to components. You can also use OIFCFG to direct components to use specific network interfaces and to retrieve component configuration information.

  See Also: Appendix D, "Oracle Interface Configuration Tool (OIFCFG) Command Reference"

- **Oracle Cluster Registry Configuration Tool (OCRCONFIG)**: OCRCONFIG is a command-line tool for OCR administration. You can also use the OCRCHECK and OCRDUMP utilities to troubleshoot configuration problems that affect OCR.

  See Also: Chapter 2, "Administering Oracle Clusterware" for more information about managing OCR

Overview of Cloning and Extending Oracle Clusterware in Grid Environments

Cloning nodes is the preferred method of creating new clusters. The cloning process copies Oracle Clusterware software images to other nodes that have similar hardware and software. Use cloning to quickly create several clusters of the same configuration. Before using cloning, you must install an Oracle Clusterware home successfully on at least one node using the instructions in your platform-specific Oracle Clusterware installation guide.

For new installations, or if you must install on only one cluster, Oracle recommends that you use the automated and interactive installation methods, such as Oracle Universal Installer or the Provisioning Pack feature of Oracle Enterprise Manager. These methods perform installation checks to ensure a successful installation. To add or delete Oracle Clusterware from nodes in the cluster, use the `addNode.sh` and `rootcrs.pl` scripts.

See Also:

- Chapter 3, "Cloning Oracle Clusterware to Create a Cluster" for step-by-step cloning procedures
- Oracle Enterprise Manager online Help system for more information about the Provisioning Pack
- Chapter 4, "Adding and Deleting Cluster Nodes"

Overview of the Oracle Clusterware High Availability Framework and APIs

Oracle Clusterware provides many high availability application programming interfaces called CLSCRS APIs that you use to enable Oracle Clusterware to manage applications or processes that run in a cluster. The CLSCRS APIs enable you to provide high availability for all of your applications. Oracle Clusterware with Oracle ASM enables you to create a consolidated pool of storage to support both single-instance Oracle databases and Oracle RAC databases.

See Also: Appendix F, "Oracle Clusterware C Application Program Interfaces" for more detailed information about the CLSCRS APIs

You can define a VIP address for an application to enable users to access the application independently of the node in the cluster on which the application is running. This is referred to as the application VIP. You can define multiple application VIPs, with generally one application VIP defined for each application running. The application VIP is related to the application by making it dependent on the application resource defined by Oracle Clusterware.

To maintain high availability, Oracle Clusterware components can respond to status changes to restart applications and processes according to defined high availability rules. You can use the Oracle Clusterware high availability framework by registering your applications with Oracle Clusterware and configuring the clusterware to start, stop, or relocate your application processes. That is, you can make custom applications highly available by using Oracle Clusterware to create profiles that monitor, relocate, and restart your applications.

2

Administering Oracle Clusterware

This chapter describes how to administer Oracle Clusterware and includes the following topics:

- Cluster Time Management
- Configuration and Installation for Node Fencing
- Policy-Based Cluster and Capacity Management
- Role-separated Management
- Voting Disk, Oracle Cluster Registry, and Oracle Local Registry
- Changing Network Addresses on Manually Configured Networks

Cluster Time Management

The Cluster Time Synchronization Service (CTSS) is installed as part of Oracle Clusterware and runs in *observer* mode if it detects a time synchronization service or a time synchronization service configuration, valid or broken, on the system.

If CTSS detects that there is no time synchronization service or time synchronization service configuration on *any* node in the cluster, then CTSS goes into *active* mode and takes over time management for the cluster.

When nodes join the cluster, if CTSS is in active mode, then it compares the time on those nodes to a reference clock located on one node in the cluster. If there is a discrepancy between the two times and the discrepancy is within a certain stepping limit, then CTSS steps the time of the nodes joining the cluster to synchronize them with the reference.

When Oracle Clusterware starts, if CTSS is running in active mode and the time discrepancy is outside the stepping limit, then CTSS generates an alert in the alert log, exits, and Oracle Clusterware startup fails. You must manually adjust the time of the nodes joining the cluster to synchronize with the cluster, after which Oracle Clusterware can start and CTSS can manage the time for the nodes.

Clocks on the nodes in the cluster become desynchronized with the reference clock periodically for various reasons. When this happens, CTSS either speeds up or slows down the clocks on the nodes until they synchronize with the reference clock. CTSS never runs time backward to synchronize with the reference clock. CTSS periodically writes alerts to the alert log containing information about how often it adjusts time on nodes to keep them synchronized with the reference clock.

To activate CTSS in your cluster, then stop and deconfigure the vendor time synchronization service on all nodes in the cluster. CTSS detects when this happens and assumes time management for the cluster.

Similarly, if you want to deactivate CTSS in your cluster, then configure and start the vendor time synchronization service on all nodes in the cluster. CTSS detects this change and reverts back to observer mode.

> **See Also:** *Oracle Grid Infrastructure Installation Guide* for your platform for information about configuring NTP for Oracle Clusterware, or disabling it to use CTSS

Configuration and Installation for Node Fencing

This section contains the following topics:

- About Using IPMI for Node Fencing
- About Node-termination Escalation with IPMI
- Configuring Server Hardware for IPMI
- Postinstallation Configuration of IPMI-based Failure Isolation Using crsctl

About Using IPMI for Node Fencing

To support the member-kill escalation to node-termination, you must configure and use an external mechanism capable of restarting a problem node without cooperation either from Oracle Clusterware or from the operating system running on that node. To provide this capability, Oracle Clusterware 11*g* release 2 (11.2) supports the Intelligent Management Platform Interface specification (IPMI), an industry-standard management protocol.

Normally, you configure node termination using IPMI during installation, when you are provided with the option of configuring IPMI from the Failure Isolation Support screen. If you do not configure IPMI during installation, then you can configure it after installation using `crsctl` as described in this section.

About Node-termination Escalation with IPMI

To use IPMI for node termination, each cluster member node must be equipped with a Baseboard Management Controller (BMC) running firmware compatible with IPMI version 1.5, which supports IPMI over a local area network (LAN). During database operation, member-kill escalation is accomplished by communication from the evicting CSSD daemon to the victim node's BMC over LAN. The IPMI over LAN protocol is carried over an authenticated session protected by a user name and password, which are obtained from the administrator during installation.

However, CSSD requires direct communication with the local BMC during CSS startup to obtain the IP address of the BMC. This is accomplished using a BMC probe command (OSD), which communicates with the BMC through an IPMI driver, which must be installed on each cluster system. The following sub-sections describe the required operations and interfaces.

Configuring Server Hardware for IPMI

Ensure that each node in the cluster has

- Network Requirements for IPMI
- IPMI Driver
- About BMC Configuration

- BMC Configuration Example Using ipmitool on Linux
- BMC Configuration Example Using ipmiutil on Windows 2003 R2

Network Requirements for IPMI

IPMI requires a management network. The management network should be a secure, dedicated network, but it may also be a shared, multi-purpose network. In either case, the Ethernet port used by the BMC on each node must be connected to the network used for server management.

To enable fencing with IPMI, Oracle Clusterware must have access to the management network, so that it can communicate with the BMCs on cluster member nodes. You can provide that access in one of the following ways:

- Use the same network connection both for the private network for interconnects and the management network
- Use forwarding of network traffic for the management network to the BMC addresses from the private network or some other network accessible to Oracle Clusterware.

For flexibility in network management, you can configure the BMC for dynamic IP address assignment using DHCP. The design and implementation of fencing using IPMI supports this and assumes this to be the normal case. To support dynamic addressing of BMCs, the network used for IPMI-based management must have a DHCP server to assign the BMC's IP address.

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

IPMI Driver

The IPMI driver must be permanently installed on each node, so that it is available when the node is started, so that Oracle Clusterware can communicate with the BMCs.

Typically, the IMPI hardware on a server node obtains its IP address using DHCP when the node starts. While other fencing configuration information is stored in Oracle Registries, dynamic address information must be obtained from the BMC when Oracle Clusterware starts.

Follow the instructions for installing the driver for your platform:

- Linux Driver for IPMI
- Windows Driver for IPMI

Linux Driver for IPMI On Linux platforms, use the `OpenIPMI` driver. This driver is included with the following Linux distributions:

- Red Hat Enterprise Linux 4 AS Update 2
- SUSE SLES9 SP3

For testing or configuration purposes, you can install the driver dynamically by manually loading the required modules. To install the driver manually, log in as `root` and execute the following commands:

```
# /sbin/modprobe ipmi_msghandler
# /sbin/modprobe ipmi_si
# /sbin/modprobe ipmi_devintf
```

To confirm the modules are loaded, enter `/sbin/lsmod |grep ipmi`. For example:

```
# /sbin/lsmod | grep ipmi
ipmi_devintf           12617  0
ipmi_si                33377  0
ipmi_msghandler        33701  2 ipmi_devintf,ipmi_si
```

You can install these modules automatically by running the `modprobe` commands from an initialization script (for example, `rc.local`) when the nodes are started.

Access the `OpenIPMI` driver using the device special file `/dev/ipmi0`. You can display the file using the command `ls -l /dev/ipmi0`. For example:

```
# ls -l /dev/ipmi0
crw-------  1 root root 253, 0 Sep 23 06:29 /dev/ipmi0
```

Linux systems are typically configured to recognize devices dynamically (hotplug, `udev`). However if you do not see the device file using the ls command, then `udevd` is not set up to create device files automatically, and you must create the device special file manually. To create the device file manually, you must first determine the device major number for the IPMI device. For example:

```
# grep ipmi /proc/devices
253 ipmidev
```

In the preceding example, the displayed "253" is the major number. Use this number with the `mknod` command to create the device file. For example:

```
# mknod /dev/ipmi0 c 253 0x0
```

Note in the example that the permissions on /dev/ipmi0 allow the device to be opened only by root, as otherwise the system would be vulnerable.

Windows Driver for IPMI On Windows systems, use the Microsoft IPMI driver (`ipmidrv.sys`), which is included on Windows Server 2003 R2 (released December 2005), Windows Vista, and Windows Server 2008. The driver is included as part of the Hardware Management feature, which includes the driver and the WMI (Windows Management Interface (WMI). Note that the Microsoft driver is incompatible with other (third party) drivers, and that these must be removed if they are installed.

Hardware Management is not installed and enabled by default on Windows Server 2003 or Vista systems. Install Hardware Management from the Management and Monitoring Tools section of the Add/Remove Windows Components Wizard. The following steps are taken from the Microsoft TechNet web-site (`http://technet.microsoft.com/en-us/library/cc781099.aspx`):

1. In **Control Panel**, select **Add or Remove Programs**.
2. Select **Add/Remove Windows Components**.
3. Select (but do not check) **Management and Monitoring Tools** and click **Details** to start the detailed components selection window.
4. Select and check the Hardware Management option. If a BMC is detected using the SMBIOS Table Type 38h, then a dialog box is displayed instructing you to remove any 3rd party drivers.

5. If no 3rd party IPMI drivers are installed or they have been removed from the system, then click **OK** to continue.
6. Click **OK** to select the Hardware Management Component, and then click **Next**. Hardware Management (including WinRM) will be installed.

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

```
Rundll32 ipmisetp.dll,AddTheDevice
```

An alternate driver (`imbdrv.sys`) is available from Intel as part of "Intel Server Control," but this driver has not been tested with the Oracle Fencing implementation.

About BMC Configuration

For IPMI-based fencing to function, the BMC hardware must be properly configured for remote control using a LAN. Requirements are the same for all platforms, but the configuration process is platform-dependent. The BMC configuration may be effected from the firmware interface (BIOS), using a platform-specific management utility or one of many publicly available utilities, which can be downloaded from the Internet. Two of the available utilities are `ipmitool` (`http://ipmitool.sourceforge.net/`), which is available for Linux, and `ipmiutil` (`http://ipmiutil.sourceforge.net/`), which is available for both Linux and Windows.

The BMC configuration must provide the following:

- Enable IPMI over LAN, which permits the BMC to be controlled over the network.
- Establish a static IP address, or enable dynamic IP-addressing using DHCP.
- Establish an administrator account with user name and password.
- Configure the BMC for VLAN tags, if the BMC is on a tagged VLAN

The configuration mechanism does not influence functionality if the above requirements are met.

BMC Configuration Example Using ipmitool on Linux

The following is an example of BMC configuration on Linux using ipmitool (version 1.8.6). Because the protection settings on the BMC device (`/dev/ipmi0`) restrict access to `root`, the following commands must be run with root privilege.

1. When the IPMI driver is loaded and the device special file is created, verify that ipmitool can communicate with the BMC using the driver using the command `ipmitool bmc info`. For example:

```
# ipmitool bmc info
Device ID                 : 32
.
.
.
```

2. Enable IPMI over LAN:
   a. Determine the IPMI channel number for LAN (typically 1) by printing channel attributes, starting from channel "1" until the output shows typical LAN attributes, such as the IP address. For example:

```
# ipmitool lan print 1

. . .
IP Address Source       : 0x01
IP Address              : 192.0.2.244
. . .
```

b. Turn on LAN access for the channel found. For example, where the LAN channel is 1:

```
# ipmitool lan set 1 access on
```

3. Configure IP address settings for IPMI

a. Use dynamic IP addressing (DHCP). This is the default assumed by the Oracle Universal Installer. Use of DHCP requires a DHCP-server on the subnet, but has the advantage of making the other addressing settings for you automatically. For example:

```
# ipmitool lan set 1 ipsrc dhcp
```

b. Use static IP address assignment. If the BMC shares a network connection, with the OS, then the IP address must be on the same subnet. You must set not only the IP address, but the proper values for netmask and default gateway for your network configuration.

```
# ipmitool lan set 1 ipaddr 192.168.0.55
# ipmitool lan set 1 netmask 255.255.255.0
# ipmitool lan set 1 defgw ipaddr 192.168.0.1
```

Note: The address that you specify in this example, 192.168.0.55, is associated only with the BMC and does not respond to normal pings.

---

4. Establish an administration account with username and password.

a. Set BMC to require password authentication for ADMIN access over LAN. For example:

```
# ipmitool lan set 1 auth ADMIN MD5,PASSWORD
```

b. List the account slots on the BMC and identify an unused slot (a User ID with an empty `User Name field` - in this example):

```
# ipmitool channel getaccess 1
. . .
User ID              : 4
User Name            :
Fixed Name           : No
Access Available     : call-in / callback
Link Authentication  : disabled
IPMI Messaging       : disabled
Privilege Level      : NO ACCESS
. . .
```

c. Assign the administrator user name and password and enable messaging for the identified slot. (Note that for IPMI v1.5 the user name and password can be at most 16 characters). Finally, set the privilege level for that slot when accessed over LAN (channel 1) to ADMIN (level 4). For example, using the administrator `IPMIadm` and password `myIPMIpwd`:

```
# ipmitool user set name 4 IPMIadm
# ipmitool user set password 4 myIPMIpwd
# ipmitool user enable 4
# ipmitool channel setaccess 1 4 privilege=4
```

5. Verify the setup after you complete configuration using the command `ipmitool lan print`. For example (note configuration settings in *italic*)

```
# ipmitool lan print 1
Set in Progress         : Set Complete
Auth Type Support       : NONE MD2 MD5 PASSWORD
Auth Type Enable        : Callback : MD2 MD5
                        : User     : MD2 MD5
                        : Operator : MD2 MD5
                        : Admin    : MD5 PASSWORD
                        : OEM      : MD2 MD5
IP Address Source       : Static Address (or DHCP Address)
IP Address              : 192.168.0.55
Subnet Mask             : 255.255.255.0
MAC Address             : 00:14:22:23:fa:f9
SNMP Community String   : public
IP Header               : TTL=0x40 Flags=0x40 Precedence=…
Default Gateway IP      : 192.168.0.1
Default Gateway MAC     : 00:00:00:00:00:00
.
.
.
# ipmitool channel getaccess 1 4
Maximum User IDs     : 10
Enabled User IDs     : 2
User ID              : 4
User Name            : IPMIadm
Fixed Name           : No
Access Available     : call-in / callback
Link Authentication  : enabled
IPMI Messaging       : enabled
Privilege Level      : ADMINISTRATOR
```

6. Verify that the BMC is accessible and controllable from a remote node in your cluster. For example, on node1, with user `IPMIadm`, and password `IPMIpwd`, enter the following command:

```
# ipmitool -H node1 -U IPMIadm -P IPMIpwd bmc info
```

   This command should return the BMC information from the node.

BMC Configuration Example Using ipmiutil on Windows 2003 R2

The following is an example of BMC configuration on Windows Server 2003 R2 using ipmiutil (version 2.2.3). These operations should be executed in a command window while logged in with Administrator privileges.

1. When the IPMI driver is loaded and the device special file is created, verify that ipmitool can communicate with the BMC using the driver using the command `ipmitool lan`. For example:

```
C:\bin> ipmitool lan
ipmiutil ver 2.23
PEFilter parameters displayed . . .
pefconfig, GetLanEntry for channel 1 . . .
Lan Param(0) Set in progress: 00
```

.
.
.

Caution: `ipmiutil` sets certain LAN parameters only in the context of enabling IPMI over LAN; for example, by supplying the `-l` option. This can have the undesired effect of resetting to default values of some previously established parameters if they are not supplied on the command line. For that reason, it is important to complete the following steps in order.

2. Establish remote LAN access with ADMIN privilege (`-v 4`) and the IPMI administrator user name and password (ipmiutil locates the LAN channel on its own). For example:

```
C:\bin> ipmiutil lan -l -v 4 -u root -p password
```

3. Configure dynamic or static IP address settings for the BMC:

   a. Use dynamic IP-addressing (DHCP). This is the default assumed by the Oracle Universal Installer. Use of DHCP requires a DHCP-server on the subnet, but has the advantage of making the other addressing settings for you automatically.

```
C:\bin> ipmiutil lan -l -D
```

   b. Use static IP address assignment. If the BMC shares a network connection wit the operating system, then the IP address must be on the same subnet. You must set not only the IP address, but also the proper values default gateway and net mask for your network configuration. For example:

```
C:\bin> ipmiutil lan -l -I 192.0.2.244(IP addr)
C:\bin> ipmiutil lan -l -G 192.0.2.1(gateway IP)
C:\bin> ipmiutil lan -l -S 255.255.248.0(netmask)
```

Note: The address that you specify in this example, 192.0.244, is associated only with the BMC and does not respond to normal pings.

   Also, enabling IPMI over LAN with the `-l` option resets the subnet mask to a value obtained from the operating system. Thus, when setting parameters one at a time as in the above example, the `-S` option should be specified last.

4. Verify the setup after you complete configuration using the command `ipmitool lan`, which displays the configuration. For example (note configuration settings in *italic*):

```
C:\bin> ipmiutil lan
ipmiutil ver 2.23
pefconfig ver 2.23
-- BMC version 1.40, IPMI version 1.5
pefconfig, GetPefEntry ...
PEFilter(01): 04 h ? event ... (ignore PEF entries)
...

pefconfig, GetLanEntry for channel 1 ...
Lan Param(0) Set in progress: 00
```

```
Lan Param(1) Auth type support: 17 : None MD2 MD5 Pswd
Lan Param(2) Auth type enables: 16 16 16 16 00
Lan Param(3) IP address: 192.0.2.244
Lan Param(4) IP addr src: 01 : Static
Lan Param(5) MAC addr: 00 11 43 d7 4f bd
Lan Param(6) Subnet mask: 255 255 248 0
Lan Param(7) IPv4 header: 40 40 10
GetLanEntry: completion code=cc
GetLanEntry(10), ret = -1
GetLanEntry: completion code=cc
GetLanEntry(11), ret = -1
Lan Param(12) Def gateway IP: 192.0.2.1
Lan Param(13) Def gateway MAC: 00 00 0c 07 ac dc
...
Get User Access(1): 0a 01 01 0f : No access ()
Get User Access(2): 0a 01 01 14 : IPMI, Admin  (root)
Get User Access(3): 0a 01 01 0f : No access ()
pefconfig, completed successfully
```

5. Use the `ipmitool` command to verify that the BMC is accessible and controllable from a remote node in your cluster. For example, where the IPMI administrator is root, and the node you are checking is node1:

   ```
   # ipmitool -H node1-U root -P password lan print 1
   ```

   This command should return the LAN configuration from the node.

Postinstallation Configuration of IPMI-based Failure Isolation Using crsctl

This section contains the following topics:

- IPMI Postinstallation Registration with Oracle Clusterware
- Modifying Configurations with IPMI Postinstallation Configuration Utility

IPMI Postinstallation Registration with Oracle Clusterware

When IPMI is installed during Oracle Clusterware installation, Failure Isolation is configured in two phases. Before you start installation, you install and enable the IPMI driver in the server operating system, and configure the IPMI hardware on each node (IP address mode, admin credentials, and so on). When you start Oracle Clusterware installation, the installer collects the IPMI administrator user ID and password, and stores them in an Oracle Wallet in node-local storage, in the Oracle Local Registry.

With postinstallation configuration, install and enable the IPMI driver, and configure the BMC as described in the preceding section, "Configuring Server Hardware for IPMI" on page 2-2.

After you have completed the server configuration, complete the following procedure on each cluster node to register IPMI administrators and passwords on the nodes.

> **Note:** If the BMC is configured to obtain its IP address using DHCP, it may be necessary to reset the BMC or restart the node to cause it to obtain an address.

1. Start Oracle Clusterware, which allows it to obtain the current IP address from the BMC. This confirms the ability of the clusterware to communicate with the BMC, which is necessary at startup.

If the clusterware was running before the BMC was configured, you can shut it down and restart it. Alternatively, you can use the BMC management utility to obtain the BMC's IP address and then use the cluster control utility `crsctl` to store the BMC's IP address in the Oracle Registry by issuing a command similar to the following:

```
crsctl set css ipmiaddr 192.168.10.45
```

2. Use the cluster control utility crsctl to store the previously established user ID and password for the resident BMC in the Oracle Registry by issuing the `crsctl set css ipmiadmin` command, and supplying the administrator and password at the prompt. For example:

```
crsctl set css ipmiadmin youradmin
IPMI BMC password: yourpassword
```

This command validates the supplied credentials and fails if another cluster node cannot access the local BMC using them.

After you complete hardware and operating system configuration, and register the IPMI administrator on Oracle Clusterware, IPMI-based Failure Isolation should be fully functional.

Modifying Configurations with IPMI Postinstallation Configuration Utility

To modify an existing IPMI-based fencing configuration (for example to change BMC passwords, or to configure IPMI for fencing in an existing installation), use the cluster configuration utility `crsctl` with the BMC configuration tool appropriate to your platform. For example, to change the administrator password for the BMC, you must first modify the BMC configuration as described in "Configuring Server Hardware for IPMI" on page 2, and then use `crsctl` to inform the clusterware that the password has changed.

The configuration data needed by Oracle Clusterware for IPMI is kept in an Oracle Wallet in the Oracle Registry. Because the configuration information is kept in a secure store, it must be written by the Oracle Clusterware installation owner account (the Grid user), so you must log in as that installation user.

Use the following procedure to modify an existing IPMI configuration:

1. Enter the command `crsctl set css ipmiadmin` *`admin_name`*. For example, with the user `IPMIadm`:

```
$ crsctl set css ipmiadmin IPMIadm
```

Provide the administrator password. Oracle Clusterware stores the administrator name and password for the local BMC in the Oracle Local Registry.

After storing the new credentials, Oracle Clusterware can retrieve the new credentials and distribute them as required.

2. Enter the command `crsctl set css ipmiaddr` *`bmc_ip_address`*. For example:

```
$ crsctl set css ipmiaddr 192.0.2.244
```

This command stores the new BMC IP address of the local BMC in the Oracle Registry, After storing the BMC IP address, Oracle Clusterware can retrieve the new configuration and distribute it as required.

3. Enter the command `crsctl get css ipmiaddr`. For example:

```
$ crsctl get css ipmiaddr
```

This command retrieves the IP address for the local BMC from the Oracle Registry and displays it on the console.

Policy-Based Cluster and Capacity Management

This section contains the following topics:

- Overview of Server Pools and Policy-based Management
- Server Attributes Assigned by Oracle Clusterware
- Understanding Server Pools
- How Oracle Clusterware Assigns New Servers

Overview of Server Pools and Policy-based Management

With Oracle Clusterware 11*g* release 2 (11.2) and later, **resource**s are contained in logical groups of servers called **server pool**s. Resources are hosted on a shared infrastructure and are isolated with respect to their resource consumption by policies, behaving as if they were deployed in a single-system environment.

You can choose to manage resources dynamically using server pools to provide policy-based management of resources in the cluster, or you can choose to manage resources using the traditional method of physically assigning resources to run on particular nodes.

Policy-based management:

- Enables dynamic capacity assignment when needed to provide server capacity in accordance with the priorities you set with policies
- Enables allocation of resources by importance, so that applications obtain the required minimum resources, whenever possible, and so that lower priority applications do not take resources from more important applications
- Ensures isolation where necessary, so that you can provide dedicated servers in a cluster for applications and databases

Applications and databases running in server pools do not share resources. Because of this, server pools isolate resources where necessary, but enable dynamic capacity assignments as required. Together with role-separated management, this capability addresses the needs of organizations that have a standardized cluster environments, but allow multiple administrator groups to share the common cluster infrastructure.

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for more information about resource attributes

Oracle Clusterware efficiently allocates different resources in the cluster. You need only to provide the minimum and maximum number of nodes on which a resource can run, combined with a level of importance for each resource that is running on these nodes.

Server Attributes Assigned by Oracle Clusterware

Oracle Clusterware assigns each server a set of attributes as soon as you add a server to a cluster. If you remove the server from the cluster, then Oracle Clusterware revokes those settings. Table 2–1 lists and describes server attributes.

Table 2–1 Server Attributes

Attribute	Description
NAME	The node name of the server. A server name can contain any platform-supported characters except the exclamation point (!) and the tilde (~). A server name cannot begin with a period, or with *ora*. This attribute is required.
ACTIVE_POOLS	A space-delimited list of the names of the server pools to which a server belongs. Oracle Clusterware manages this list, automatically.
STATE	A server can be in one of the following states: ONLINE The server is a member of the cluster and is available for resource placement. OFFLINE The server is not currently a member of the cluster. Subsequently, it is not available for resource placement. JOINING When a server joins a cluster, Oracle Clusterware processes it to ensure that it is valid for resource placement. Oracle Clusterware also checks the state of resources configured to run on the server. Once the validity of the server and the state of the resources are determined, the server transitions out of the state. LEAVING When a planned shutdown for a server begins, the state of the server transitions to `Leaving`, making it unavailable for resource placement. VISIBLE Servers that have Oracle Clusterware running, but not the Cluster Ready Services daemon (`crsd`), are put into the `Visible` state. This usually indicates an intermittent issue or failure and Oracle Clusterware trying to recover (restart) the daemon. Oracle Clusterware cannot manage resources on servers while the servers are in this state. RECONFIGURING When servers move between server pools due to server pool reconfiguration, a server is placed into this state if resources that ran on it in the current server pool must be stopped and relocated. This happens because resources running on the server may not be configured to run in the server pool to which the server is moving. As soon as the resources are successfully relocated, the server is put back into the `Online` state. Use the `crsctl status server` command to obtain server information.

Table 2–1 (Cont.) Server Attributes

Attribute	Description
STATE_DETAILS	This is a read-only attribute that Oracle Clusterware manages. The attribute provides additional details about the state of a server. Possible additional details about a server state are: Server state: ONLINE: ■ AUTOSTARTING RESOURCES Indicates that the resource autostart procedure (performed when a server reboots or the Oracle Clusterware stack is restarted) is in progress for the server. ■ AUTOSTART QUEUED The server is waiting for the resource autostart to commence. Once that happens, the attribute value changes to AUTOSTARTING RESOURCES. Server state: RECONFIGURING: ■ STOPPING RESOURCES Resources that are restricted from running in a new server pool are stopping. ■ STARTING RESOURCES Resources that can run in a new sever pool are starting. ■ RECONFIG FAILED One or more resources did not stop and thus the server cannot transition into the ONLINE state. At this point, manual intervention is required. You must stop or unregister resources that did not stop. After that, the server automatically transitions into the ONLINE state. Server state: JOINING: ■ CHECKING RESOURCES Whenever a server reboots, the Oracle Clusterware stack restarts, or crsd on a server restarts, the policy engine must determine the current state of the resources on the server. While that procedure is in progress, this value is returned.

Understanding Server Pools

This section contains the following topics:

- How Server Pools Work
- The Free Server Pool
- The Generic Server Pool
- Servers Moving from Server Pool to Server Pool

How Server Pools Work

Server pools divide the cluster into groups of servers hosting the same or similar resources. They distribute a uniform workload (a set of Oracle Clusterware resources) over several servers in the cluster. For example, you can restrict Oracle databases to run only in a particular server pool. When you enable role-separated management, you can explicitly grant permission to operating system users to change attributes of certain server pools.

Top-level server pools:

- Logically divide the cluster
- Are always exclusive, meaning that one server can only reside in one particular server pool at a certain point in time

Server pools each have three attributes that they are assigned when they are created:

- `MIN_SIZE`: The minimum number of servers the server pool should contain. If the number of servers in a server pool is below the value of this attribute, then Oracle Clusterware automatically moves servers from elsewhere into the server pool until the number of servers reaches the attribute value.
- `MAX_SIZE`: The maximum number of servers the server pool should contain.
- `IMPORTANCE`: A number from 0 to 1000 (0 being least important) that ranks a server pool among all other server pools in a cluster.

When Oracle Clusterware is installed, two server pools are created automatically: *Generic* and *Free*. All servers in a new installation are assigned to the Free server pool, initially. Servers move from Free to newly defined server pools automatically. When you upgrade Oracle Clusterware, all nodes are assigned to the Generic server pool, to ensure compatibility with database releases before Oracle Database 11*g* release 2 (11.2).

The Free Server Pool

The Free server pool contains servers that are not assigned to any other server pools. The attributes of the Free server pool are restricted, as follows:

- `SERVER_NAMES`, `MIN_SIZE`, and `MAX_SIZE` cannot be edited by the user
- `IMPORTANCE` and `ACL` can be edited by the user

The Generic Server Pool

The Generic server pool stores pre-11*g* release 2 (11.2) databases and administrator-managed databases that have fixed configurations. Additionally, the Generic server pool contains servers that match either of the following:

- Servers that you specified in the `HOSTING_MEMBERS` attribute of all resources of the `application` resource type

  See Also: "HOSTING_MEMBERS" on page B-6 for more information about this attribute

- Servers with names you specified in the `SERVER_NAMES` attribute of the server pools that list the Generic server pool as a parent server pool

The Generic server pool's attributes are restricted, as follows:

- No one can modify configuration attributes of the Generic server pool (all attributes are read-only)
- When you specify a server name in the `HOSTING_MEMBERS` attribute, Oracle Clusterware only allows it if the server is:
  - Online and exists in the Generic server pool
  - Online and exists in the Free server pool, in which case Oracle Clusterware moves the server into the Generic server pool
  - Online and exists in any other server pool *and* the client is either a cluster administrator or is allowed to use the server pool's servers, in which case, the server is moved into the Generic server pool

  - Offline and the client is a cluster administrator

- When you register a child server pool with the Generic server pool, Oracle Clusterware only allows it if the server names pass the same requirements as previously specified for the resources.

  Servers are initially considered for assignment into the Generic server pool at cluster startup time or when a server is added to the cluster, and only after that to other server pools.

Servers Moving from Server Pool to Server Pool

If the number of servers in a server pool falls below the value of the `MIN_SIZE` attribute for the server pool (such as when a server fails), based on values you set for the `MIN_SIZE` and `IMPORTANCE` attributes for all server pools, Oracle Clusterware can move servers from other server pools into the server pool whose number of servers has fallen below the value for `MIN_SIZE`. Oracle Clusterware selects servers from other server pools to move into the deficient server pool that meet the following criteria:

- For server pools that have a lower `IMPORTANCE` value than the deficient server pool, Oracle Clusterware can take servers from those server pools even if it means that the number of servers falls below the value for the `MIN_SIZE` attribute.
- For server pools with equal or greater `IMPORTANCE`, Oracle Clusterware only takes servers from those server pools if the number of servers in a server pool is greater than the value of its `MIN_SIZE` attribute.

Table 2–2 lists and describes all server pool attributes.

Table 2–2 Server Pool Attributes

Attribute	Values and Format	Description
ACL	String in the following format: owner:*user*:rwx,pgrp:*group*:rwx,other::r–	Defines the owner of the server pool and which privileges are granted to various operating system users and groups. The server pool owner defines the operating system user of the owner, and which privileges that user is granted. The value of this optional attribute is populated at the time a server pool is created based on the identity of the process creating the server pool, unless explicitly overridden. The value can subsequently be changed, if such a change is allowed based on the existing privileges of the server pool. In the string: ■ owner: The operating system user of the server pool owner, followed by the privileges of the owner ■ pgrp: The operating system group that is the primary group of the owner of the server pool, followed by the privileges of members of the primary group ■ other: Followed by privileges of others ■ r: Read only ■ w: Modify attributes of the pool or delete it ■ x: Assign resources to this pool By default, the identity of the client that creates the server pool is the owner. Also by default, root, and the *user* specified in owner have full privileges. You can grant required operating system users and operating system groups their privileges by adding the following lines to the ACL attribute: user:*username*:rwx group:*group_name*:rwx
ACTIVE_SERVERS	A string of server names in the following format: server_name1 server_name2 ...	Oracle Clusterware automatically manages this attribute, which contains the space-delimited list of servers that are currently assigned to a server pool.
EXCLUSIVE_POOLS	String	This optional attribute indicates if servers assigned to this server pool are shared with other server pools. A server pool can explicitly state that it is exclusive of any other server pool that has the same value for this attribute. Two or more server pools are mutually exclusive when the sets of servers assigned to them do not have a single server in common. For example, server pools A and B must be exclusive if they both set the value of this attribute to foo_A_B. Top-level server pools are mutually exclusive, by default.
IMPORTANCE	Any integer from 0 to 1000	Relative importance of the server pool, with 0 denoting the lowest level of importance and 1000, the highest. This optional attribute is used to determine how to reconfigure the server pools when a node joins or leaves the cluster. The default value is 0.
MAX_SIZE	Any nonnegative integer or -1 (no limit)	The maximum number of servers a server pool can contain. This attribute is optional and is set to -1 (no limit), by default. **Note:** A value of -1 for this attribute spans the entire cluster.

Table 2–2 (Cont.) Server Pool Attributes

Attribute	Values and Format	Description
MIN_SIZE	Any nonnegative integer	The minimum size of a server pool. If the number of servers contained in a server pool is below the number you specify in this attribute, then Oracle Clusterware automatically moves servers from other pools into this one until the that number is met. **Note:** The value of this optional attribute does not set a hard limit. It governs the priority for server assignment whenever the cluster is reconfigured. The default value is 0.
NAME	String	The name of the server pool, which you must specify when you create the server pool. Server pool names must be unique within the domain of names of user-created entities, such as resources, types, and servers. A server pool name can contain any platform-supported characters except the exclamation point (!) and the tilde (~). A server pool name cannot begin with a period nor with *ora*. This attribute is required.
PARENT_POOLS	A string of space-delimited server pool names in the following format: sp1 sp2 ...	Use of this attribute makes it possible to create nested server pools. Server pools listed in this attribute are referred to as *parent* server pools. A server pool included in a parent server pool is referred to as a *child* server pool.
SERVER_NAMES	A string of space-delimited server names in the following format: server1 server2 ...	A list of candidate node names that may be associated with a server pool. If this optional attribute is empty, Oracle Clusterware assumes that any server may be assigned to any server pool, to the extent allowed by values of other attributes, such as PARENT_POOLS. The server names identified as candidate node names are not validated to confirm that they are currently active cluster members. Cluster administrators can use this attribute to define servers as candidates that have not yet been added to the cluster.

You manage server pools that are managing Oracle RAC databases with the Server Control (SRVCTL) utility. Use the Oracle Clusterware Control (CRSCTL) utility to manage all other server pools. Only cluster administrators have permission to create top-level server pools.

How Oracle Clusterware Assigns New Servers

Oracle Clusterware assigns new servers to server pools in the following order:

1. Generic server pool
2. User-created server pool
3. Free server pool

When a server joins a cluster, several things occur.

Consider the server pools configured in Table 2–3:

Table 2–3 Sample Server Pool Attributes Configuration

NAME	IMPORTANCE	MIN_SIZE	MAX_SIZE	PARENT_POOLS	EXCLUSIVE_POOLS
sp1	1	1	10		
sp2	3	1	6		
sp3	2	1	2		

Table 2–3 (Cont.) Sample Server Pool Attributes Configuration

NAME	IMPORTANCE	MIN_SIZE	MAX_SIZE	PARENT_ POOLS	EXCLUSIVE_ POOLS
sp2_1	2	1	5	sp2	S123
sp2_2	1	1	5	sp2	S123

For example, assume that there are no servers in a cluster; all server pools are empty.

When a server, named `server1`, joins the cluster:

1. Server-to-pool assignment commences.
2. Oracle Clusterware only processes top-level server pools (those that have no parent server pools), first. In this example, the top-level server pools are `sp1`, `sp2`, and `sp3`.
3. Oracle Clusterware lists the server pools in order of `IMPORTANCE`, as follows: `sp2`, `sp3`, `sp1`.
4. Oracle Clusterware assigns `server1` to `sp2` because `sp2` has the highest `IMPORTANCE` value and its `MIN_SIZE` value has not yet been met.
5. Oracle Clusterware processes the remaining two server pools, `sp2_1` and `sp2_2`. The sizes of both server pools are below the value of the `MIN_SIZE` attribute (both server pools are empty and have `MIN_SIZE` values of `1`).
6. Oracle Clusterware lists the two remaining pools in order of `IMPORTANCE`, as follows: `sp2_1`, `sp2_2`.
7. Oracle Clusterware assigns `server1` to `sp2_1` but cannot assign `server1` to `sp2_2` because `sp2_1` is configured to be exclusive with `sp2_2`.

After processing, the cluster configuration appears, as follows

Table 2–4 Post Processing Server Pool Configuration

Server Pool Name	Assigned Servers
sp1	
sp2	server1
sp3	
sp2_1	server1
sp2_2	

Role-separated Management

This section contains the following topics

- About Role-separated Management
- Managing Cluster Administrators in the Cluster
- Configuring Horizontal Role Separation

About Role-separated Management

Role-separated management is a feature you can implement that enables multiple resources to share the same cluster and hardware resources by setting permissions on

server pools or resources, and then using access control lists (ACLs) to provide access. By default, this feature is not implemented during installation.

Role-separated management can be implemented in two ways:

- **Vertical implementation**: Access permissions to server pools or resources are granted by assigning ownership of them to different users for each layer in the stack, and using ACLs assigned to those users. Oracle ASM provides an even more granular approach using groups. Careful planning is required to enable overlapping tasks.
- **Horizontal implementation**: Access permissions for resources are granted using ACLS assigned to server pools and policy-managed databases or applications.

Role-separated management in Oracle Clusterware depends on a **cluster administrator**. The set of users that are cluster administrators is managed within Oracle Clusterware, as opposed to being an operating system group. By default, after an Oracle grid infrastructure for a cluster installation or after an upgrade, all users are cluster administrators (denoted by the asterisk (`*`) in the list of cluster administrators). However, the user that installed Oracle Clusterware in the Grid infrastructure home (Grid home) and `root` are *permanent* cluster administrators, and only these two users can add or remove users from the group. Additionally, only a permanent cluster administrator can remove the asterisk (`*`) value from the cluster administrator group, changing the group to enable role-separation management. When you enable this feature, you can limit the cluster administrator group to only those users added by the permanent cluster administrators.

If the cluster is shared by various users, then the cluster administrator can restrict access to certain server pools and, consequently, to certain hardware resources to specific users in the cluster. The permissions are stored for each server pool in the `ACL` attribute, described in Table 2–2.

Managing Cluster Administrators in the Cluster

Use the following commands to manage cluster administrators in the cluster:

- To query the list of users that are cluster administrators:

  ```
  $ crsctl query crs administrator
  ```

- To enable role-separated management, you must remove the `*` value from the list of cluster administrators, as either the user who installed Oracle Clusterware or `root`, as follows:

  ```
  # crsctl delete crs administrator -u "*"
  ```

  The asterisk (`*`) must be enclosed in double quotation marks (`""`).

- To add specific users to the group of cluster administrators:

  ```
  # crsctl add crs administrator -u user_name
  ```

  To make all users cluster administrators, enter `-u "*"`.

- To remove specific users from the group of cluster administrators:

  ```
  # crsctl delete crs administrator -u user_name
  ```

Configuring Horizontal Role Separation

Use the `crsctl` command `crsctl setperm` to configure horizontal role separation using ACLs that are assigned to server pools, resources, or both. The `crsctl`

command is located in the path *Grid_home*/bin, where *Grid_home* is the Oracle grid infrastructure for a cluster home.

The command uses the following syntax, where the access control string (ACL) is indicated by italics:

```
crsctl setperm {resource|type|serverpool} name {-u aclstring|-x aclstring|-o user_
name|-g group_name}
```

The flag options are:

- -u

  Update the entity ACL

- -x

  Delete the entity ACL

- -o

  Change the entity owner

- -g

  Change the entity primary group

The ACL strings are:

```
{ user:user_name[:readPermwritePermexecPerm]   |
     group:group_name[:readPermwritePermexecPerm] |
     other[::readPermwritePermexecPerm] }
```

where:

- user

  designates the user ACL (access permissions granted to the designated user)

- group

  designates the group ACL (permissions granted to the designated group members)

- other

  designates the other ACL (access granted to users or groups not granted particular access permissions)

- *readperm*

  Location of the read permission; r grants, and - forbids)

- *writeperm*

  Location of the write permission; w grants, and - forbids)

- *execperm*

  Location of the execute permission; x grants, and - forbids)

For example, to set permissions on a server pool called psft for the group personnel, where the administrative user has read/write/execute privileges, the psft group has read/write privileges, and users outside of the group are granted no access, enter the following command as the root user:

```
# crsctl setperm serverpool psft -o personadmin -g personnel:rwxr-w---
```

Voting Disk, Oracle Cluster Registry, and Oracle Local Registry

This section includes the following topics:

About Voting Disks, Oracle Cluster Registry, and Oracle Local Registry

Oracle Clusterware includes three components: voting disks, Oracle Cluster Registry (OCR), and Oracle Local Registry (OLR).

- Voting disks manage information about node membership. Each voting disk must be accessible by all nodes in the cluster for nodes to be members of the cluster
- OCR manages Oracle Clusterware and Oracle RAC database configuration information
- OLR resides on every node in the cluster and manages Oracle Clusterware configuration information for each particular node

You can store voting disks and the OCR on Oracle Automatic Storage Management (Oracle ASM), or a certified cluster file system.

Oracle Universal Installer for Oracle Clusterware 11*g* release 2 (11.2), does not support the use of raw or block devices. However, if you upgrade from a previous Oracle Clusterware release, then you can continue to use raw or block devices. Oracle recommends that you use Oracle ASM to store voting disks and OCR.

Oracle recommends that you select the option to configure multiple voting disks during Oracle Clusterware installation to improve availability. If necessary, you can dynamically add or replace voting disks after you complete the Oracle Clusterware installation process without stopping the cluster.

Oracle recommends that you select the option to configure multiple OCRs during Oracle Clusterware installation to improve availability. If necessary, you can dynamically add or replace OCRs after you complete the Oracle Clusterware installation process without stopping the cluster.

Managing Voting Disks

This section includes the following topics for managing voting disks in your cluster:

Notes:

- Voting disk backups are stored in OCR.
- Voting disk management requires a valid and working OCR. Before you add, delete, replace, or restore voting disks, run the `ocrcheck` command as `root`. If OCR is not available or it is corrupt, then you must restore OCR as described in "Restoring Oracle Cluster Registry" on page 2-34.
- If you upgrade from a previous version of Oracle Clusterware to 11*g* release 2 (11.2) and you want to store voting disks in an Oracle ASM disk group, then you must set the **ASM Compatibility** compatibility attribute to `11.2.0.0`.

See Also:

- *Oracle Database Storage Administrator's Guide* for information about setting Oracle ASM compatibility attributes
- *Oracle Database Administrator's Guide* for information about creating server parameter files

Storing Voting Disks on Oracle ASM

Oracle ASM manages voting disks differently from other files that it stores. When you place voting disks on disks in an Oracle ASM disk group, Oracle Clusterware records exactly where they are located. If Oracle ASM fails, then Cluster Synchronization Services (CSS) can still access the voting disks.

If you choose to store your voting disks in Oracle ASM, then Oracle ASM stores all the voting disks for the cluster.

The number of voting files you can store in a particular Oracle ASM disk group depends upon the redundancy of the disk group.

- **External redundancy**: A disk group with external redundancy can store only one voting disk
- **Normal redundancy**: A disk group with normal redundancy can store up to three voting disks
- **High redundancy**: A disk group with high redundancy can store up to five voting disks

By default, Oracle ASM puts each voting disk in its own failure group within the disk group. A failure group is a subset of the disks in a disk group, which could fail at the same time because they share hardware. The failure of common hardware must be tolerated. For example, four drives that are in a single removable tray of a large JBOD (Just a Bunch of Disks) array are in the same failure group because the tray could be removed, making all four drives fail at the same time.

Conversely, drives in the same cabinet can be in multiple failure groups if the cabinet has redundant power and cooling so that it is not necessary to protect against failure of the entire cabinet. However, Oracle ASM mirroring is not intended to protect against a fire in the computer room that destroys the entire cabinet. If voting disks stored on Oracle ASM with Normal or High redundancy, and the storage hardware in one failure group suffers a failure, then if there is another disk available in a disk group in an unaffected failure group, Oracle ASM recovers the voting disk in the unaffected failure group.

A normal redundancy disk group must contain at least two failure groups but if you are storing your voting disks on Oracle ASM, then a normal redundancy disk group must contain at least three failure groups. A high redundancy disk group must contain at least three failure groups. However, Oracle recommends using several failure groups. A small number of failure groups, or failure groups of uneven capacity, can create allocation problems that prevent full use of all of the available storage.

You must specify enough failure groups in each disk group to support the redundancy type for that disk group.

See Also:

- *Oracle Database Storage Administrator's Guide* for more information about disk group redundancy and failure groups
- "Adding, Deleting, or Migrating Voting Disks" on page 2-24 for information about migrating voting disks

Backing Up Voting Disks

In Oracle Clusterware 11*g* release 2 (11.2), you no longer have to back up the voting disk. The voting disk data is automatically backed up in OCR as part of any configuration change and is automatically restored to any voting disk added. If all voting disks are corrupted, however, you can restore them as described in "Restoring Voting Disks" on page 2-23.

Restoring Voting Disks

If you have multiple voting disks, then you can remove the voting disks and add them back into your environment using the following commands, where *GUID* is the file universal identifier of the voting disk and *path_to_voting_disk* is the directory path to the voting disk:

```
$ crsctl delete css votedisk FUID
$ crsctl add css votedisk path_to_voting_disk
```

Run the `crsctl query css votedisk` command to obtain the GUIDs of the voting disks in the cluster.

If all of the voting disks are corrupted, then you can restore them, as follows:

1. Restore OCR as described in "Restoring Oracle Cluster Registry" on page 2-34, if necessary.

   This step is necessary only if OCR is also corrupted or otherwise unavailable, such as if OCR is on Oracle ASM and the disk group is no longer available.

   See Also: *Oracle Database Storage Administrator's Guide* for more information about managing Oracle ASM disk groups

2. Run the following command as `root` from only one node to start the Oracle Clusterware stack in exclusive mode, which does not require voting files to be present or usable:

   ```
   # crsctl start crs -excl
   ```

3. Run the following command to retrieve the list of voting files currently defined:

   ```
   $ crsctl query css votedisk
   ```

This list may be empty if all voting disks are corrupted, or may have entries that are marked as status 3 or OFF.

4. Depending on where you store your voting files, do one of the following:
   - If the voting disks are stored in Oracle ASM, then run the following command to migrate the voting disks to the Oracle ASM disk group you specify:

     ```
     crsctl replace votedisk +asm_disk_group
     ```

     The Oracle ASM disk group to which you migrate the voting files must exist in Oracle ASM. You can use this command whether the voting disks were stored in Oracle ASM or some other storage device.
   - If voting disks are OFFLINE and are not stored in Oracle ASM (as indicated by the absence of a name in the last column of the string of information returned by the `crsctl query css votedisk` command), then run the following command using the File Universal Identifier (FUID) obtained in the previous step:

     ```
     $ crsctl delete css votedisk FUID
     ```

     Add a voting disk, as follows:

     ```
     $ crsctl add css votedisk path_to_voting_disk
     ```

5. Stop the Oracle Clusterware stack as `root`:

   ```
   # crsctl stop crs
   ```

6. Restart the Oracle Clusterware stack in normal mode as `root`:

   ```
   # crsctl start crs
   ```

Adding, Deleting, or Migrating Voting Disks

You can add, remove, and migrate voting disks after you install Oracle Clusterware. Note that the commands you use to do this are different, depending on whether your voting disks are located on Oracle ASM, or are located on another storage option.

Use the following commands to modify voting disks, depending on your storage option:

- To display the voting disk FUID and file path of each current voting disk, run the following command:

  ```
  $ crsctl query css votedisk
  1. ONLINE   296641fd201f4f3fbf3452156d3b5881 (/ocfs2/staih09_vd3) []
  ```

  This command returns a disk sequence number, the status of the disk, the FUID, and the path of the disk or the name of the Oracle ASM disk group on which the disk is stored.
- To replace a voting disk with an Oracle ASM disk group, run the following command:

  ```
  $ crsctl replace votedisk +asm_disk_group
  ```

- To add one or more voting disks to a storage location other than Oracle ASM storage, run the following command, replacing the *path_to_voting_disk* variable with one or more space-delimited, complete paths to the voting disks you want to add:

  ```
  $ crsctl add css votedisk path_to_voting_disk [...]
  ```

- To replace voting disk A with voting disk B, you must add voting disk B, and then delete voting disk A. To add a new disk and remove the existing disk, run the following command, replacing the *path_to_voting_diskB* variable with the fully qualified path name of voting disk B:

  ```
  $ crsctl add css votedisk path_to_voting_diskB -purge
  ```

  The `-purge` option deletes existing voting disks.

  Use the `crsctl replace votedisk` command to replace a voting disk with an Oracle ASM disk group.

- To remove a voting disk, run the following command, specifying one or more space-delimited, voting disk FUIDs or comma-delimited directory paths to the voting disks you want to remove:

  ```
  $ crsctl delete css votedisk {FUID | path_to_voting_disk[...]}
  ```

- To migrate voting disks from a storage device other than Oracle ASM to Oracle ASM, or to migrate from Oracle ASM to an alternative storage device, specify the Oracle ASM disk group name or path to the non-Oracle ASM storage device in the following command:

  ```
  $ crsctl replace votedisk {+asm_disk_group | path_to_voting_disk}
  ```

  You can run this command on any node in the cluster.

  Note: If the cluster is down and cannot restart due to lost voting disks, then you must start CSS in exclusive mode to replace the voting disks by entering the following command:

  ```
  $ crsctl start crs -excl
  ```

After modifying the voting disk, verify the voting disk location, as follows:

```
$ crsctl query css votedisk
```

See Also: Appendix E, "CRSCTL Utility Reference" for more information about CRSCTL commands

Managing the Oracle Cluster Registry and Oracle Local Registries

This section describes how to manage the OCR and the Oracle Local Registry (OLR) with the following utilities: OCRCONFIG, OCRDUMP, and OCRCHECK.

The OCR contains information about all Oracle resources in the cluster.

The OLR is a registry similar to the OCR located on each node in a cluster, but contains information specific to each node. It contains manageability information about Oracle Clusterware, including dependencies between various services. The Oracle High Availability Services uses this information. The OLR is located on local storage on each node in a cluster. Its default location is in the path *Grid_home*`/cdata/`*host_name*`.olr`, where *Grid_home* is the Oracle grid infrastructure home, and *host_name* is the host name of the node.

This section describes how to administer the OCR in the following topics:

- Migrating Oracle Cluster Registry to Oracle Automatic Storage Management

- Adding, Replacing, Repairing, and Removing Oracle Cluster Registry Locations
- Backing Up Oracle Cluster Registry
- Restoring Oracle Cluster Registry
- Diagnosing Oracle Cluster Registry Problems
- Administering Oracle Cluster Registry with Oracle Cluster Registry Export and Import Commands
- Oracle Local Registry
- Upgrading and Downgrading the Oracle Cluster Registry Configuration

> **See Also:** "About OCRCONFIG" on page G-2 for information about the OCRCONFIG utility, and "Oracle Cluster Registry Troubleshooting" on page G-11 for information about the OCRDUMP and OCRCHECK utilities

Migrating Oracle Cluster Registry to Oracle Automatic Storage Management

To improve Oracle Clusterware storage manageability, OCR is configured, by default, to use Oracle ASM in Oracle Database 11*g* release 2 (11.2). With the Oracle Clusterware storage residing in an Oracle ASM disk group, you can manage both database and clusterware storage using Oracle Enterprise Manager.

However, if you upgrade from a previous version of Oracle Clusterware, you can migrate OCR to reside on Oracle ASM, and take advantage of the improvements in managing Oracle Clusterware storage.

Note: If you upgrade from a previous version of Oracle Clusterware to 11*g* release 2 (11.2) and you want to store OCR in an Oracle ASM disk group, then you must set the **ASM Compatibility** compatibility attribute to `11.2.0.0`.

> **See Also:** *Oracle Database Storage Administrator's Guide* for information about setting Oracle ASM compatibility attributes

To migrate OCR to Oracle ASM using OCRCONFIG:

1. Ensure that Oracle Clusterware upgrade to 11*g* release 2 (11.2) is complete. Run the following command to verify the current running version:

   ```
   $ crsctl query crs activeversion
   ```

2. Use the Oracle ASM Configuration Assistant (ASMCA) to configure and start Oracle ASM on all nodes in the cluster.

   > **See Also:** *Oracle Database Storage Administrator's Guide* for more information about using ASMCA

3. Use ASMCA to create an Oracle ASM disk group that is at least the same size of the existing OCR and has at least normal redundancy.

Notes:

- You can store the OCR in an Oracle ASM disk group that has external redundancy.

  If a disk fails in the disk group, or if you bring down Oracle ASM, then you can lose the OCR because it depends on Oracle ASM for I/O.

  To avoid this issue, add another OCR to a different disk group. Alternatively, you can store OCR on a block device, or on a shared file system using OCRCONFIG to enable OCR redundancy.

  Oracle does not support storing the OCR on different storage types simultaneously, such as storing OCR on both Oracle ASM and a shared file system, except during a migration.
- If Oracle ASM fails, then OCR is not accessible on the node on which Oracle ASM failed, but the cluster remains operational. The entire cluster only fails if the Oracle ASM instance on the OCR master node fails, if the majority of the OCR locations are in Oracle ASM, and if there is an OCR read or write access, then the `crsd` stops and the node becomes inoperative.
- Ensure that Oracle ASM disk groups that you create are mounted on all of the nodes in the cluster.

See Also: *Oracle Grid Infrastructure Installation Guide* for more detailed sizing information

4. To add OCR to an Oracle ASM disk group, ensure that the **Oracle Clusterware stack** is running and run the following command as `root`:

   ```
   # ocrconfig -add +new_disk_group
   ```

   You can run this command more than once if you add multiple OCR locations. You can have up to five OCR locations. However, each successive run must point to a different disk group.

5. To remove storage configurations no longer in use, run the following command as `root`:

   ```
   # ocrconfig -delete old_storage_location
   ```

   Run this command for every configured OCR.

The following example shows how to migrate two OCRs to Oracle ASM using OCRCONFIG.

```
# ocrconfig -add +new_disk_group
# ocrconfig -delete /dev/raw/raw2
# ocrconfig -delete /dev/raw/raw1
```

Note: OCR inherits the redundancy of the disk group. If you want high redundancy for OCR, you must configure the disk group with high redundancy when you create it.

Migrating Oracle Cluster Registry from Oracle ASM to Other Types of Storage To migrate OCR from Oracle ASM to another storage type:

1. Ensure that Oracle Clusterware upgrade to 11*g* release 2 (11.2) is complete. Run the following command to verify the current running version:

   ```
   $ crsctl query crs activeversion
   ```

2. Create a file with the following permissions: `root`, `oinstall`, `640`.

   Note: Create a mirror of the primary storage location to eliminate a single point of failure for OCR.

3. Ensure there is at least 280 MB of space on the mount partition.
4. Ensure that the file you created is visible from all nodes in the cluster.
5. To add the file as an OCR location, ensure that the Oracle Clusterware stack is running and run the following command as `root`:

   ```
   # ocrconfig -add new_file_location
   ```

   You can run this command more than once if you add more than one OCR location. Each successive run of this command must point to a different file location.

6. To remove storage configurations no longer in use, run the following command as `root`:

   ```
   # ocrconfig -delete unused_storage_location
   ```

   You can run this command more than once if there is more than one OCR location configured.

The following example shows how to migrate OCR from Oracle ASM to block devices using OCRCONFIG. For OCRs not stored on Oracle ASM, Oracle recommends that you mirror OCR on different devices.

```
# ocrconfig -add /dev/sdd1
# ocrconfig -add /dev/sde1
# ocrconfig -add /dev/sdf1
# ocrconfig -delete +unused_disk_group
```

Adding, Replacing, Repairing, and Removing Oracle Cluster Registry Locations

The Oracle installation process for Oracle Clusterware gives you the option of automatically mirroring OCR. You can manually put the mirrored OCRs on a shared network file system (NFS), or on any cluster file system that is certified by Oracle. Alternatively, you can place the OCR on Oracle ASM and allow it to create mirrors automatically, depending on the redundancy option you select.

This section includes the following topics:

- Adding an Oracle Cluster Registry Location
- Replacing an Oracle Cluster Registry Location
- Repairing an Oracle Cluster Registry Configuration on a Local Node
- Removing an Oracle Cluster Registry Location
- Overriding the Oracle Cluster Registry Data Loss Protection Mechanism

You can manually mirror OCR, as described in the "Adding an Oracle Cluster Registry Location" on page 2-30 section, if you:

- Upgraded to 11*g* release 2 (11.2) but did not choose to mirror OCR during the upgrade
- Created only one OCR location during the Oracle Clusterware installation

---

Notes:

- Oracle recommends that you configure:

  At least three OCR locations, if the OCR is configured on non-mirrored or non-redundant storage. Oracle strongly recommends that you mirror the OCR if the underlying storage is not RAID. Mirroring can help prevent the OCR from becoming a single point of failure.

  At least two OCR locations if the OCR is configured on an Oracle ASM disk group. You should configure the OCR in two independent disk groups. Typically this is the work area and the recovery area.

  At least two OCR locations if the OCR is configured on mirrored hardware or third-party mirrored volumes.
- If the original OCR location does not exist, then you must create an empty (0 byte) OCR location before you run the `ocrconfig -add` or `ocrconfig -replace` commands.
- Ensure that the OCR devices that you specify in the OCR configuration exist and that these OCR devices are valid.
- Ensure that the Oracle ASM disk group that you specify exists and is mounted.
- The new OCR file, device, or disk group must be accessible from all of the active nodes in the cluster.

See Also:

- *Oracle Grid Infrastructure Installation Guide* for information about creating OCRs
- *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management

In addition to mirroring OCR locations, you can also:

- Replace an OCR location if there is a misconfiguration or other type of OCR error, as described in the "Replacing an Oracle Cluster Registry Location" on page 2-30 section.
- Repair an OCR location if Oracle Database displays an OCR failure alert in Oracle Enterprise Manager or in the Oracle Clusterware alert log file, as described in the "Repairing an Oracle Cluster Registry Configuration on a Local Node" on page 2-31 section.
- Remove an OCR location if, for example, your system experiences a performance degradation due to OCR processing or if you transfer your OCR to RAID storage devices and choose to no longer use multiple OCR locations, as described in the "Removing an Oracle Cluster Registry Location" on page 2-31 section.

> **Note:** The operations in this section affect OCR clusterwide: they change the OCR configuration information in the `ocr.loc` file on Linux and UNIX systems and the Registry keys on Windows systems. However, the `ocrconfig` command cannot modify OCR configuration information for nodes that are shut down or for nodes on which Oracle Clusterware is not running.

Adding an Oracle Cluster Registry Location Use the procedure in this section to add an OCR location. Oracle Clusterware can manage up to five redundant OCR locations.

> **Note:** If OCR resides on a cluster file system file or a network file system, create an empty (0 byte) OCR location file before performing the procedures in this section.

As the `root` user, run the following command to add an OCR location to either Oracle ASM or other storage device:

```
# ocrconfig -add +asm_disk_group | file_name
```

> **Note:** On Linux and UNIX systems, you must be `root` to run `ocrconfig` commands. On Windows systems, the user must be a member of the Administrator's group.

Replacing an Oracle Cluster Registry Location If you must change an existing OCR location, or change a failed OCR location to a working location, then you can use the following procedure, if one OCR location remains online.

To change an Oracle Cluster Registry location:

Complete the following procedure:

1. Use the OCRCHECK utility to verify that a copy of OCR other than the one you are going to replace is *online*, using the following command:

   ```
   $ ocrcheck
   ```

   OCRCHECK displays all OCR locations that are registered and whether they are available (online). If an OCR location suddenly becomes unavailable, then it might take a short period for Oracle Clusterware to show the change in status.

   > **Note:** The OCR location that you are *replacing* can be either online or offline.

2. Use the following command to verify that Oracle Clusterware is running on the node on which the you are going to perform the replace operation:

   ```
   $ crsctl check crs
   ```

3. Run the following command as `root` to replace the current OCR location using either *`destination_file`* or *`+ASM_disk_group`* to indicate the current and target OCR locations:

   ```
   # ocrconfig -replace current_OCR_location -replacement new_OCR_location
   ```

If you have only one OCR location, then use the following commands:

```
# ocrconfig -add +new_storage_disk_group
# ocrconfig -delete +current_disk_group
```

> **See Also:** *Oracle Database Storage Administrator's Guide* for more information about migrating storage

4. If any node that is part of your current Oracle RAC cluster is shut down, then use the following command syntax on the stopped node to let that node rejoin the cluster after the node is restarted where you use either a *destination_file* or *+ASM_disk_group* to indicate the current and target OCR locations:

   ```
   ocrconfig -repair -replace current_OCR_location -replacement new_OCR_location
   ```

Repairing an Oracle Cluster Registry Configuration on a Local Node It may be necessary to repair the OCR if your cluster configuration changes while that node is stopped. Repairing an OCR involves either adding, deleting, or replacing an OCR location. For example, you may have to repair an OCR location on a node that was stopped while you were adding, replacing, or removing the OCR. To repair an OCR, run the following command as `root` on the node on which you have stopped the Oracle Clusterware daemon:

```
# ocrconfig -repair -add file_name | -delete file_name | -replace
current_file_name -replacement new_file_name
```

This operation only changes the OCR on the node on which you run this command. For example, if the OCR location is `/dev/sde1`, then use the command syntax `ocrconfig -repair -add /dev/sde1` on this node to repair the OCR on that node.

Notes:

- You cannot repair the OCR on a node on which Oracle Clusterware is running.
- When you repair the OCR on a stopped node using `ocrconfig -repair`, you must provide the same OCR filename (which should be case-sensitive) as the OCR filenames on other nodes.
- If you run the `ocrconfig -add | -repair | -replace` command, then the device, file, or Oracle ASM disk group that you are adding must be accessible. This means that a device must exist. You must create an empty (0 byte) OCR location, or the Oracle ASM disk group must exist and be mounted.
- If you store OCR on Oracle ASM, then

> **See Also:** *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management

Removing an Oracle Cluster Registry Location To remove an OCR location, at least one other OCR must be online. You can remove an OCR location to reduce OCR-related overhead or to stop mirroring your OCR because you moved OCR to redundant storage such as RAID.

Perform the following procedure as the `root` user to remove an OCR location from your Oracle Clusterware environment:

1. Ensure that *at least one* OCR location other than the OCR location that you are removing is online.

   Caution: Do *not* perform this OCR removal procedure unless there is at least one other active OCR location online.

2. Run the following command on any node in the cluster to remove an OCR location from either Oracle ASM or other location:

   ```
   # ocrconfig -delete +ASM_disk_group | file_name
   ```

   The *`file_name`* variable can be a device name or a file name. This command updates the OCR configuration on all of the nodes on which Oracle Clusterware is running.

Overriding the Oracle Cluster Registry Data Loss Protection Mechanism OCR has a mechanism that prevents data loss due to accidental overwrites. If you configure a mirrored OCR and if Oracle Clusterware cannot access the mirrored OCR locations and also cannot verify that the available OCR location contains the most recent configuration, then Oracle Clusterware prevents further modification to the available OCR location. In addition, the process prevents overwriting by prohibiting Oracle Clusterware from starting on the node on which only one OCR is available. In such cases, Oracle Database displays an alert message in either Oracle Enterprise Manager, the Oracle Clusterware alert log files, or both. If this problem is local to only one node, you can use other nodes to start your cluster database.

However, if you are unable to start any cluster node in your environment and if you can neither repair OCR nor restore access to all OCR locations, then you can override the protection mechanism. The procedure described in the following list enables you to start the cluster using the available OCR location. However, overriding the protection mechanism can result in the loss of data that was not available when the previous known good state was created.

Note: Overriding OCR using the following procedure can result in the loss of OCR updates that were made between the time of the last known good OCR update made to the currently accessible OCR and the time at which you performed the overwrite. In other words, running the `ocrconfig -overwrite` command can result in data loss if the OCR location that you are using to perform the overwrite does not contain the latest configuration updates for your cluster environment.

Perform the following procedure to overwrite OCR if a node cannot start *and* if the alert log contains CLSD-1009 and CLSD-1011 messages.

1. Attempt to resolve the cause of the CLSD-1009 and CLSD-1011 messages.

   Compare the node's OCR configuration (`ocr.loc` on Linux and UNIX systems and the Registry on Windows systems) with other nodes on which Oracle Clusterware is running.

   - If the configurations do not match, run `ocrconfig -repair`.

- If the configurations match, ensure that the node can access all of the configured OCRs by running an `ls` command on Linux and UNIX systems. On Windows, use a `dir` command if the OCR location is a file and run `GuiOracleObjectManager.exe` to verify that the part of the cluster with the name exists.

2. Ensure that the most recent OCR contains the latest OCR updates.

   Look at output from the `ocrdump` command and determine whether it has your latest updates.

3. If you cannot resolve the problem that caused the CLSD message, then run the command `ocrconfig -overwrite` to start the node.

Backing Up Oracle Cluster Registry

This section describes how to back up OCR content and use it for recovery. The first method uses automatically generated OCR copies and the second method enables you to issue a backup command manually:

- **Automatic backups**: Oracle Clusterware automatically creates OCR backups every four hours. At any one time, Oracle Database always retains the last three backup copies of OCR. The CRSD process that creates the backups also creates and retains an OCR backup for each *full day* and *at the end of each week*. You cannot customize the backup frequencies or the number of files that Oracle Database retains.
- **Manual backups**: Use the `ocrconfig -manualbackup` command to force Oracle Clusterware to perform a backup of OCR at any time, rather than wait for the automatic backup. The `-manualbackup` option is especially useful when you want to obtain a binary backup on demand, such as before you make changes to the OCR. The OLR only supports manual backups.

When the clusterware stack is down on all nodes in the cluster, the backups that are listed by the command `ocrconfig -showbackup` may differ from node to node. After you install or upgrade Oracle Clusterware on a node, or add a node to the cluster, when the `root.sh` script finishes, it backs up the OLR.

Listing Backup Files

Run the following command to list the backup files:

```
# ocrconfig -showbackup
```

On Windows:

```
C:\>ocrconfig -showbackup
```

The `ocrconfig -showbackup` command to displays the backup location, timestamp, and the originating node name of the backup files that Oracle Clusterware creates. By default, the `-showbackup` option displays information for both automatic and manual backups but you can include the `auto` or `manual` flag to display only the automatic backup information or only the manual backup information, respectively.

Run the following command to inspect the contents and verify the integrity of the backup file:

```
# ocrdump -backupfile backup_file_name
```

On Windows:

```
C:\>ocrdump -backupfile backup_file_name
```

You can use any backup software to copy the automatically generated backup files at least once daily to a different device from where the primary OCR resides.

The default location for generating backups on Linux or UNIX systems is *Grid_home*/cdata/*cluster_name*, where *cluster_name* is the name of your cluster. The Windows default location for generating backups uses the same path structure. Because the default backup is on a local file system, Oracle recommends that you include the backup file created with the OCRCONFIG utility as part of your operating system backup using standard operating system or third-party tools.

Tip: You can use the `ocrconfig -backuploc` option to change the location where OCR creates backups. Appendix G, "Managing the Oracle Cluster Registry" describes the OCRCONFIG utility options.

Note: On Linux and UNIX systems, you must be `root` user to run most but not all of the `ocrconfig` command options. On Windows systems, the user must be a member of the Administrator's group.

See Also: "Administering Oracle Cluster Registry with Oracle Cluster Registry Export and Import Commands" on page 2-38 to use manually created OCR export files to copy OCR content and use it for recovery

Restoring Oracle Cluster Registry

If a resource fails, then before attempting to restore OCR, restart the resource. As a definitive verification that OCR failed, run `ocrcheck` and if the command returns a failure message, then both the primary OCR and the OCR mirror have failed. Attempt to correct the problem using the OCR restoration procedure for your platform.

Notes:

- You *cannot* restore your configuration from an OCR backup file using the `-import` option, which is explained in "Administering Oracle Cluster Registry with Oracle Cluster Registry Export and Import Commands" on page 2-38. You *must instead* use the `-restore` option, as described in the following sections.
- If you store OCR on an Oracle ASM disk group and the disk group is not available, then you must recover and mount the Oracle ASM disk group.

See Also: *Oracle Database Storage Administrator's Guide* for more information about managing Oracle ASM disk groups

- Restoring the Oracle Cluster Registry on Linux or UNIX Systems
- Restoring the Oracle Cluster Registry on Windows Systems

Restoring the Oracle Cluster Registry on Linux or UNIX Systems

If you are storing the OCR on an Oracle ASM disk group, and that disk group is corrupt, then you must restore the Oracle ASM disk group using Oracle ASM utilities,

and then mount the disk group again before recovering the OCR. Recover the OCR by running the command `ocrconfig -restore`.

> **See Also:** *Oracle Database Storage Administrator's Guide* for information about how to restore Oracle ASM disk groups

Use the following procedure to restore OCR on Linux or UNIX systems:

1. List the nodes in your cluster by running the following command on one node:

   ```
   $ olsnodes
   ```

2. Stop Oracle Clusterware by running the following command as `root` on all of the nodes:

   ```
   # crsctl stop crs
   ```

   If the preceding command returns any error due to OCR corruption, stop Oracle Clusterware by running the following command as `root` on all of the nodes:

   ```
   # crsctl stop crs -f
   ```

3. If you are restoring OCR to a cluster file system or network file system, then run the following command as `root` to restore OCR with an OCR backup that you can identify in "Listing Backup Files" on page 2-33:

   ```
   # ocrconfig -restore file_name
   ```

   After you complete this step, skip to step 8.

4. Start the Oracle Clusterware stack on one node in exclusive mode by running the following command as `root`:

   ```
   # crsctl start crs -excl
   ```

   Ignore any errors that display.

   Check whether `crsd` is running. If it is, stop it by running the following command as `root`:

   ```
   # crsctl stop resource ora.crsd -init
   ```

   > **Caution:** *Do not* use the `-init` flag with any other command.

5. Restore OCR with an OCR backup that you can identify in "Listing Backup Files" on page 2-33 by running the following command as `root`:

   ```
   # ocrconfig -restore file_name
   ```

   Notes:

   - If the original OCR location does not exist, then you must create an empty (0 byte) OCR location before you run the `ocrconfig -restore` command.
   - Ensure that the OCR devices that you specify in the OCR configuration exist and that these OCR devices are valid.
   - If you configured OCR in an Oracle ASM disk group, then ensure that the Oracle ASM disk group exists and is mounted.

See Also:

- *Oracle Grid Infrastructure Installation Guide* for information about creating OCRs
- *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management

6. Verify the integrity of OCR:

```
# ocrcheck
```

7. Stop Oracle Clusterware on the node where it is running in exclusive mode:

```
# crsctl stop crs -f
```

8. Begin to start Oracle Clusterware by running the following command as `root` on all of the nodes:

```
# crsctl start crs
```

9. Verify the OCR integrity of all of the cluster nodes that are configured as part of your cluster by running the following CVU command:

```
$ cluvfy comp ocr -n all -verbose
```

See Also: Appendix A, "Cluster Verification Utility Reference" for more information about enabling and using CVU

Restoring the Oracle Cluster Registry on Windows Systems

If you are storing the OCR on an Oracle ASM disk group, and that disk group is corrupt, then you must restore the Oracle ASM disk group using Oracle ASM utilities, and then mount the disk group again before recovering the OCR. Recover the OCR by running the command `ocrconfig -restore`.

See Also: *Oracle Database Storage Administrator's Guide* for information about how to restore Oracle ASM disk groups

Use the following procedure to restore OCR on Windows systems:

1. List the nodes in your cluster by running the following command on one node:

```
C:\>olsnodes
```

2. Stop Oracle Clusterware by running the following command as a Windows administrator on all of the nodes:

```
C:\>crsctl stop crs
```

   If the preceding command returns any error due to OCR corruption, stop Oracle Clusterware by running the following command as a Windows administrator on all of the nodes:

```
C:\>crsctl stop crs -f
```

3. Start the Oracle Clusterware stack on one node in exclusive mode by running the following command as a Windows administrator:

```
C:\>crsctl start crs -excl
```

   Ignore any errors that display.

Check whether `crsd` is running. If it is, stop it by running the following command as a Windows administrator:

```
C:\>crsctl stop resource ora.crsd -init
```

Caution: *Do not* use the `-init` flag in any other command.

4. Restore OCR with the OCR backup file that you identified in "Listing Backup Files" on page 2-33 by running the following command as a Windows administrator:

```
C:\>ocrconfig -restore file_name
```

Make sure that the OCR devices that you specify in the OCR configuration exist and that these OCR devices are valid.

Notes:

- If the original OCR location does not exist, then you must create an empty (0 byte) OCR location before you run the `ocrconfig -restore` command.
- Ensure that the OCR devices that you specify in the OCR configuration exist and that these OCR devices are valid.
- Ensure that the Oracle ASM disk group you specify exists and is mounted.

See Also:

- *Oracle Grid Infrastructure Installation Guide* for information about creating OCRs
- *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management

5. Verify the integrity of OCR:

```
C:\>ocrcheck
```

6. Stop Oracle Clusterware on the node where it is running in exclusive mode:

```
C:\>crsctl stop crs -f
```

7. Begin to start Oracle Clusterware by running the following command as a Windows administrator on all of the nodes:

```
C:\>crsctl start crs
```

8. Run the following Cluster Verification Utility (CVU) command to verify the OCR integrity of all of the nodes in your cluster database:

```
C:\>cluvfy comp ocr -n all -verbose
```

See Also: Appendix A, "Cluster Verification Utility Reference" for more information about enabling and using CVU

Diagnosing Oracle Cluster Registry Problems

You can use the OCRDUMP and OCRCHECK utilities to diagnose OCR problems as described under the following topics:

- Using the OCRDUMP Utility
- Using the OCRCHECK Utility

Using the OCRDUMP Utility Use the OCRDUMP utility to write the OCR contents to a file so that you can examine the OCR content.

> **See Also:** "OCRDUMP Utility Syntax and Options" on page G-13 for more information about the OCRDUMP utility

Using the OCRCHECK Utility Use the OCRCHECK utility to verify the OCR integrity.

> **See Also:** "Using the OCRCHECK Utility" on page G-12 for more information about the OCRCHECK utility

Administering Oracle Cluster Registry with Oracle Cluster Registry Export and Import Commands

In addition to using the automatically created OCR backup files, you should also export the OCR contents before and after making significant configuration changes, such as adding or deleting nodes from your environment, modifying Oracle Clusterware resources, and upgrading, downgrading or creating a database. Do this by using the `ocrconfig -export` command, which exports the OCR content to a file format.

Caution: Note the following restrictions for restoring the OCR:

- The file format generated by `ocrconfig -restore` is incompatible with the file format generated by `ocrconfig -export`. The `ocrconfig -export` and `ocrconfig -import` commands are compatible. The `ocrconfig -manualbackup` and `ocrconfig -restore` commands are compatible. The two file formats are incompatible and must not be interchangeably used.
- When exporting the OCR, Oracle recommends including "`ocr`", the cluster name, and the timestamp in the name string. For example:

```
ocr_mycluster1_20090521_2130_export
```

Using the `ocrconfig -export` command also enables you to restore OCR using the `-import` option if your configuration changes cause errors. For example, if you have unresolvable configuration problems, or if you are unable to restart Oracle Clusterware after such changes, then restore your configuration using the procedure for your platform.

Notes: Oracle recommends that you use either automatic or manual backups and the `ocrconfig -restore` command instead of the `ocrconfig -export` and `ocrconfig -import` commands to restore OCR for the following reasons:

- A backup is a consistent snapshot of OCR, whereas an export is not.
- Backups are created when the system is online. You must shut down Oracle Clusterware on all nodes in the cluster to get a consistent snapshot using the `ocrconfig -export` command.
- You can inspect a backup using the OCRDUMP utility. You cannot inspect the contents of an export.
- You can list backups with the `ocrconfig -showbackup` command, whereas *you* must keep track of all generated exports.

Note: Most configuration changes that you make not only change the OCR contents, the configuration changes also cause file and database object creation. Some of these changes are often not restored when you restore OCR. Do not restore OCR as a correction to revert to previous configurations, if some of these configuration changes should fail. This may result in an OCR location that has contents that do not match the state of the rest of your system.

Importing Oracle Cluster Registry Content on Linux or UNIX Systems

Note: This procedure assumes default installation of Oracle Clusterware on all nodes in the cluster, where Oracle Clusterware autostart is enabled.

Use the following procedure to import OCR on Linux or UNIX systems:

1. List the nodes in your cluster by running the following command on one node:

   ```
   $ olsnodes
   ```

2. Stop Oracle Clusterware by running the following command as `root` on all of the nodes:

   ```
   # crsctl stop crs
   ```

   If the preceding command returns any error due to OCR corruption, stop Oracle Clusterware by running the following command as `root` on all of the nodes:

   ```
   # crsctl stop crs -f
   ```

3. Start the Oracle Clusterware stack on one node in exclusive mode by running the following command as `root`:

   ```
   # crsctl start crs -excl
   ```

   Ignore any errors that display.

Check whether `crsd` is running. If it is, stop it by running the following command as `root`:

```
# crsctl stop resource ora.crsd -init
```

Caution: *Do not* use the `-init` flag with any other command.

4. Import the OCR by running the following command as `root`:

```
# ocrconfig -import file_name
```

Notes:

- If the original OCR location does not exist, then you must create an empty (0 byte) OCR location before you run the `ocrconfig -import` command.
- Ensure that the OCR devices that you specify in the OCR configuration exist and that these OCR devices are valid.
- If you configured OCR in an Oracle ASM disk group, then ensure that the Oracle ASM disk group exists and is mounted.

See Also:

- *Oracle Grid Infrastructure Installation Guide* for information about creating OCRs
- *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management

5. Verify the integrity of OCR:

```
# ocrcheck
```

6. Stop Oracle Clusterware on the node where it is running in exclusive mode:

```
# crsctl stop crs -f
```

7. Begin to start Oracle Clusterware by running the following command as `root` on all of the nodes:

```
# crsctl start crs
```

8. Verify the OCR integrity of all of the cluster nodes that are configured as part of your cluster by running the following CVU command:

```
$ cluvfy comp ocr -n all -verbose
```

Note: You *can only* import an exported OCR. To restore OCR from a backup, you must instead use the `-restore` option, as described in "Backing Up Oracle Cluster Registry" on page 2-33.

See Also: Appendix A, "Cluster Verification Utility Reference" for more information about enabling and using CVU

Oracle Local Registry

In Oracle Clusterware 11*g* release 2 (11.2), each node in a cluster has a local registry for node-specific resources, called an Oracle Local Registry (OLR), that is installed and configured when Oracle Clusterware installs OCR. Multiple processes on each node have simultaneous read and write access to the OLR particular to the node on which they reside, regardless of whether Oracle Clusterware is running or fully functional.

By default, OLR is located at *Grid_home*/cdata/*host_name*.olr on each node.

Manage OLR using the OCRCHECK, OCRDUMP, and OCRCONFIG utilities as `root` with the `-local` option.

- You can check the status of OLR on the local node using the OCRCHECK utility, as follows:

```
# ocrcheck -local

Status of Oracle Cluster Registry is as follows :
        Version                  :          3
        Total space (kbytes)     :     262132
        Used space (kbytes)      :       9200
        Available space (kbytes) :     252932
        ID                       :  604793089
        Device/File Name         : /private2/crs/cdata/localhost/dglnx6.olr
                                   Device/File integrity check succeeded

        Local OCR integrity check succeeded
```

- You can display the content of OLR on the local node to the text terminal that initiated the program using the OCRDUMP utility, as follows:

```
# ocrdump -local -stdout
```

- You can perform administrative tasks on OLR on the local node using the OCRCONFIG utility.
  - To export OLR to a file:

```
# ocrconfig -local -export file_name
```

Notes:

- Oracle recommends that you use the `-manualbackup` and `-restore` commands and not the `-import` and `-export` commands.
- When exporting OLR, Oracle recommends including "`olr`", the host name, and the timestamp in the name string. For example:

```
olr_myhost1_20090603_0130_export
```

  - To import a specified file to OLR:

```
# ocrconfig -local -import file_name
```

  - To manually back up OLR:

```
# ocrconfig -local -manualbackup
```

Note: The OLR is backed up at the end of an installation or an upgrade. After that time, you can only manually back up the OLR. Automatic backups are not supported for the OLR. You should create a new backup when you migrate the OCR from Oracle ASM to other storage, or you migrate the OCR from other storage to Oracle ASM.

The default backup location for the OLR is in the path *Grid_home*/cdata/*host_name*.

- To view the contents of the OLR backup file:

```
ocrdump -local -backupfile olr_backup_file_name
```

- To change the ORL backup location:

```
ocrconfig -local -backuploc new_olr_backup_path
```

- To restore OLR:

```
# crsctl stop crs
# ocrconfig -local -restore file_name
# ocrcheck -local
# crsctl start crs
$ cluvfy comp olr
```

Upgrading and Downgrading the Oracle Cluster Registry Configuration

When you install Oracle Clusterware, it automatically runs the `ocrconfig -upgrade` command. To downgrade, follow the downgrade instructions for each component and also downgrade OCR using the `ocrconfig -downgrade` command. If you are upgrading OCR, then you can use the OCRCHECK utility to verify the integrity of OCR.

Changing Network Addresses on Manually Configured Networks

This section contains the following topics:

Understanding When You Must Configure Network Addresses

An Oracle Clusterware configuration requires at least two interfaces:

- A public network interface, on which users and application servers connect to access data on the database server
- A private network interface for internode communication.

If you use Grid Naming Service and DHCP to manage your network connections, then you may not need to configure address information on the cluster. Using GNS allows public Virtual Internet Protocol (VIP) addresses to be dynamic, DHCP-provided addresses. Clients submit name resolution requests to your network's Domain Name Service (DNS), which forwards the requests to the grid naming service (GNS), managed within the cluster. GNS then resolves these requests to nodes in the cluster.

If you do not use GNS, and instead configure networks manually, then public VIP addresses must be statically configured in the DNS, VIPs must be statically configured in the DNS and hosts file, and private IP addresses require static configuration.

Understanding SCAN Addresses and Client Service Connections

Public network addresses are used to provide services to clients. If your clients are connecting to the Single Client Access Name addresses, then you may need to change public and virtual IP addresses as you add or remove nodes from the cluster, but you do not need to update clients with new cluster addresses.

SCANs function like a cluster alias. However, SCANs are resolved on any node in the cluster, so unlike a VIP address for a node, clients connecting to the SCAN no longer require updated VIP addresses as nodes are added to or removed from the cluster. Because the SCAN addresses resolve to the cluster, rather than to a node address in the cluster, nodes can be added to or removed from the cluster without affecting the SCAN address configuration.

The SCAN is a fully qualified name (host name+domain) that is configured to resolve to all the addresses allocated for the SCAN. The addresses resolve using Round Robin DNS either on the DNS server, or within the cluster in a GNS configuration. SCAN listeners can run on any node in the cluster. SCANs provide location independence for the databases, so that client configuration does not have to depend on which nodes run a particular database.

Oracle Database 11*g* release 2 (11.2) and later instances only register with SCAN listeners as remote listeners. Upgraded databases register with SCAN listeners as remote listeners, and also continue to register with all node listeners.

Changing the Virtual IP Addresses

Clients configured to use Public VIP addresses for Oracle Database releases before Oracle Database 11*g* release 2 (11.2) can continue to use their existing connection addresses. Oracle recommends that you configure clients to use SCANs, but it is not required that you use SCANs. When an earlier version of Oracle Database is upgraded, it is registered with the SCAN, and clients can start using the SCAN to connect to that database, or continue to use VIP addresses for connections.

If you continue to use VIP addresses for client connections, you can modify the VIP address while Oracle Database and Oracle ASM continue to run. However, you must stop services while you modify the address. When you restart the VIP address, services are also restarted on the node.

This procedure cannot be used to change a static public subnet to use DHCP. Only the command `srvctl add nodeapps -S` creates a DHCP network.

Note: The following instructions describe how to change only a VIP address, and assume that the host name associated with the VIP address does not change. Note that you do not need to update VIP addresses manually if you are using GNS, and VIPs are assigned using DHCP.

If you are changing only the VIP address, then update the DNS and the client hosts files. Also, update the server hosts files, if those are used for VIP addresses.

Perform the following steps to change a VIP address:

1. Stop all services running on the node whose VIP address you want to change using the following command syntax, where *database_name* is the name of the database, *service_name_list* is a list of the services you want to stop, and *my_node* is the name of the node whose VIP address you want to change:

   ```
   srvctl stop service -d database_name  -s service_name_list -n my_node
   ```

   This example specifies the database name (`grid`) using the `-d` option and specifies the services (`sales,oltp`) on the appropriate node (`mynode`).

   ```
   $ srvctl stop service -d grid -s sales,oltp -n mynode
   ```

2. Confirm the current IP address for the VIP address by running the `srvctl config vip` command. This command displays the current VIP address bound to one of the network interfaces. The following example displays the configured VIP address:

   ```
   $ srvctl config vip -n stbdp03
   VIP exists.:stbdp03
   VIP exists.: /stbdp03-vip/192.168.2.20/255.255.255.0/eth0
   ```

3. Stop the VIP address using the `srvctl stop vip` command:

   ```
   $ srvctl stop vip -n mynode
   ```

4. Verify that the VIP address is no longer running by running the `ifconfig -a` command on Linux and UNIX systems (or issue the `ipconfig /all` command on Windows systems), and confirm that the interface (in the example it was `eth0:1`) is no longer listed in the output.

5. Make any changes necessary to the `/etc/hosts` files on all nodes on Linux and UNIX systems, or the `%windir%\system32\drivers\etc\hosts` file on Windows systems, and make any necessary DNS changes to associate the new IP address with the old host name.

6. Modify the node applications and provide the new VIP address using the following `srvctl modify nodeapps` syntax:

   ```
   $ srvctl modify nodeapps -n node_name -A new_vip_address
   ```

   The command includes the following flags and values:

   - `-n` *node_name* is the node name
   - `-A` *new_vip_address* is the node-level VIP address: *name*`|`*ip*`/netmask[/if1[|if2|...]])`

     For example, issue the following command as the `root` user:

     ```
     srvctl modify nodeapps -n mynode -A 192.168.2.125/255.255.255.0/eth0
     ```

     Attempting to issue this command as the installation owner account may result in an error. For example, if the installation owner is `oracle`, then you may see the error `PRCN-2018: Current user oracle is not a privileged user`.

     To avoid the error, run the command as the `root` or system administrator account.

Note: To use a different subnet or NIC for the default network before any VIP resource is changed, you must use the command syntax `srvctl modify nodeapps -S` *`new_subnet/new_netmask/new_interface`* to change the network resource, where *`new_subnet`* is the new subnet address, *`new_netmask`* is the new netmask, and *`new_interface`* is the new interface. After you change the subnet, then you must change each node's VIP to an IP address on the new subnet, using the command syntax `srvctl modify nodeapps -A` *`new_ip`*.

7. Start the node VIP by running the `srvctl start vip` command:

   ```
   $ srvctl start vip -n node_name
   ```

   The following command example starts the VIP on the node named `mynode`:

   ```
   $ srvctl start vip -n mynode
   ```

8. Repeat the steps for each node in the cluster.

   Because the SRVCTL utility is a clusterwide management tool, you can accomplish these tasks for any specific node from any node in the cluster, without logging in to each of the cluster nodes.

9. Run the following command to verify node connectivity between all of the nodes for which your cluster is configured. This command discovers all of the network interfaces available on the cluster nodes and verifies the connectivity between all of the nodes by way of the discovered interfaces. This command also lists all of the interfaces available on the nodes which are suitable for use as VIP addresses.

   ```
   $ cluvfy comp nodecon -n all -verbose
   ```

Changing Oracle Clusterware Private Network Configuration

This section contains the following topics:

- About Private Networks, Network Interfaces, and Network Adapters
- Consequences of Changing Interface Names Using OIFCFG
- Changing or Deleting a Network Interface From a Cluster Configuration File
- Changing the Network Adapter for the Interconnect

About Private Networks, Network Interfaces, and Network Adapters

Oracle Clusterware requires that each node is connected through a private network (in addition to the public network). The private network connection is referred to as the *cluster interconnect*.

Oracle only supports clusters in which all of the nodes use the same network interface connected to the same subnet (defined as a global interface with the `oifcfg` command). You cannot use different network interfaces for each node (node-specific interfaces). Refer to Appendix D, "Oracle Interface Configuration Tool (OIFCFG) Command Reference" for more information about global and node-specific interfaces. Table 2–5 describes how the network interface card (NIC), or network adapter and the private IP address are stored.

Table 2–5 Storage for the Network Adapter, Private IP Address, and Private Host Name

Entity	Stored In...	Comments
Network adapter name	Operating system For example: `eth1`	Must be the same on all nodes. It can be changed globally.
Private network Interfaces	Oracle Clusterware, in the Grid Plug and Play (GPnP) Profile	Configure an interface for use as a private interface during installation by marking the interface as **Private**, or use the `oifcfg cluster_interconnects` command to designate an interface as a private interface.

Note: You cannot use the steps in this section to change the private node name after you have installed Oracle Clusterware.

Consequences of Changing Interface Names Using OIFCFG

The consequences of changing interface names depend on which name you are changing, and whether you are also changing the IP address. In cases where you are only changing the interface names, the consequences are minor. If you change the name for the Public Interface that is stored in the OCR, then you also must modify the node applications for each node. Therefore, you must stop the node applications for this change to take effect.

See Also: My Oracle Support (formerly Oracle*MetaLink*) note 276434.1 for more details about changing the nodeapps to use a new public interface name, available at the following URL:

`https://metalink.oracle.com`

Changing or Deleting a Network Interface From a Cluster Configuration File

Use the following procedure to change or delete a network interface.

Caution: The interface used by the Oracle RAC (RDBMS) interconnect must be the same interface that Oracle Clusterware is using with the hostname. Do not configure the private interconnect for Oracle RAC on a separate interface that is not monitored by Oracle Clusterware.

1. Ensure that Oracle Clusterware is running on all of the cluster nodes by running the following command:

   ```
   olsnodes -s
   ```

   The output from this command should show that Oracle Clusterware is running on all of the nodes in the cluster. For example:

   ```
   ./olsnodes -s
   myclustera Active
   myclusterc Active
   myclusterb Active
   ```

2. Ensure that the replacement interface is configured and operational in the operating system on all of the nodes. To do thus, use the form of the `ifconfig` command for your platform. For example, on Linux, use:

```
/sbin/ifconfig..
```

3. Add the new interface to the cluster as follows, providing the name of the new interface and the subnet address, using the following commands:

```
$ oifcfg setif -global
/interface_name/subnet/:cluster_interconnect
```

> **Note:** You can use wildcards in the preceding command example.

4. Ensure that the previous step completes. Then you can remove the former subnet as follows by providing the name and subnet address of the former interface:

```
$ oifcfg delif -global /interface_name/subnet/
```

5. Verify the current configuration using the following command:

```
oifcfg getif
```

   For example:

```
$ oifcfg getif
eth2 10.220.52.0 global cluster_interconnect
eth0 10.220.16.0 global public
```

6. On all of the nodes, stop Oracle Clusterware by running the following command as the `root` user:

```
# crsctl stop crs
```

7. When the cluster stops, you can deconfigure the deleted network interface in the operating system using the following command:

```
$ ifconfig down
```

At this point, the IP address from network interfaces for the old subnet is deconfigured from Oracle Clusterware. This command does not affect the configuration of the IP address on the operating system.

8. Restart Oracle Clusterware by running the following command on each cluster member node as the `root` user:

```
# crsctl start crs
```

   The changes take effect when Oracle Clusterware restarts.

   If you use the `CLUSTER_INTERCONNECTS` initialization parameter, then you must update it to reflect the changes.

Changing the Network Adapter for the Interconnect

To change the network interface for the private interconnect (for example, `eth1`), you must perform the change on all nodes (globally). This is because Oracle currently does not support the use of different network interface cards in the same subnet for the cluster interconnect.

To change the network interface, perform the following steps:

1. Make sure that the Oracle Clusterware stack is up and running on all cluster nodes.

2. Use operating system commands (`ifconfig`, or the command for your system) to ensure that the new or replacement interface is configured and up on all cluster member nodes.
3. On a single node in the cluster add the new global interface specification:

```
$ oifcfg setif -global interface_name/subnet:cluster_interconnect
```

> **Note:** You can use wild cards with the interface name. For example, `oifcfg setif -global "eth*/192.168.0.0:cluster_interconnect` is valid syntax. However, be careful to avoid ambiguity with other addresses or masks used with other cluster interfaces. If you use wild cards, then you see warning similar to the following:
>
> ```
> eth* 192.168.0.0 global cluster_interconnect
> PRIF-29: Warning: wildcard in network parameters can cause mismatch
> among GPnP profile, OCR, and system
> ```
>
> Legacy network configuration does not support wildcards; thus wildcards are resolved using current node configuration at the time of the update.

4. On a node in the cluster, use the `ifconfig` command to ensure that the new IP address exists.
5. Add the new subnet, with the following command, providing the name of the interface and the subnet address. The changes take effect when Oracle Clusterware restarts:

```
$ oifcfg setif -global interface_name/subnet:cluster_interconnect
```

> **See Also:** Appendix D, "Oracle Interface Configuration Tool (OIFCFG) Command Reference" for more information about using the OIFCFG command

6. Verify the configuration with the `oifcfg getif` command.
7. Stop Oracle Clusterware on all nodes by running the following command as `root` on each node:

```
# crsctl stop crs
```

> **Note:** With cluster network configuration changes, the cluster must be fully stopped; do not use rolling stops and restarts.

8. Assign the current network address to the new network adapter using the `ifconfig` command.

   As `root` user, issue the `ifconfig` operating system command to assign the currently used private network address to the network adapter intended to be used for the interconnect. This usually requires some downtime for the current interface and the new interface. See your platform-specific operating system documentation for more information about issuing the `ifconfig` command.
9. Update the network configuration settings on the operating system.

You must update the operating system configuration changes, because changes made using `ifconfig` are not persistent.

> **See Also:** Your operating system documentation for more information about how to make `ifconfig` commands persistent

10. Remove the former subnet, as follows, providing the name and subnet address of the former interface:

```
oifcfg delif -global interface_name/subnet
```

For example:

```
$ oifcfg delif -global eth1/10.10.0.0
```

> **Caution:** This step should be performed only after a replacement interface is committed into the Grid Plug and Play configuration. Simple deletion of cluster interfaces without providing a valid replacement can result in invalid cluster configuration.

11. Restart Oracle Clusterware by issuing the following command as `root` user on all nodes:

```
# crsctl start crs
```

You must restart Oracle Clusterware after running the `oifcfg delif` command, because Oracle Clusterware, Oracle ASM, and Oracle RAC continue to use the former subnet until they are restarted.

3

Cloning Oracle Clusterware to Create a Cluster

This chapter describes how to clone an Oracle grid infrastructure home and use the cloned home to create a cluster. You perform the cloning procedures in this chapter by running scripts in silent mode. The cloning procedures are applicable to Linux and UNIX systems. Although the examples in this chapter use Linux and UNIX commands, the cloning concepts and procedures apply generally to all platforms.

This chapter contains the following topics:

Introduction to Cloning Oracle Clusterware

Cloning is the process of copying an existing Oracle Clusterware installation to a different location and then updating the copied installation to work in the new environment. Changes made by one-off patches applied on the source Oracle grid infrastructure home are also present after cloning. During cloning, you run a script that replays the actions that installed the Oracle grid infrastructure home.

Cloning requires that you start with a successfully installed Oracle grid infrastructure home. You use this home as the basis for implementing a script that extends the Oracle grid infrastructure home to create a cluster based on the original Grid home.

Manually creating the cloning script can be error prone because you prepare the script without interactive checks to validate your input. Despite this, the initial effort is worthwhile for scenarios where you run a single script to configure tens or even hundreds of clusters. If you have only one cluster to install, then you should use the traditional, automated and interactive installation methods, such as Oracle Universal Installer (OUI) or the Provisioning Pack feature of Oracle Enterprise Manager.

Note: Cloning is not a replacement for Oracle Enterprise Manager cloning that is a part of the Provisioning Pack. During Oracle Enterprise Manager cloning, the provisioning process simplifies cloning by interactively asking for details about the Oracle home. The interview questions cover such topics as the location to which you want to deploy the cloned environment, the name of the Oracle database home, a list of the nodes in the cluster, and so on.

The Provisioning Pack feature of Oracle Enterprise Manager Grid Control provides a framework that automates the provisioning of nodes and clusters. For data centers with many clusters, the investment in creating a cloning procedure to provision new clusters and new nodes to existing clusters is worth the effort.

The following list describes some situations in which cloning is useful:

- Cloning prepares an Oracle grid infrastructure home once and deploys it to many hosts simultaneously. You can complete the installation in silent mode, as a noninteractive process. You do not need to use a graphical user interface (GUI) console, and you can perform cloning from a Secure Shell (SSH) terminal session, if required.
- Cloning enables you to create an installation (copy of a production, test, or development installation) with all patches applied to it in a single step. Once you have performed the base installation and applied all patch sets and patches on the source system, cloning performs all of these individual steps as a single procedure. This is in contrast to going through the installation process to perform the separate steps to install, configure, and patch the installation on each node in the cluster.
- Installing Oracle Clusterware by cloning is a quick process. For example, cloning an Oracle grid infrastructure home to a cluster with more than two nodes requires a few minutes to install the Oracle software, plus a few minutes more for each node (approximately the amount of time it takes to run the `root.sh` script).
- Cloning provides a guaranteed method of accurately repeating the same Oracle Clusterware installation on multiple clusters.

A cloned installation acts the same as its source installation. For example, you can remove the cloned Oracle grid infrastructure home using OUI or patch it using OPatch. You can also use the cloned Oracle grid infrastructure home as the source for another cloning operation. You can create a cloned copy of a test, development, or production installation by using the command-line cloning scripts.

The default cloning procedure is adequate for most cases. However, you can also customize some aspects of cloning, for example, to specify custom port assignments or to preserve custom settings.

The cloning process works by copying all of the files from the source Oracle grid infrastructure home to the destination Oracle grid infrastructure home. You can clone either a non-shared or shared Oracle grid infrastructure home. Thus, any files used by the source instance that are located outside the source Oracle grid infrastructure home's directory structure are not copied to the destination location.

The size of the binary files at the source and the destination may differ because these files are relinked as part of the cloning operation, and the operating system patch levels may also differ between these two locations. Additionally, the number of files in the cloned home would increase because several files copied from the source, specifically those being instantiated, are backed up as part of the clone operation.

Preparing the Oracle Grid Infrastructure Home for Cloning

To prepare the source Oracle grid infrastructure home to be cloned, create a copy of an installed Oracle grid infrastructure home and then use it to perform the cloning procedure on other nodes. Use the following step-by-step procedure to prepare the copy of the Oracle grid infrastructure home.

Step 1: Install Oracle Clusterware

Use the detailed instructions in the *Oracle Grid Infrastructure Installation Guide* to perform the following steps on the source node:

1. Install Oracle Clusterware 11*g* release 2 (11.2). This installation puts Oracle Cluster Registry (OCR) and the voting disk on Oracle Automatic Storage Management (Oracle ASM).

   Note: Either install and configure the grid infrastructure for a cluster or install just the Oracle Clusterware software, as described in your platform-specific *Oracle Grid Infrastructure Installation Guide*.

   To install and configure the grid infrastructure for a cluster, stop Oracle Clusterware before performing the cloning procedures. If you install just Oracle Clusterware, then you do not have to stop Oracle Clusterware.

2. Install any patches that are required (for example, 11.2.0.*n*), if necessary.

3. Apply one-off patches, if necessary.

   See Also: *Oracle Grid Infrastructure Installation Guide* for Oracle Clusterware installation instructions

Step 2: Shut Down Running Software

Before copying the source Oracle grid infrastructure home, shut down all of the services, databases, listeners, applications, Oracle Clusterware, and Oracle ASM instances that run on the node. Use the Server Control (SRVCTL) and Oracle Clusterware Control (CRSCTL) utilities to shut down these components.

Step 3: Create a Copy of the Oracle Grid Infrastructure Home

To keep the installed Oracle grid infrastructure home as a working home, make a full copy of the source Oracle grid infrastructure home for cloning. Because the Oracle grid infrastructure home contains files that are relevant only to the source node, you can optionally remove the unnecessary files from the copy.

Note: When creating the copy, a best practice is to include the release number in the name of the file.

Use one of the following methods to create a compressed copy of the Oracle grid infrastructure home.

Method 1: Create a copy of the Oracle grid infrastructure home and remove the unnecessary files from the copy:

1. On the source node, create a copy of the Oracle grid infrastructure home. To keep the installed Oracle grid infrastructure home as a working home, make a full copy of the source Oracle grid infrastructure home and remove the unnecessary files from the copy. For example, as `root` on Linux systems, run the `cp` command:

   ```
   # cp -prf Grid_home location_of_the_copy_of_Grid_home
   ```

2. Delete unnecessary files from the copy.

The Oracle grid infrastructure home contains files that are relevant only to the source node, so you can remove the unnecessary files from the copy in the `log`, `crs/init`, and `cdata` directories. The following example for Linux and UNIX systems shows the commands to run to remove the unnecessary files from the copy of the Oracle grid infrastructure home:

```
[root@node1 root]# cd /opt/oracle/product/11g/crs
[root@node1 crs]# rm -rf /opt/oracle/product/11g/crs/log/host_name
[root@node1 crs]# rm -rf crs/init
[root@node1 crs]# rm -rf cdata
[root@node1 crs]# rm -rf gpnp/*
[root@node1 crs]# rm -rf network/admin/*.ora
[root@node1 crs]# find . -name '*.ouibak' -exec rm {} \;
[root@node1 crs]# find . -name '*.ouibak.1' -exec rm {} \;
[root@node1 crs]# rm -rf root.sh*
[root@node1 crs]# rm -rf Grid_
home/inventory/ContentsXML/oraclehomeproperties.xml
[root@node1 crs]# cd cfgtoollogs
[root@node1 cfgtoollogs]# find . -type f -exec rm -f {} \;
```

3. Create a compressed copy of the previously copied Oracle grid infrastructure home using tar or gzip on Linux and UNIX systems. Ensure that the tool you use preserves the permissions and file timestamps. For example:

   On Linux and UNIX systems:

   ```
   [root@node1 root]# cd /opt/oracle/product/11g/crs/
   [root@node1 crs]# tar -zcvf /path_name/gridHome.tgz .
   ```

   In the example, the `cd` command changes the location to the Oracle grid infrastructure home, and the `tar` command creates the copy named `crs11101.tgz`. In the `tar` command, *`path_name`* represents the location of the file.

   On AIX or HPUX systems:

   ```
   tar cpf - . | compress -fv > temp_dir/gridHome.tar.Z
   ```

Method 2: Create a compressed copy of the Oracle grid infrastructure home using the -X option:

1. Create a file that lists the unnecessary files in the Oracle grid infrastructure home. For example, list the following file names, using the asterisk (*) wildcard, in a file called `excludeFileList`:

   ```
   ./opt/oracle/product/11g/crs/log/host_name
   ./opt/oracle/product/11g/crs/root.sh*
   ./opt/oracle/products/11g/crs/gpnp
   ./opt/oracle/products/11g/crs/network/admin/*.ora
   ```

2. Use the `tar` command or Winzip to create a compressed copy of the Oracle grid infrastructure home. For example, on Linux and UNIX systems, run the following command to archive and compress the source Oracle grid infrastructure home:

   ```
   tar cpfX - excludeFileList . | compress -fv > temp_dir/gridHome.tar.Z
   ```

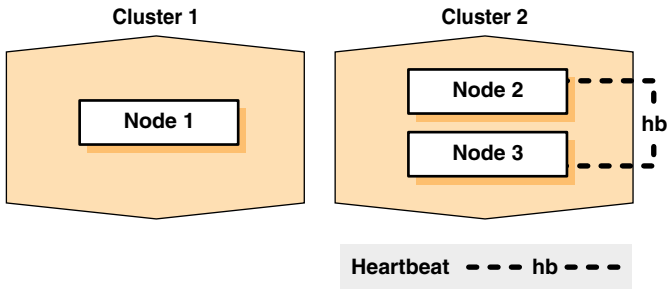
Note: Do not use the jar utility to copy and compress the Oracle grid infrastructure home.

Creating a Cluster by Cloning Oracle Clusterware

This section explains how to create a cluster by cloning a successfully installed Oracle Clusterware environment and copying it to the nodes on the destination cluster. OCR and voting disks are not shared between the two clusters after you successfully create a cluster from a clone.

For example, you can use cloning to quickly duplicate a successfully installed Oracle Clusterware environment to create a cluster. Figure 3–1 shows the result of a cloning procedure in which the Oracle grid infrastructure home on Node 1 has been cloned to Node 2 and Node 3 on Cluster 2, making Cluster 2 a new two-node cluster.

Figure 3–1 Cloning to Create a Oracle Clusterware Environment



The steps to create a cluster through cloning are as follows:

- Prepare the new cluster nodes
- Deploy Oracle Clusterware on the destination nodes
- Run the `clone.pl` script on each destination node
- Prepare `crsconfig_params` file on all nodes
- Run the `orainstRoot.sh` script on each node
- Run the `Grid_home/root.sh` script
- Run the configuration assistants and CVU

Step 1: Prepare the New Cluster Nodes

On each destination node, perform the following preinstallation steps:

- Specify the kernel parameters
- Configure block devices for Oracle Clusterware devices
- Ensure that you have set the block device permissions correctly
- Use short, nondomain-qualified names for all of the names in the Hosts file
- Test whether the interconnect interfaces are reachable using the `ping` command
- Verify that the VIP addresses are not active at the start of the cloning process by using the `ping` command (the `ping` command of the VIP address must fail)
- Delete all files in the *`Grid_home`*`/gpnp` folder

> **Note:** If the *`Grid_home`*`/gpnp` folder contains any files, then cluster creation fails. All resources are added to the existing cluster, instead.

- Run CVU to verify your hardware and operating system environment

Refer to your platform-specific Oracle Clusterware installation guide for the complete preinstallation checklist.

Note: Unlike traditional methods of installation, the cloning process does not validate your input during the preparation phase. (By comparison, during the traditional method of installation using OUI, various checks occur during the interview phase.) Thus, if you make errors during the hardware setup or in the preparation phase, then the cloned installation fails.

Step 2: Deploy Oracle Clusterware on the Destination Nodes

Before you begin the cloning procedure that is described in this section, ensure that you have completed the prerequisite tasks to create a copy of the Oracle grid infrastructure home, as described in the section titled "Preparing the Oracle Grid Infrastructure Home for Cloning" on page 3-2.

1. On each destination node, deploy the copy of the Oracle grid infrastructure home that you created in "Step 3: Create a Copy of the Oracle Grid Infrastructure Home" on page 3-3, as follows:

   If you do not have a shared Oracle grid infrastructure home, then restore the copy of the Oracle grid infrastructure home on each node in the destination cluster. Use the equivalent directory structure as the directory structure that was used in the Oracle grid infrastructure home on the source node. Skip this step if you have a shared Oracle grid infrastructure home.

   For example, on Linux or UNIX systems, run commands similar to the following:

   ```
   [root@node1 root]# mkdir -p /u01/app/11.2.0/grid
   [root@node1 root]# cd /u01/app/11.2.0/grid
   [root@node1 crs]# tar -zxvf /path_name/gridHome.tgz
   ```

   In this example, *path_name* represents the directory structure in which you want to install the Oracle grid infrastructure home. Note that you can change the Grid Home location as part of the clone process

2. Change the ownership of all of the files to belong to the `oracle:oinstall` group, and create a directory for the Oracle Inventory. The following example shows the commands to do this on a Linux system:

   ```
   [root@node1 crs]# chown -R oracle:oinstall /u01/app/11.2.0/grid
   [root@node1 crs]# mkdir -p /u01/app/oraInventory
   [root@node1 crs]# chown oracle:oinstall /u01/app/oracle/oraInventory
   ```

3. It is important to remove any Oracle network files from the `/u01/app/11.2.0/grid/network/admin` directory on both nodes before continuing. For example, remove any `tnsnames.ora`, `listener.ora` or `sqlnet.ora` files.

   See Also: "Locating and Viewing Log Files Generated During Cloning" on page 3-12

Step 3: Run the clone.pl Script on Each Destination Node

Note: Step 3 must be run to completion before you start Step 4. Similarly, Step 4 must be run to completion before you start Step 5.

You can perform Step 3, Step 4, and Step 5 simultaneously on different nodes. Step 5 *must* be complete on *all* nodes before you can run Step 6.

To set up the new Oracle Clusterware environment, the `clone.pl` script requires you to provide several setup values for the script. You can provide the variable values by either supplying input on the command line when you run the `clone.pl` script, or by creating a file in which you can assign values to the cloning variables. The following discussions describe these options.

Supplying input to the clone.pl script on the command line

If you do not have a shared Oracle grid infrastructure home, navigate to the `$ORACLE_HOME/clone/bin` directory on each destination node and run the `clone.pl` script, which performs the main Oracle Clusterware cloning tasks. To run the script, you must supply input to several parameters. Table 3–1 describes the `clone.pl` script parameters.

Table 3–1 Parameters for the clone.pl Script

Parameters	Description
`ORACLE_BASE=ORACLE_BASE`	The complete path to the Oracle base to be cloned. If you specify an invalid path, then the script exits. This parameter is required.
`ORACLE_HOME=GRID_HOME`	The complete path to the grid infrastructure home for cloning. If you specify an invalid path, then the script exits. This parameter is required.
`ORACLE_HOME_NAME=Oracle_home_name (or) -defaultHomeName`	The Oracle home name of the home to be cloned. Optionally, you can specify the `-defaultHomeName` flag. This parameter is not required.
`INVENTORY_LOCATION=location_of_inventory`	The location for the Oracle Inventory.
`-O'"CLUSTER_NODES={node1, node2}"'`	The short node names for the nodes that are to be part of this new cluster.
`-O'"LOCAL_NODE=node1"'`	The short node name for the node `clone.pl` is running on
`-debug`	Specify this option to run the `clone.pl` script in debug mode.
`-help`	Specify this option to obtain help for the `clone.pl` script.

For example, on Linux and UNIX systems:

```
$ perl clone.pl -silent ORACLE_BASE=/u01/app/oracle ORACLE_HOME=
/u01/app/1.2.0/grid ORACLE_HOME_NAME=OraHome1Grid \
INVENTORY_LOCATION=/u01/app/oraInventory -O'"CLUSTER_NODES={node1, node2}"'
-O'"LOCAL_NODE=node1"'
```

Refer to Table 3–2 and Table 3–3 for descriptions of the various variables in the preceding examples.

If you have a shared Oracle grid infrastructure home, then append the `-cfs` option to the command example in this step and provide a complete path location for the cluster file system.

Supplying Input to the clone.pl Script in a File

Because the `clone.pl` script is sensitive to the parameter values that it receives, you must be accurate in your use of brackets, single quotation marks, and double quotation marks. To avoid errors, create a file that is similar to the `start.sh` script shown in Example 3–1 in which you can specify environment variables and cloning parameters for the `clone.pl` script.

Example 3–1 shows an excerpt from an example script called `start.sh` that calls the `clone.pl` script; the example is configured for a cluster named `crscluster`. Run the script as the operating system user that installed Oracle Clusterware.

Example 3–1 Excerpt From the start.sh Script to Clone Oracle Clusterware

```
#!/bin/sh
ORACLE_BASE=/u01/app/oracle
GRID_HOME=/u01/app/11.2.0/grid
THIS_NODE=`hostname -s`

E01=ORACLE_BASE=${ORACLE_BASE}
E02=ORACLE_HOME=${ORACLE_HOME}
E03=ORACLE_HOME_NAME=OraGridHome1
E04=INVENTORY_LOCATION=${ORACLE_BASE}/oraInventory

#C00="-O'-debug'"
C01="'-O\"CLUSTER_NODES={node1,node2}\"'"
C02="'-O\"LOCAL_NODE=${THIS_NODE}\"'"

perl ${GRID_HOME}/clone/bin/clone.pl -silent $E01 $E02 $E03 $E04 $C01 $C02
```

The `start.sh` script sets several environment variables and cloning parameters, as described in Table 3–2 and Table 3–3, respectively. Table 3–2 describes the environment variables E01, E02, E03, and E04 that are shown in bold typeface in Example 3–1.

Table 3–2 Environment Variables Passed to the clone.pl Script

Symbol	Variable	Description
E01	`ORACLE_BASE`	The location of the Oracle base directory.
E02	`ORACLE_HOME`	The location of the Oracle grid infrastructure home. This directory location must exist and must be owned by the Oracle operating system group: oinstall.
E03	`ORACLE_HOME_NAME`	The name of the Oracle grid infrastructure home. This is stored in the Oracle Inventory.
E04	`INVENTORY_LOCATION`	The location of the Oracle Inventory. This directory location must exist and must initially be owned by the Oracle operating system group: oinstall.
C01	`CLUSTER_NODES`	This list of short node names for the nodes in the cluster.
C02	`LOCAL_NODE`	The short name of the local node.

Step 4: Prepare the crsconfig_params File on All Nodes

Prepare the `/u01/app/11.2.0/grid/install/crsconfig_params` file on all of the nodes in the cluster. You can copy the file from one node to all of the other nodes.

Table 3–3 Key Parameters for the CRSCONFIG_PARAMS File

Parameter Name and Value	Description
SILENT=true	OUI sets the value to true or false based on the mode of installation. true for silent install (runInstaller -silent) and false otherwise.
ORACLE_OWNER=oracle	OUI sets the value to login name of the installing user.
ORA_DBA_GROUP=oinstall	OUI sets the value to active primary group of the installing user.
ORA_ASM_GROUP=oinstall	OUI sets the value to the OSASM group selected by you during the interview. For example, asmadmin.
LANGUAGE_ID='AMERICAN_ AMERICA.WE8ISO8859P1'	OUI sets the value to the LANGUAGE_ TERRITORY.CHARACTERSET corresponding to the locale in which OUI is run.
ORACLE_HOME=/u01/app/11.2.0/grid	OUI sets the value to the Oracle home ('Software Location') entered during the grid installation interview.
ORACLE_BASE=/u01/app/oracle	OUI sets the value to the ORACLE_BASE ('Oracle Base') entered during interview of the grid installation. For example. /u01/app/oracle.
JREDIR=/u01/app/11.2.0/grid/jdk/jre /	Set to $ORACLE_HOME/jdk/jre.
JLIBDIR=/u01/app/11.2.0/grid/jlib	Set to $ORACLE_HOME/jlib.
NETCFGJAR_NAME=netcfg.jar	Explicitly set.
EWTJAR_NAME=ewt3.jar	Explicitly set.
JEWTJAR_NAME=jewt4.jar	Explicitly set.
SHAREJAR_NAME=share.jar	Explicitly set.
HELPJAR_NAME=help4.jar	Explicitly set.
EMBASEJAR_NAME=oemlt.jar	Explicitly set.
VNDR_CLUSTER=false	Explicitly set.
OCR_LOCATIONS=NO_VAL	OUI sets the value for the OCR and mirror locations to a comma-delimited list of OCR and mirror location path names. If OCR and the voting disk are on Oracle ASM, then set it to NO_ VAL.
CLUSTER_NAME=rac-cluster	OUI sets the value to cluster name specified by you during interview.
HOST_NAME_LIST=node1,node2	OUI sets the value to list of nodes specified by you.
NODE_NAME_LIST=node1,node2	OUI sets the value to list of nodes specified by you.
PRIVATE_NAME_LIST=	
VOTING_DISKS=NO_VAL	OUI sets the value for the voting disk and mirror locations to a comma-delimited list of voting disk location path names specified. If OCR and voting disk are on Oracle ASM, then set it to NO_VAL.
#VF_DISCOVERY_STRING=%s_ vfdiscoverystring%	
ASM_UPGRADE=false	OUI sets the value to true if Oracle ASM is being upgraded in this session, otherwise false.
ASM_SPFILE=	Leave blank.

Table 3–3 (Cont.) Key Parameters for the CRSCONFIG_PARAMS File

Parameter Name and Value	Description
`ASM_DISK_GROUP=DATA`	OUI sets the value to the name specified by you during the interview for the disk group to store OCR and the voting disk. For example, `DATA`
`ASM_DISCOVERY_STRING=/dev/sd?1`	OUI sets the value to the disk discovery string specified by you during the interview for the disk group to store OCR and the voting disk. If disks are on default raw device locations, such as `/dev/raw/*` on Linux, then this is left empty.
`ASM_ DISKS=/dev/sdb1,/dev/sdc1,/dev/sdd1 ,/dev/sde1,/dev/sdf1`	OUI sets the value to the disks selected by you during the interview for the disk group to store OCR and the voting disks. The disks that you specify should match the discovery pattern specified.
`ASM_REDUNDANCY=NORMAL`	OUI sets the value to the redundancy level specified by you during the interview for the disk group to store OCR and the voting disk.
`CRS_STORAGE_OPTION=1`	OUI sets the value to 1 for OCR and the voting disk on Oracle ASM and 2 for OCR and voting disk on a file system.
`CSS_LEASEDURATION=400`	Explicitly set.
`CRS_ NODEVIPS=node1-vip/255.255.255.0/et h0,node2-vip/255.255.255.0/eth0`	OUI sets the value to be the list of the VIPs that you specified. If you are using DHCP, then set this to `AUTO`. The format of the list of VIPs is `{`*`name | ip`*`}/netmask[/if1[|if2|...]]`. **See Also:** *Oracle Real Application Clusters Administration and Deployment Guide* for more information about this format
`NODELIST=node1,node2`	OUI sets the value to be the list of nodes that you specify.
`NETWORKS="eth0"/10.10.10.0:public," eth1"/192.168.1.0:cluster_ interconnect`	OUI sets the value to list of interface selections by the user format of each part: `"interface name"/Subnet/`*`Type`*, where *`Type`* is one of `public` or `cluster_interconnect`.
`SCAN_NAME=rac-cluster-scan`	OUI sets the value to the SCAN Name specified by you.
`SCAN_PORT=1521`	OUI sets the value to port number for SCAN listener specified by you.
`GPNP_PA=`	
`OCFS_CONFIG=`	OUI sets it to the list of partitions selected by you to be formatted to OCFS format, on Windows. Can be left empty for UNIX.
`GNS_CONF=false`	OUI sets the value to true if you have selected to enable GNS for this installation.
`GNS_ADDR_LIST=`	OUI sets the value to GNS virtual IP address specified by you.
`GNS_DOMAIN_LIST=`	OUI sets the value to GNS domain specified by you.
`GNS_ALLOW_NET_LIST=`	
`GNS_DENY_NET_LIST=`	
`GNS_DENY_ITF_LIST=`	
`NEW_HOST_NAME_LIST=`	
`NEW_NODE_NAME_LIST=`	
`NEW_PRIVATE_NAME_LIST=`	
`NEW_ NODEVIPS=node1-vip/255.255.255.0/et h0,node2-vip/255.255.255.0/eth0`	Same as `CRS_NODEVIPS`, however this one is only used when adding a new node.
`GPNPCONFIGDIR=$ORACLE_HOME`	

Table 3–3 (Cont.) Key Parameters for the CRSCONFIG_PARAMS File

Parameter Name and Value	Description
GPNPGCONFIGDIR=$ORACLE_HOME	
OCRLOC=	
OLRLOC=	
OCRID=	
CLUSTER_GUID=	
CLSCFG_MISSCOUNT=	

To use GNS, Oracle recommends that you add GNS to the cluster after your cloned cluster is running. Add GNS using the `crsctl add gns` command.

Step 5: Run the orainstRoot.sh Script on Each Node

In the Central Inventory directory on each destination node, run the `orainstRoot.sh` script as the operating system user that installed Oracle Clusterware. This script populates the `/etc/oraInst.loc` directory with the location of the central inventory. You can run the script on each node simultaneously. For example:

```
[root@node1 root]# /opt/oracle/oraInventory/orainstRoot.sh
```

Ensure that the `orainstRoot.sh` script has completed on each destination node before proceeding to the next step.

Step 6: Run the GRID_HOME/root.sh and rootcrs.pl Scripts

On each destination node, run the `GRID_HOME/root.sh` script, followed by the `rootcrs.pl` script. You must run these scripts on only one node at a time. The following example is for a Linux or UNIX system. On the first node, run the following command:

```
[root@node1 root]# /u01/app/11.2.0/grid/root.sh
```

Then run the following command:

```
[root@node1 root]# /u01/app/11.2.0/grid/perl/bin/perl \
-I/u01/app/11.2.0/grid/perl/lib -I/u01/app/11.2.0/grid/crs/install \
/u01/app/11.2.0/grid/crs/install/rootcrs.pl
```

Ensure that the `root.sh` and `rootcrs.pl` scripts have completed on the first node before running them on the second node and subsequent nodes. On each subsequent node, run the following command:

```
[root@node2 root]# /u01/app/11.2.0/grid/root.sh
```

Then run the following command:

```
[root@node1 root]# /u01/app/11.2.0/grid/perl/bin/perl \
-I/u01/app/11.2.0/grid/perl/lib -I/u01/app/11.2.0/grid/crs/install \
/u01/app/11.2.0/grid/crs/install/rootcrs.pl
```

The `root.sh` script automatically configures the following node applications:

- Global Services Daemon (GSD)
- Oracle Notification Service (ONS)

- Enhanced ONS (eONS)
- Virtual IP (VIP) resources in the Oracle Cluster Registry (OCR)
- Single Client Access Name (SCAN) VIPs and SCAN listeners
- Oracle ASM

Step 7: Run the Configuration Assistants and the Oracle Cluster Verification Utility

1. At the end of the Oracle Clusterware installation, on each new node, manually run the configuration assistants and CVU. The following commands should be run from the first node only.

```
[oracle] $ /u01/app/11.2.0/grid/bin/netca \
                /orahome /u01/app/11.2.0/grid \
                /orahnam OraGridHome1 \
                /instype typical \
                /inscomp client,oraclenet,javavm,server\
                /insprtcl tcp \
                /cfg local \
                /authadp NO_VALUE \
                /responseFile /u01/app/11.2.0/grid/network/install/netca_
typ.rsp \
                 /silent
```

2. If you use a supported cluster file system, then you do not need to execute this command. If you are using Oracle ASM, then run the following command:

```
[oracle] $ /u01/app/11.2.0/grid/bin/asmca -silent -postConfigureASM
-sysAsmPassword oracle -asmsnmpPassword oracle
```

3. If you a plan to run a pre-11*g* release 2 (11.2) database on this cluster, then you should run `oifcfg` as described in the Oracle Database 11*g* release 2 (11.2) documentation.
4. To use IPMI, use the `crsctl` command to configure IPMI on each node.

   See Also: "`crsctl set css ipmiaddr`" on page E-44

5. Run a final CVU check to confirm that your grid infrastructure home has been cloned correctly.

```
[oracle] $ /u01/app/11.2.0/grid/bin/cluvfy  stage -post  crsinst -n
node1,node2
```

Locating and Viewing Log Files Generated During Cloning

The cloning script runs multiple tools, each of which can generate log files. After the `clone.pl` script finishes running, you can view log files to obtain more information about the status of your cloning procedures. Table 3–4 shows the log files that are generated during cloning that are the key log files for diagnostic purposes:

Table 3–4 Cloning Log Files and their Descriptions

Log File Name and Location	Description
`Central_Inventory/logs/cloneActions` timestamp.log	Contains a detailed log of the actions that occur during the OUI part of the cloning.
`Central_Inventory/logs/oraInstall` timestamp.err	Contains information about errors that occur when OUI is running.
`Central_Inventory/logs/oraInstall` timestamp.out	Contains other miscellaneous information.

Table 3–5 describes how to find the location of the Oracle inventory directory.

Table 3–5 Finding the Location of the Oracle Inventory Directory

Type of System	Location of the Oracle Inventory Directory
All UNIX computers except Linux and IBM AIX	`/var/opt/oracle/oraInst.loc`
IBM AIX and Linux	`/etc/oraInst.loc` file

4

Adding and Deleting Cluster Nodes

This chapter describes how to add nodes to an existing cluster, and how to delete nodes from clusters. This chapter provides procedures for these tasks for Linux and UNIX systems.

> **Note:** Oracle recommends that you use the cloning procedure described in Chapter 3, "Cloning Oracle Clusterware to Create a Cluster" to create clusters.

The topics in this chapter include the following:

- Prerequisite Steps for Adding Cluster Nodes
- Adding and Deleting Cluster Nodes on Linux and UNIX Systems

Prerequisite Steps for Adding Cluster Nodes

Complete the following steps to prepare nodes to add to the cluster:

1. Make physical connections.

   Connect the nodes' hardware to the network infrastructure of your cluster. This includes establishing electrical connections, configuring network interconnects, configuring shared disk subsystem connections, and so on. See your hardware vendor documentation for details about this step.

2. Install the operating system.

   Install a cloned image of the operating system that matches the operating system on the other nodes in your cluster. This includes installing required service patches, updates, and drivers. See your operating system vendor documentation for details about this process.

   > **Note:** Oracle recommends that you use a cloned image. However, if the installation fulfills the installation requirements, then you can use this procedure on your environment.

3. Create Oracle users.

   As `root`, create the Oracle users and groups using the same user ID and group ID as on the existing nodes.

4. Ensure that SSH is configured on the node.

Note: SSH configuration is done when you install Oracle Clusterware 11*g* release 2 (11.2). If, however, SSH is not configured, see *Oracle Grid Infrastructure Installation Guide* for information about configuring SSH.

5. Verify the hardware and operating system installations with the Cluster Verification Utility (CVU).

   After you configure the hardware and operating systems on the nodes you want to add, you can run the following commands to verify that the nodes you want to add are reachable by other nodes in the cluster. You can also use this command to verify user equivalence to all given nodes the local node, node connectivity among all of the given nodes, accessibility to shared storage from all of the given nodes, and so on.

   a. From the *Grid_home*/bin directory on an existing node, run the CVU command to verify your installation at the post-hardware installation stage as shown in the following example, where *node_list* is a comma-delimited list of nodes you want to add to your cluster:

      ```
      $ cluvfy stage -post hwos -n node_list | all [-verbose]
      ```

      See Also: Appendix A, "Cluster Verification Utility Reference" for more information about CVU command usage

   b. From the *Grid_home*/bin directory on an existing node, run the CVU command to obtain a detailed comparison of the properties of the reference node with all of the other nodes that are part of your current cluster environment. Replace *ref_node* with the name of a node in your existing cluster against which you want CVU to compare the nodes to be added. Specify a comma-delimited list of nodes after the -n option. In the following example, *orainventory_group* is the name of the Oracle inventory group, and *osdba_group* is the name of the OSDBA group:

      ```
      $ cluvfy comp peer [-refnode ref_node] -n node_list
      [-orainv orainventory_group] [-osdba osdba_group] [-verbose]
      ```

      Note: For the reference node, select a cluster node against which you want CVU to compare, for example, the nodes that you want to add that you specify with the -n option.

After completing the procedures in this section, you are ready to add the nodes to the cluster.

Note: Avoid changing host names after you complete the Oracle Clusterware installation, including adding or deleting domain qualifications. Nodes with changed host names must be deleted from the cluster and added back with the new name.

Adding and Deleting Cluster Nodes on Linux and UNIX Systems

This section explains cluster node addition and deletion on Linux and UNIX systems. The procedures in this section assume that you have performed the steps in the "Prerequisite Steps for Adding Cluster Nodes" section.

The last step of the node addition process includes extending the Oracle Clusterware home from an Oracle Clusterware home on an existing node to the nodes that you want to add.

This section includes the following topics:

- Adding a Cluster Node on Linux and UNIX Systems
- Deleting a Cluster Node on Linux and UNIX Systems

Adding a Cluster Node on Linux and UNIX Systems

This procedure describes how to add a node to your cluster. This procedure assumes that:

- There is an existing cluster with a node named `node1`
- You are adding a node named `node2`
- You have successfully installed Oracle Clusterware on `node1` in a nonshared home, where *`Grid_home`* represents the successfully installed home

To add a node:

1. Ensure that you have successfully installed Oracle Clusterware on at least one node in your cluster environment. To perform the following procedure, *`Grid_home`* must identify your successfully installed Oracle Clusterware home.

   See Also: *Oracle Grid Infrastructure Installation Guide* for Oracle Clusterware installation instructions

2. Verify the integrity of the cluster and `node2`:

   ```
   $ cluvfy stage -pre nodeadd -n node2 [-fixup [-fixupdir fixup_dir]] [-verbose]
   ```

   You can specify the `-fixup` option and a directory into which CVU prints instructions to fix the cluster or node if the verification fails.

3. Navigate to the *`Grid_home`*`/oui/bin` directory on `node1` and run the `addNode.sh` script using the following syntax, where `node2` is the name of the node that you are adding and `node2-vip` is the VIP name for the node:

   If you are using Grid Naming Service (GNS):

   ```
   $ ./addNode.sh -silent "CLUSTER_NEW_NODES={node2,node3}"
   ```

   If you are not using GNS:

   ```
   $ ./addNode.sh -silent "CLUSTER_NEW_NODES={node2,node3}"
   "CLUSTER_NEW_VIRTUAL_HOSTNAMES={node2-vip,node3-vip}"
   ```

   Alternatively, you can specify the entries shown in Example 4–1 in a response file, where *`file_name`* is the name of the file, and run the `addNode.sh` script, as follows:

   ```
   $ addNode.sh -silent -responseFile file_name
   ```

   When prompted, run `root.sh` before the `addNode.sh` script completes.

Example 4–1 Response File Entries for Adding Oracle Clusterware Home

```
RESPONSEFILE_VERSION=2.2.1.0.0

CLUSTER_NEW_NODES = {"newnode1","newnode2"}
```

```
CLUSTER_NEW_VIRTUAL_HOSTNAMES = {"newnode1-vip","newnode2-vip"}
```

See Also: *Oracle Universal Installer and OPatch User's Guide* for details about how to configure command-line response files

Notes:

- If you are not using Oracle Grid Naming Service (GNS), then you must add the name and address of `node2` to DNS.
- Command-line values always override response file values.

4. Check that your cluster is integrated and that the cluster is not divided into separate parts by running the following CVU command. This command verifies that any number of specific nodes has been successfully added to the cluster at the network, shared storage, and clusterware levels:

```
$ cluvfy stage -post nodeadd -n node2 [-verbose]
```

See Also: "cluvfy stage [-pre | -post] nodeadd" on page A-45 for more information about this CVU command

you can optionally extend Oracle Database with Oracle Real Application Clusters (Oracle RAC) components to the new nodes, making them members of an existing Oracle RAC database.

See Also: *Oracle Real Application Clusters Administration and Deployment Guide* for more information about extending Oracle Database with Oracle RAC to new nodes

Deleting a Cluster Node on Linux and UNIX Systems

This section describes the procedure for deleting a node from a cluster.

Notes:

- If you run a dynamic Grid Plug and Play cluster using DHCP and GNS, then you need only perform steps 3 (remove VIP resource) and 7 (update inventory on remaining nodes).
- Voting disks are automatically backed up in OCR after any changes you make to the cluster.

To delete a node from a cluster:

1. Ensure that *`Grid_home`* correctly specifies the full directory path for the Oracle Clusterware home on each node, where *`Grid_home`* is the location of the installed Oracle Clusterware software.
2. If Cluster Synchronization Services (CSS) is not running on the node you are deleting, then the `crsctl unpin css` command in this step fails. Before you run the `crsctl unpin css` command, run the following command as either `root` or the user that installed Oracle Clusterware:

```
$ olsnodes -s -t
```

This command shows whether the node is active and whether it is pinned. If the node is unpinned, then you do not need to run the `crsctl unpin css` command.

From any node that you *are not deleting*, run the following command from the *Grid_home*`/bin` directory as `root` to expire the CSS lease on the node you are deleting:

```
# crsctl unpin css -n node_to_be_deleted
```

Note:

- You *cannot* unpin a node that has an instance of Oracle RAC that is older than 11*g* release 2 (11.2) if you installed Oracle Clusterware 11*g* release 2 (11.2) on that node.
- If the node you are deleting is not accessible, then you can skip steps 3, 5, and 6.

3. Disable the Oracle Clusterware applications and daemons running on the node. Run the `rootcrs.pl` script as `root` from the *Grid_home*`/crs/install` directory on the node to be deleted, as follows:

Note: Before you run this command, you must stop the `EMAGENT`.

```
# ./rootcrs.pl -delete -force
```

If you are deleting multiple nodes, then run this script on each node that you are deleting.

Notes:

- If you do not use the `-force` option in the preceding command or the node you are deleting is not accessible for you to execute the preceding command, then the VIP resource remains running on the node. You must manually stop and remove the VIP resource using the following commands as `root` from any node that you are not deleting:

  ```
  # srvctl stop vip -i vip_name -f
  # srvctl remove vip -i vip_name -f
  ```

  Where *vip_name* is the VIP for the node to be deleted. If you specify multiple VIP names, then separate the names with commas and surround the list in double quotation marks ("").
- If the node you are deleting is not accessible, then you can skip steps 5 and 6.

4. From any node that you *are not deleting*, run the following command from the *Grid_home*`/bin` directory as `root` to delete the node from the cluster:

```
# crsctl delete node -n node_to_be_deleted
```

5. On the node you want to delete, run the following command as the user that installed Oracle Clusterware from the *Grid_home*/oui/bin directory where *node_to_be_deleted* is the name of the node that you are deleting:

```
$ ./runInstaller -updateNodeList ORACLE_HOME=Grid_home "CLUSTER_NODES=
{node_to_be_deleted}" CRS=TRUE -local
```

6. On the node that you are deleting, run the runInstaller command as the user that installed Oracle Clusterware. Depending on whether you have a shared or nonshared Oracle home, complete one of the following procedures:

   - If you have a shared home, then run the following command from the *Grid_home*/oui/bin directory on the node you want to delete:

     ```
     $ ./runInstaller -detachHome  ORACLE_HOME=Grid_home
     ```

   - For a nonshared home, deinstall the Oracle Clusterware home from the node that you want to delete, as follows, by running the following command from the *Grid_home*/deinstall directory, where *Grid_home* is the path defined for the Oracle Clusterware home:

     ```
     $ ./deinstall -local
     ```

     Caution: If you do not specify the -local flag, then the command removes the grid infrastructure homes from every node in the cluster.

7. On any node other than the node you are deleting, run the following command from the *Grid_home*/oui/bin directory where *remaining_nodes_list* is a comma-delimited list of the nodes that are going to remain part of your cluster:

```
$ ./runInstaller -updateNodeList ORACLE_HOME=Grid_home
"CLUSTER_NODES={remaining_nodes_list}" CRS=TRUE
```

8. Run the following CVU command to verify that the specified nodes have been successfully deleted from the cluster:

```
$ cluvfy stage -post nodedel -n node_list [-verbose]
```

See Also: "cluvfy stage -post nodedel" on page A-46 for more information about this CVU command

5

Making Applications Highly Available Using Oracle Clusterware

When an application, process, or server fails in a cluster, you want the disruption to be as short as possible, if not completely unknown to users. For example, when an application fails on a server, that application can be restarted on another server in the cluster, minimizing or negating any disruption in the use of that application. Similarly, if a server in a cluster fails, then all of the applications and processes running on that server must be able to fail over to another server to continue providing service to the users. Using customizable **action script**s and application agent programs, as well as resource attributes that you assign to applications and processes, Oracle Clusterware can manage all these entities to ensure high availability.

This chapter explains how to use Oracle Clusterware to start, stop, monitor, restart, and relocate applications. Oracle Clusterware is the underlying cluster solution for Oracle Real Application Clusters (Oracle RAC). The same functionality and principles you use to manage Oracle RAC databases are applied to the management of applications.

This chapter includes the following topics:

The Oracle Clusterware Agent Framework

This section discusses the framework that Oracle Clusterware uses to monitor and manage **resource**s, in order to ensure high application availability.

This section includes the following topics:

Agents

Oracle Clusterware manages applications when they are registered as a resources with Oracle Clusterware, and Oracle Clusterware has access to application-specific primitives that have the ability to start, stop, and monitor a specific resource. Oracle Clusterware runs all resource-specific commands through an entity called an *agent*.

An agent is a process that contains the agent framework and user code to manage resources. The *agent framework* is a library that enables you to plug in your application-specific code to manage customized applications. You program all of the actual application management functions, such as starting, stopping and checking the health of an application, into the agent. These functions are referred to as *entry points*.

The agent framework is responsible for invoking these entry point functions on behalf of Oracle Clusterware. Agent developers can use these entry points to plug in the required functionality for a specific resource, with respect to how to start, stop, and monitor a resource. Agents are capable of managing multiple resources.

Agent developers can set the following entry points as callbacks to their code:

- **START**: The START entry point acts to bring a resource online. The agent framework calls this entry point whenever it receives the start command from Oracle Clusterware.
- **STOP**: The STOP entry points acts to gracefully bring down a resource. The agent framework calls this entry point whenever it receives the stop command from Oracle Clusterware.
- **CHECK**: The CHECK (monitor) entry point acts to monitor the health of a resource. The agent framework periodically calls this entry point. If it notices any state change during this action, then the agent framework notifies Oracle Clusterware about the change in the state of the specific resource.
- **CLEAN**: The CLEAN entry point acts whenever there is a need to clean up a resource. It is a non-graceful operation that is invoked when users must forcefully terminate a resource. This command cleans up the resource-specific environment so that the resource can be restarted.
- **ABORT**: If any of the other entry points hang, the agent framework calls the ABORT entry point to abort the ongoing action. If the agent developer does not supply an abort function, then the agent framework exits the agent program.

START, STOP, CHECK, and CLEAN are mandatory entry points and the agent developer must provide these entry points when building an agent. Agent developers have several options to implement these entry points, including using C, C++, or scripts. It is also possible to develop agents that use both C or C++ and script-type entry points. When initializing the agent framework, if any of the mandatory entry points are not provided, then the agent framework invokes a script pointed to by the `ACTION_SCRIPT` resource attribute.

> **See Also:** "ACTION_SCRIPT" on page B-4 for information about this resource attribute

At any given time, the agent framework invokes only one entry point per application. If that entry point hangs, then the agent framework calls the ABORT entry point to abort the current operation. The agent framework periodically invokes the CHECK entry point to determine the state of the resource. This entry point must return one of the following states as the resource state:

- **CLSAGFW_ONLINE**: The CHECK entry point returns ONLINE if the resource was brought up successfully and is currently in a functioning state. The agent framework continues to monitor the resource when it is in this state.
- **CLSAGFW_UNPLANNED_OFFLINE/CLSAGFW_PLANNED_OFFLINE**: The OFFLINE state indicates that the resource is not currently running. Two distinct categories exist to describe an resource's offline state: *planned* and *unplanned*.

  When the state of the resource transitions to OFFLINE through Oracle Clusterware, then it is assumed that the *intent* for this resource is to be offline (`TARGET=OFFLINE`), regardless of which value is returned from the CHECK entry point. However, when an agent detects that the state of a resource has changed independent of Oracle Clusterware (such as somebody stopping the resource through a non-Oracle interface), then the intent must be carried over from the agent to the Cluster Ready Services daemon (`crsd`). The intent then becomes the determining factor for the following:

  – Whether to keep or to change the value of the resource's `TARGET` resource attribute. PLANNED_OFFLINE indicates that the `TARGET` resource attribute must be changed to OFFLINE *only if* the resource was running before. If the resource was not running (`STATE=OFFLINE`, `TARGET=OFFLINE`) and a request comes in to start it, then the value of the `TARGET` resource attribute changes to `ONLINE`. The start request then goes to the agent and the agent reports back to Oracle Clusterware a PLANNED_OFFLINE resource state, and the value of the `TARGET` resource attribute remains `ONLINE`. UNPLANNED_OFFLINE does not change the `TARGET` attribute.

  – Whether to leave the resource's state as UNPLANNED_OFFLINE or attempt to recover the resource by restarting it locally or failing it over to a another server in the cluster. The PLANNED_OFFLINE state makes `crsd` leave the resource as is, whereas the UNPLANNED_OFFLINE state prompts resource recovery.
- **CLSAGFW_UNKNOWN**: The CHECK entry point returns UNKNOWN if the current state of the resource cannot be determined. In response to this state, Oracle Clusterware does not attempt to failover or to restart the resource. The agent framework continues to monitor the resource if the previous state of the resource was either ONLINE or PARTIAL.
- **CLSAGFW_PARTIAL**: The CHECK entry point returns PARTIAL when it knows that a resource is partially ONLINE and some of its services are available. Oracle Clusterware considers this state as partially ONLINE and does not attempt to failover or to restart the resource. The agent framework continues to monitor the resource in this state.
- **CLSAGFW_FAILED**: The CHECK entry point returns FAILED whenever it detects that a resource is not in a functioning state and some of its components have failed and some clean up is required to restart the resource. In response to this state, Oracle Clusterware calls the CLEAN action to clean up the resource. After the CLEAN action finishes, the state of the resource is expected to be OFFLINE. Next, depending on the policy of the resource, Oracle Clusterware may attempt to failover or restart the resource. Under no circumstances does the agent framework monitor failed resources.

The agent framework implicitly monitors resources in the states listed in Table 5–1 at regular intervals, as specified by the `CHECK_INTERVAL` or `OFFLINE_CHECK_INTERVAL` resource attributes.

See Also: "CHECK_INTERVAL" on page B-5 and "OFFLINE_CHECK_INTERVAL" on page B-7 for more information about these resource attributes

Table 5–1 Agent Framework Monitoring Characteristics

State	Condition	Frequency
ONLINE	Always	`CHECK_INTERVAL`
PARTIAL	Always	`CHECK_INTERVAL`
OFFLINE	Only if the value of the `OFFLINE_CHECK_INTERVAL` resource attribute is greater than 0.	`OFFLINE_CHECK_INTERVAL`
UNKNOWN	Only monitored if the resource was previously being monitored as a result of any one of the previously mentioned conditions.	Whatever the value of either the `CHECK_INTERVAL` or `OFFLINE_CHECK_INTERVAL` attributes.

Whenever an agent starts, the state of all the resources it monitors is set to UNKNOWN. After receiving an initial probe request from Oracle Clusterware, the agent framework executes the CHECK entry point for all of the resources to determine their current states.

Once the CHECK action successfully completes for a resource, the state of the resource transitions to one of the previously mentioned states. The agent framework then starts resources based on commands issued from Oracle Clusterware. After the completion of every action, the agent framework invokes the CHECK action to determine the current resource state. If the resource is in one of the monitored states listed in Table 5–1, then the agent framework periodically executes the CHECK entry point to check for changes in resource state.

By default, the agent framework does not monitor resources that are offline. However, if the value of the `OFFLINE_CHECK_INTERVAL` attribute is greater than 0, then the agent framework monitors offline resources.

Building an Agent

Building an agent for a specific application involves the following steps:

1. Implement the agent framework entry points either in scripts, C, or C++.
2. Build the agent executable (for C and C++ agents).
3. Collect all the parameters needed by the entry points and define a new resource type. Set the `AGENT_FILENAME` attribute to the absolute path of the newly built executable.

See Also: Example B–3 on page B-16 for an example of an action script for an agent

Resources

Oracle Clusterware manages applications and processes as resources that you register with Oracle Clusterware. The number of resources you register with Oracle Clusterware to manage an application depends on the application. Applications that consist of only one process are usually represented by only one resource. More complex applications, built on multiple processes or components, may require multiple resources.

When you register an application as a resource in Oracle Clusterware, you define how Oracle Clusterware manages the application using resource attributes you ascribe to the resource. The frequency with which the resource is checked and the number of attempts to restart a resource on the same server after a failure before attempting to start it on another server (failover) are examples of resource attributes. The registration information also includes a path to an action script or application-specific action program that Oracle Clusterware calls to start, stop, check, and clean up the application.

An action script is a shell script (a batch script in Windows) that a generic script agent provided by Oracle Clusterware calls. An application-specific agent is usually a C or C++ program that calls Oracle Clusterware-provided APIs directly.

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for an example of an action script

Oracle Clusterware 11*g* release 2 (11.2) includes the following built-in agents so that you can use scripts to protect an application:

- **`scriptagent`**: Use this agent (`scriptagent.exe` in Windows) to use shell or batch scripts to protect an application. Both the `cluster_resource` and `local_resource` resource types are configured to use this agent, and any resources of these types automatically take advantage of this agent.
- **`appagent`**: This agent (`appagent.exe` in Windows) automatically protects any resources of the `application` resource type used in previous versions of Oracle Clusterware. You are not required to configure anything to take advantage of the agent. It invokes action scripts in the manner done with previous versions of Oracle Clusterware and should only be used for the `application` resource type.

> **Note:** Oracle recommends that you use `scriptagent` for all resources of types other than `application`. Oracle provides the application agent for backward compatibility with the deprecated `application` type.

By default, all resources not of the `application` resource type, use the script agent, unless you override this behavior by creating a new resource type and specifying a different agent as part of the resource type specification (using the `AGENT_FILENAME` attribute).

> **See Also:** "Resource Type" on page 5-5 for more information about resource types

Resource Type

Generally, all resources are unique but some resources may have common attributes. Oracle Clusterware uses resource types to organize these similar resources. Benefits that resource types provide are:

- Manage only necessary resource attributes
- Manage all resources based on the resource type

Every resource that you register in Oracle Clusterware must have a certain resource type. In addition to the resource types included in Oracle Clusterware, you can define custom resource types using the Oracle Clusterware Control (CRSCTL) utility. The included resource types are:

- **Local resource**: Instances of local resources—type name is `local_resource`—run on each server of the cluster. When a server joins the cluster, Oracle Clusterware automatically extends local resources to have instances tied to the new server. When a server leaves the cluster, Oracle Clusterware automatically sheds the instances of local resources that ran on the departing server. Instances of local resources are pinned to their servers; they do not fail over from one server to another.
- **Cluster resource**: Cluster-aware resource types—type name is `cluster_resource`—are aware of the cluster environment and are subject to cardinality and cross-server switchover and failover.

See Also:

- Appendix E, "CRSCTL Utility Reference" for more information about using CRSCTL to add resource types
- "Resource State" on page 5-8 for more information about resource state

---

Note: Previous versions of Oracle Clusterware only supported the *application* resource type. This resource type still exists, but only for backward compatibility. Oracle recommends that you register application-type resources as cluster resource-type resources in Oracle Clusterware 11*g* release 2 (11.2). If you decide not to register your application-type resources as cluster resource-type resources, consult the documentation that corresponds to those applications for administration information.

Registering a Resource in Oracle Clusterware

Register resources in Oracle Clusterware 11*g* release 2 (11.2) using the `crsctl add resource` command.

Note: The `CRS_REGISTER` and `CRS_PROFILE` commands are still available in the Oracle Clusterware home but are deprecated for this release.

To register an application as a resource:

```
$ crsctl add resource resource_name -type resource_type [-file file_path] |
[-attr "attribute_name='attribute_value', attribute_name='attribute_value', ..."]
```

Choose a name for the resource based on the application for which it is being created. For example, if you create a resource for an Apache Web server, then you might name the resource `myApache`.

The name of the resource type follows the `-type` option. You can specify resource attributes in either a text file following the `-file` option or in a comma-delimited list of resource attribute-value pairs enclosed in double quotation marks (`""`) following the `-attr` option. You must enclose space or comma-delimited attribute values and values enclosed in parentheses in single quotation marks (`''`).

Following is an example of an attribute file:

```
PLACEMENT=favored
HOSTING_MEMBERS=node1 node2 node3
```

```
RESTART_ATTEMPTS@CARDINALITYID(1)=0
RESTART_ATTEMPTS@CARDINALITYID(2)=0
FAILURE_THRESHOLD@CARDINALITYID(1)=2
FAILURE_THRESHOLD@CARDINALITYID(2)=4
FAILURE_INTERVAL@CARDINALITYID(1)=300
FAILURE_INTERVAL@CARDINALITYID(2)=500
CHECK_INTERVAL=2
CARDINALITY=2
```

See Also:

- "Adding Resources" on page 5-17 for examples of using the `crsctl add resource` command
- "crsctl add resource" on page E-7 for more information about using the `crsctl add resource` command

Overview of Using Oracle Clusterware to Enable High Availability

Oracle Clusterware manages resources based on how you configure them to increase their availability. You can configure your resources so that Oracle Clusterware:

- Starts resources during cluster or server start
- Restarts resources when failures occur
- Relocates resources to other servers, if the servers are available

To manage your applications with Oracle Clusterware:

1. Create an action script or use an existing agent.
2. Register your applications as resources with Oracle Clusterware.

   If a single application requires that you register multiple resources, you may be required to define relevant dependencies between the resources.
3. Assign the appropriate privileges to the resource.
4. Start or stop your resources.

When a resource fails, Oracle Clusterware attempts to restart the resource based on attribute values that you provide when you register an application or process as a resource. If a server in a cluster fails, then you can configure your resources so that processes that were assigned to run on the failed server restart on another server. Based on various resource attributes, Oracle Clusterware supports a variety of configurable scenarios.

When you register a resource in Oracle Clusterware, the relevant information about the application and the resource-relevant information, is registered in the Oracle Cluster Registry (OCR). This information includes:

- **Path to the action script or application-specific agent**: The absolute path to the script or application-specific agent that defines the start, stop, and check actions that Oracle Clusterware performs on the application. An additional action is included in Oracle Clusterware 11*g* release 2 (11.2): *clean*.

  See Also: "Agents" on page 5-2 for more information about these actions

- **Privileges**: Oracle Clusterware has the necessary privileges to control all of the components of your application for high availability operations, including the right to start processes that are owned by other user identities. Oracle Clusterware

must run as a privileged user to control applications with the correct start and stop processes.

- **Resource Dependencies**: Relationships among resources that imply an operational ordering or affect the placement of resources on servers in the cluster. For example, Oracle Clusterware can only start a resource that has a hard start dependency on another resource if the other resource is running. Oracle Clusterware prevents stopping a resource if other resources that depend on it are running. However, you can force a resource to stop using the `crsctl stop resource -f` command, which first stops all resources that depend on the resource being stopped.

This section includes the following topics:

Resource Attributes

Resource attributes define how Oracle Clusterware manages resources of a specific resource type. Each resource type has a unique set of attributes. Some resource attributes are specified when you register resources, while others are internally managed by Oracle Clusterware.

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for complete details of resource attributes

Resource State

Every resource in a cluster is in a particular state at any time. Certain actions or events can cause that state to change.

Table 5–2 lists and describes the possible **resource state**s.

Table 5–2 Possible Resource States

State	Description
ONLINE	The resource is running.
OFFLINE	The resource is not running.
UNKNOWN	An attempt to stop the resource has failed. Oracle Clusterware does not actively monitor resources that are in this state. You must perform an application-specific action to ensure that the resource is offline, such as stop a process, and then run the `crsctl stop resource` command to reset the state of the resource to OFFLINE.

Table 5–2 (Cont.) Possible Resource States

State	Description
INTERMEDIATE	A resource can be in the INTERMEDIATE state because of one of two events: 1. Oracle Clusterware cannot determine the state of the resource but the resource was either attempting to go online or was online the last time its state was precisely known. Usually, the resource transitions out of this state on its own over time, as the conditions that impeded the check action no longer apply. 2. A resource is partially online. For example, the Oracle Database VIP resource fails over to another server when its home server leaves the cluster. However, applications cannot use this VIP to access the database while it is on a non-home server. Similarly, when an Oracle Database instance is started and not open, the resource is partially online: it is running but is not available to provide services. Oracle Clusterware actively monitors resources that are in the INTERMEDIATE state and, typically, you are not required to intervene. If the resource is in the INTERMEDIATE state due to the preceding reason 1, then as soon as the state of the resource is established, Oracle Clusterware transitions the resource out of the INTERMEDIATE state. If the resource is in the INTERMEDIATE state due to the preceding reason 2, then it stays in this state if it remains partially online. For example, the home server of the VIP must rejoin the cluster so the VIP can switch over to it. A database administrator must issue a command to open the database instance. In either case, however, Oracle Clusterware transitions the resource out of the INTERMEDIATE state automatically as soon as it is appropriate.Use the `STATE_DETAILS` resource attribute to explain the reason for a resource being in the INTERMEDIATE state and provide a solution to transition the resource out of this state.

Resource Dependencies

You can configure resources to be dependent on other resources, so that the dependent resources can only start or stop when certain conditions of the resources on which they depend are met. For example, when Oracle Clusterware attempts to start a resource, it is necessary for any resources on which the initial resource depends to be running and in the same location. If Oracle Clusterware cannot bring the resources online, then the initial (dependent) resource cannot be brought online, either. If Oracle Clusterware stops a resource or a resource fails, then any dependent resource is also stopped.

Some resources require more time to start than others. Some resources must start whenever a server starts, while other resources require a manual start action. These and many other examples of resource-specific behavior imply that each resource must be described in terms of how it is expected to behave and how it relates to other resources (resource dependencies).

Previous versions of Oracle Clusterware included only two dependency specifications: the `REQUIRED_RESOURCES` resource attribute and the `OPTIONAL_RESOURCES` resource attribute. The `REQUIRED_RESOURCES` resource attribute applied to both start and stop resource dependencies.

> **Note:** The `REQUIRED_RESOURCES` and `OPTIONAL_RESOURCES` resource attributes are still available only for resources of `application` type. Their use to define resource dependencies in Oracle Clusterware 11*g* release 2 (11.2) is deprecated.

In Oracle Clusterware 11*g* release 2 (11.2), however, resource dependencies are separated into start and stop categories. This separation improves and expands the start and stop dependencies between resources and resource types.

This section includes the following topics:

- Start Dependencies
- Stop Dependencies

Start Dependencies

Oracle Clusterware considers start dependencies contained in the profile of a resource when the **start effort evaluation** for that resource begins. You specify start dependencies for resources using the `START_DEPENDENCIES` resource attribute. You can use modifiers on each dependency to further configure the dependency.

> **See Also:** "START_DEPENDENCIES" on page B-8 for more information about the resource attribute, modifiers, and usage

This section includes descriptions of the following START dependencies:

- `hard`
- `weak`
- `attraction`
- `pullup`
- `dispersion`

hard

Define a `hard` start dependency for a resource if another resource must be running before the dependent resource can start. For example, if resource A has a `hard` start dependency on resource B, then resource B must be running before resource A can start. By default, resources A and B must be located on the same server (co-located).

> **Note:** Oracle recommends that resources with `hard` start dependencies also have `pullup` start dependencies.

You can configure the `hard` start dependency with the following constraints:

- Use the `global` modifier to specify that resources need not be co-located. For example, if resource A has a `hard(global:resourceB)` start dependency on resource B, then, if resource B is running on any node in the cluster, resource A can start.
- Use the `intermediate` modifier to specify that the dependent resource can start if a resource on which it depends is in either the `ONLINE` or `INTERMEDIATE` state.
- Use the `type` modifier to specify whether the `hard` start dependency acts on a particular resource or a resource type. For example, if you specify that resource A

has a `hard` start dependency on the `cluster_resource` type, then if any resource of the `cluster_resource` type is running, resource A can start.

weak

If resource A has a `weak` start dependency on resource B, then an attempt to start resource A attempts to start resource B, if resource B is not running. The result of the attempt to start resource B is, however, of no consequence to the result of starting resource A. By default, resources A and B must be co-located.

You can configure the `weak` start dependency with the following constraints:

- Use the `global` modifier to specify that resources need not be co-located. For example, if resource A has a `weak(global:resourceB)` start dependency on resource B, then, if resource B is running on any node in the cluster, resource A can start.
- Use the `concurrent` modifier to specify whether resource A must wait for resource B to start before it can start or whether they can start concurrently.
- Use the `type` modifier to specify whether the dependency acts on a resource of a particular resource type.

attraction

If resource A has an `attraction` dependency on resource B, then Oracle Clusterware prefers to place resource A on servers hosting resource B. Dependent resources, such as resource A in this case, are more likely to run on servers on which resources to which they have `attraction` dependencies are running. Oracle Clusterware places dependent resources on servers with resources to which they are attracted.

You can configure the `attraction` start dependency with the following constraints:

- Use the `intermediate` modifier to specify whether the resource is attracted to resources that are in the `INTERMEDIATE` state.
- Use the `type` modifier to specify whether the dependency acts on a particular resource type. The dependent resource is attracted to the server hosting the greatest number of resources of a particular type.

Note: Previous versions of Oracle Clusterware used the now deprecated `OPTIONAL_RESOURCES` attribute to express attraction dependency.

---

pullup

Use the `pullup` start dependency if resource A must automatically start whenever resource B starts. This dependency only affects resource A if it is not running. As is the case for other dependencies, `pullup` may cause the dependent resource to start on any server. Use the `pullup` dependency whenever there is a hard stop dependency, so that if resource A depends on resource B and resource B fails and then recovers, then resource A is restarted.

Note: Oracle recommends that resources with `hard` start dependencies also have `pullup` start dependencies.

You can configure the `pullup` start dependency with the following constraints:

- Use the `intermediate` modifier to specify whether resource B can be either in the `ONLINE` or `INTERMEDIATE` state to start resource A.

  If resource A has a `pullup` dependency on multiple resources, then resource A starts only when all resources upon which it depends, start.

- Use the `always` modifier to specify whether Oracle Clusterware starts resource A despite the value of the `TARGET` attribute of the resource on which resource A depends, whether the value of the `TARGET` attribute is `ONLINE` or `OFFLINE`. By default, `pullup` only starts resources if the value of the `TARGET` attribute of the resource on which they depend is `ONLINE`.
- Use the `type` modifier to specify that the dependency acts on a particular resource type.

dispersion

If you specify the `dispersion` start dependency for a resource, then Oracle Clusterware starts this resource on a server that has the fewest number of resources to which this resource has dispersion. Resources with dispersion may still end up running on the same server if there are not enough servers to disperse them to.

You can configure the `dispersion` start dependency with the following modifiers:

- Use the `intermediate` modifier to specify that Oracle Clusterware disperses resource A whether resource B is either in the `ONLINE` or `INTERMEDIATE` state.
- Typically, dispersion is only applied when starting resources. If at the time of starting, resources that disperse each other start on the same server (because there are not enough servers at the time the resources start), then Oracle Clusterware leaves the resources alone once they are running, even when more servers join the cluster. However, Oracle Clusterware reapplies dispersion on resources later when new servers join the cluster, if you specify the `active` modifier.

Stop Dependencies

Oracle Clusterware considers stop dependencies between resources whenever a resource is stopped (the resource state changes from `ONLINE` to any other state).

hard

If resource A has a `hard` stop dependency on resource B, then resource A must be stopped when B stops running. The two resources may attempt to start or relocate to another server, depending upon how they are configured. Oracle recommends that resources with `hard` stop dependencies also have `hard` start dependencies.

The following constraints for a `hard` stop dependency:

You can configure the `hard` stop dependency with the following modifiers:

- Use the `intermediate` modifier to specify whether resource B must either be in the `ONLINE` or `INTERMEDIATE` state for resource A to stay online.
- Use the `global` modifier to specify whether resource A requires that resource B be present on the same server or on any server in the cluster to remain online. If this constraint is not specified, then resources A and B must be running on the same server. Oracle Clusterware stops resource A when that condition is no longer met.
- Use the `shutdown` modifier to stop the resource only when you shut down the Oracle Clusterware stack using either the `crsctl stop crs` or `crsctl stop cluster` commands.

> **See Also:** "STOP_DEPENDENCIES" on page B-11 for more information about modifiers

Affect of Resource Dependencies on Resource State Recovery

When a resource goes from a running to a non-running state, while the intent to have it running remains unchanged, this transition is called a *resource failure*. At this point, Oracle Clusterware applies a resource state recovery procedure that may try to restart the resource locally, relocate it to another server, or just stop the dependent resources, depending on the high availability policy for resources and the state of entities at the time.

When two or more resources depend on each other, a failure of one of them may end up causing the other to fail, as well. In most cases, it is difficult to control or even predict the order in which these failures are detected. For example, even if resource A depends on resource B, Oracle Clusterware may detect the failure of resource B after the failure of resource A.

This lack of failure order predictability may lead to Oracle Clusterware attempting to restart dependent resources in parallel, which, ultimately, leads to the failure to restart some resources, because the resources upon which they depend are being restarted out of order.

In this case, Oracle Clusterware reattempts to restart the dependent resources locally if either or both the `hard` stop and `pullup` dependencies are used. For example, if resource A has either a `hard` stop dependency or `pullup` dependency, or both on resource B, and resource A fails because resource B failed, then Oracle Clusterware may end up trying to restart both resources at the same time. If the attempt to restart resource A fails, then as soon as resource B successfully restarts, Oracle Clusterware reattempts to restart resource A.

Resource Placement

As part of the start effort evaluation, the first decision that Oracle Clusterware must make is where to start (or place) the resource. Making such a decision is easy when the caller specifies the target server by name. If a target server is not specified, however, then Oracle Clusterware attempts to locate the best possible server for placement given the resource's configuration and the current state of the cluster.

Oracle Clusterware considers a resource's placement policy first and filters out servers that do not fit with that policy. Oracle Clusterware sorts the remaining servers in a particular order depending on the value of the `PLACEMENT` resource attribute of the resource.

> **See Also:** "Application Placement Policies" on page 5-21 for more information about the `PLACEMENT` resource attribute

The result of this consideration is a maximum of two lists of candidate servers on which Oracle Clusterware can start the resource. One list contains preferred servers and the other contains possible servers. The list of preferred servers will be empty if the value of the `PLACEMENT` resource attribute for the resource is set to `balanced` or `restricted`. The placement policy of the resource implies on which server the resource wants to run. Oracle Clusterware considers preferred servers over possible servers, if there are servers in the preferred list.

Oracle Clusterware then considers the resource's dependencies to determine where to place the resource, if any exist. The `attraction` and `dispersion` start dependencies affect the resource placement decision, as do some of the dependency modifiers.

Oracle Clusterware applies these placement hints to further order the servers in the two previously mentioned lists. Note that Oracle Clusterware processes each list of servers independently, so that the effect of the resource's placement policy is not confused by that of dependencies.

Finally, Oracle Clusterware chooses the first server from the list of preferred servers, if any servers are listed. If there are no servers on the list of preferred servers, then Oracle Clusterware chooses the first server from the list of possible servers, if any servers are listed. When no servers exist in either list, Oracle Clusterware generates a resource placement error.

Note: Neither the placement policies nor the dependencies of the resources related to the resource Oracle Clusterware is attempting to start affect the placement decision.

Registering an Application as a Resource

This section presents examples of the procedures for registering an application as a resource in Oracle Clusterware. The procedures instruct you how to add an Apache Web server as a resource to Oracle Clusterware.

Assume for the examples in this section that the Oracle Clusterware administrator has full administrative privileges over Oracle Clusterware and the user or group that owns the application that Oracle Clusterware is going to manage. Once the registration process is complete, Oracle Clusterware can start any application on behalf of any operating system user.

Oracle Clusterware distinguishes between an owner of a registered resource and a user. The owner of a resource is the operating system user under which the agent runs. The `ACL` resource attribute of the resource defines permissions for the users and the owner. Only `root` can modify any resource.

See Also: "Role-separated Management" on page 2-18

Notes:

- Oracle Clusterware commands prefixed with `crs_` are deprecated with this release. CRSCTL commands replace those commands. See Appendix E, "CRSCTL Utility Reference" for a list of CRSCTL commands and their corresponding `crs_` commands.
- Do not use CRSCTL commands on any resources that have names prefixed with `ora` (because these are Oracle resources), unless Oracle Support directs you to do so.

  You can, however, create resources that depend on Oracle resources. When creating resources, do not use an *ora* prefix in the resource name. This prefix is reserved for Oracle use only.

  To configure Oracle resources, use the server control utility, SRVCTL, which provides you with all configurable options.

This section includes the following topics:

- Creating an Application VIP Managed by Oracle Clusterware
- Adding Resources

- Managing Resources Using Oracle Enterprise Manager
- Changing Resource Permissions
- Application Placement Policies
- Unregistering Applications and Application Resources

Creating an Application VIP Managed by Oracle Clusterware

If clients of an application access the application through a network, then you must register a virtual internet protocol address (VIP) on which the application depends. An application VIP is a cluster resource that Oracle Clusterware manages (Oracle Clusterware provides a standard VIP agent for application VIPs). You should base any new application VIPs on this VIP type to ensure that your system experiences consistent behavior among all of the VIPs that you deploy in your cluster.

While you can add a VIP, as you can add any other resource that Oracle Clusterware manages, Oracle recommends using the script *Grid_home*/bin/appvipcfg to create or delete an application VIP.

The usage of this script is as follows:

```
appvipcfg create -network=network_number -ip=ip_address -vipname=vip_name
-user=user_name [-group=group_name appvipcfg delete -vipname=vip_name]
```

Where *network_number* is the number of the network, *ip_address* is the IP address, *vip_name* is the name of the VIP, and *user_name* is the name of the user.

For example, as root user, run the following command:

```
# Grid_home/bin/appvipcfg create -network=1 -ip=148.87.58.196 -vipname=appsVIP
-user=root
```

The script only requires a network number (default 1), the IP and a name for the VIP resource as well as the user that owns the application VIP resource. A VIP resource is typically owned by root because VIP related operations require root privileges.

To delete an application VIP, use the same script with the -delete option. This option accepts the VIP name as a parameter.

After you have created the application VIP using this configuration script, you can view the VIP profile using the following command:

```
Grid_home/bin/crsctl status res VIPname -p
```

Verify and, if required, modify the following parameters using the *Grid_home*/bin/crsctl modify res command.

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for detailed information about using CRSCTL commands

The appvipcfg script assumes that the default ora.vip network resource (ora.net1.network) is used as the default. In addition, it is also assumed that a default app.appvip.type is used for those purposes.

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for detailed information about using CRSCTL commands

In the preceding example, the VIP is defined as follows:

- RESTART_ATTEMPTS=2: Oracle Clusterware tries to restart the resource twice before failing it over to another server.
- START_TIMEOUT: CRSD waits 100 seconds for the VIP to start before CRSD stops and reports an error.
- STOP_TIMEOUT: CRSD waits 100 seconds for the VIP to stop.
- CHECK_INTERVAL=10: Oracle Clusterware checks the resource every 10 seconds to determine its status.
- USR_ORA_VIP=192.168.10.10: The IP address that the resource uses. You can use an IP address that resolves through DNS.
- START_DEPENDENCIES: The resource has hard and pull-up START dependencies on the network resource type.
- STOP_DEPENDENCIES: The resource has a hard STOP dependency on the network resource type.

Note: Because the resource is based on the ora.cluster_vip.type resource type, no VIP-specific user script is necessary. Oracle Clusterware uses the same agent that ora.cluster_vip.type uses.

On Linux and UNIX operating systems, an application VIP must run as root. Unless you added the VIP resource as root, you must ensure that the VIP can run as root. To ensure that the VIP can run as root:

1. Log in as root and run the following command:

```
# crsctl setperm resource appsVIP -o root
```

2. Run the following command to enable the Oracle Database installation owner to run this script:

```
# crsctl setperm resource appsVIP -u user:oracle:r-x
```

3. As the Oracle Database installation owner, start the VIP resource:

```
$ crsctl start resource appsVIP
```

Adding an Application VIP with Oracle Enterprise Manager

To add an application VIP with Oracle Enterprise Manager:

1. Log into Oracle Enterprise Manager Database Control.
2. Click the **Cluster** tab.
3. Click **Administration**.
4. Click **Manage Resources**.
5. Enter a cluster administrator user name and password to display the Manage Resources page.
6. Click **Add VIP**.
7. Enter a name for the VIP in the **Name** field.
8. Select **Start the resource after creation** if you want the VIP to start immediately.

Adding Resources

You can add resources to Oracle Clusterware at any time. However, if you add a resource that is dependent on another resource, then you must first add the resource upon which it is dependent.

In the example in this section, assume that an action script, `myApache.scr`, resides in the `/opt/cluster/scripts` directory on each node to facilitate adding the resource to the cluster. You must decide whether to use administrator or policy management for the application.

Use administrator management for smaller, two-node configurations, where your cluster configuration is not likely to change. Use policy management for more dynamic configurations when your cluster consists of more than two nodes. For example, if a resource only runs on node 1 and node 2, for example, because only those nodes have the necessary files, then administrator management is probably more appropriate.

Note: Oracle recommends that you use shared storage, such as Oracle Automatic Storage Management Cluster File System, to store action scripts to decrease script maintenance.

This section includes the following procedures:

- Adding User-Defined Resources
- Adding Resources Using Oracle Enterprise Manager

Adding User-Defined Resources

Oracle Clusterware supports the deployment of applications in access-controlled server pools made up of anonymous servers and strictly based on the desired pool size. Cluster administrator-defined policies can and must be used in this case to govern the server assignment with desired sizes and levels of importance. Alternatively, a strict or preferred server assignment can be used, in which resources run on specifically named servers. This represents the pre-existing model available in earlier releases of Oracle Clusterware.

Conceptually, a cluster hosting applications developed and deployed in both of the schemes can be viewed as two logically separated collections of servers. One server is used for server pools, enabling role separation and server capacity control. The other server assumes a fixed assignment based on named servers in the cluster.

A built-in server pool named "Generic" always owns the servers used by applications of the latter scheme. The Generic server pool is a logical division and can be used to separate the two parts of the cluster using different management schemes.

For third party developers to use the model to deploy applications, server pools must be used. To take advantage of the pre-existing application development and deployment model based on named servers, sub-pools of Generic (server pools that have Generic as their parent pool, defined by the server pool attribute `PARENT_POOLS`) must be used. By creating sub-pools that use Generic as their parent and enumerating servers by name in the sub-pool definitions, applications ensure that named servers are in Generic and are used exclusively for applications using the named servers model.

To manage an application using either deployment scheme, you must create a server pool before adding the resource to the cluster. In the following example, it is assumed that a server pool has been created to host an application. This server pool is not a

sub-pool of Generic, but instead it is used to host the application in a top-level server pool.

This section includes the following topics:

- Adding a Resource to a Top Level Server Pool
- Adding a Resource Using a Server Specific Deployment

Adding a Resource to a Top Level Server Pool To add the Apache Web server to a top- level server pool as a resource using the policy based deployment scheme, run the following command as the user that is supposed to run the Apache Server. For an Apache Server this is typically the `root` user:

```
$ crsctl add resource myApache -type cluster_resource
-attr "ACTION_SCRIPT=/opt/cluster/scripts/myapache.scr, PLACEMENT=restricted,
SERVER_POOLS=server_pool_list,CHECK_INTERVAL=30,RESTART_ATTEMPTS=2,
START_DEPENDENCIES=hard(appsvip),STOP_DEPENDENCIES=hard(appsvip)"
```

> **See Also:** >"Third-Party Applications Using the Script Agent" on page B-15

In the preceding example, myApache is the name of the resource added to the cluster.

> **Note:** A resource name cannot begin with a period or with the character string "ora."

Notice that attribute values are enclosed in single quotation marks (' '). Configure the resource as follows:

- The resource is a cluster_resource type.
- `ACTION_SCRIPT=/opt/cluster/scripts/myapache.scr`: The path to the required action script.
- `PLACEMENT=restricted`
- `SERVER_POOLS=sp1 sp3`: This resource can only run in the server pools specified in this space-separated list.
- `CHECK_INTERVAL=30`: Oracle Clusterware checks this resource every 30 seconds to determine its status.
- `RESTART_ATTEMPTS=2`: Oracle Clusterware attempts to restart this resource twice before failing it over to another node.
- `START_DEPENDENCIES=hard(appsvip)`: This resource has a hard START dependency on the appsvip resource. The appsvip resource must be online in order for myApache to start.
- `STOP_DEPENDENCIES=hard(appsvip)`: This resource has a hard STOP dependency on the appsvip resource. The myApache resource stops if the appsvip resource goes offline.

Adding a Resource Using a Server Specific Deployment To add the Apache Web server as a resource that uses a named server deployment, it is assumed that the resource is added to a server pool that is by definition a sub-pool of the Generic server pool. Server pools that represent sub-pools of Generic are created using the `crsctl add serverpool` command. These server pools define the Generic server pool as their parent in the server pool attribute `PARENT_POOLS`. In addition, they include a list of

server names in the SERVER_NAMES parameter to specify the servers that should be assigned to the respective pool. For example:

```
$ crsctl add serverpool myApache_sp -attr "PARENT_POOLS=Generic, SERVER_
NAMES=stado36 stado37"
```

Once this sub-pool has been created, you can add the resource, as in the previous example:

```
$ crsctl add resource myApache -type cluster_resource
-attr "ACTION_SCRIPT=/opt/cluster/scripts/myapache.scr, PLACEMENT='restricted',
SERVER_POOLS=myApache_sp, CHECK_INTERVAL='30', RESTART_ATTEMPTS='2',
START_DEPENDENCIES='hard(appsvip)', STOP_DEPENDENCIES='hard(appsvip)'"
```

Note: A resource name cannot begin with a period or with the character string "ora."

In addition, note that the server pools listed in the SERVER_POOLS resource parameter, must be sub-pools under Generic. These sub-pools are then typically assigned to run on certain, named servers.

> **See Also:** "Policy-Based Cluster and Capacity Management" on page 2-11

Adding Resources Using Oracle Enterprise Manager

To add resources to Oracle Clusterware using Oracle Enterprise Manager:

1. Log into Oracle Enterprise Manager Database Control.
2. Click the **Cluster** tab.
3. Click **Administration**.
4. Click **Add Resource**.
5. Enter a cluster administrator user name and password to display the Add Resource page.
6. Enter a name for the resource in the **Name** field.

Note: A resource name cannot begin with a period nor with *ora*.

---

7. Choose either **cluster_resource** or **local_resource** from the **Resource Type** drop down.
8. Optionally, enter a description of the resource in the **Description** field.
9. Select **Start the resource after creation** if you want the resource to start immediately.
10. The optional parameters in the **Placement** section define where in a cluster Oracle Clusterware places the resource.

> **See Also:** "Application Placement Policies" on page 5-21 for more information about placement

The attributes in this section correspond to the attributes described in Appendix B, "Oracle Clusterware Resource Reference"

11. In the **Action Program** section, choose from the **Action Program** drop down whether Oracle Clusterware calls an action script, an agent file, or both to manage the resource.

    You must also specify a path to the script, file, or both, depending on what you select from the drop down.

    If you choose **Action Script**, then you can click **Create New Action Script** to use the Oracle Enterprise Manager action script template to create an action script for your resource, if you have not yet done so.

12. To further configure the resource, click **Parameters**. On this page, you can configure start, stop, and status parameters, and offline monitoring and any attributes that you define.

13. Click **Advanced Settings** to enable more detailed resource attribute configurations.

14. Click **Dependencies** to configure start and stop dependencies between resources.

    See Also: "Resource Dependencies" on page 5-9 for more information about dependencies

15. Click **Submit** when you finish configuring the resource.

Managing Resources Using Oracle Enterprise Manager

You can use CRSCTL to manage resources or you can use Oracle Enterprise Manager. To manage resources with Oracle Enterprise Manager:

1. Log into Oracle Enterprise Manager Database Control.
2. Click the **Cluster** tab.
3. Click **Administration**.
4. Click **Manage Resources**.
5. Enter a cluster administrator user name and password to display the Manage Resources page.
6. Select **Show Oracle Resources** to display a list of Oracle resources or type in the name of a particular resource you want to manage. When you select this option, the system might display resources such as the VIP, network, ONS, database, service, listener, oc4j, GNS, and so on.
7. Enter a resource name for the VIP in the **Name** field.
8. The resource is based on the `ora.cluster_vip.type` resource type.
9. Optionally, enter a description for the resource in the **Description** field.
10. Select **Start the resource after creation** if you want the resource to start immediately.
11. The optional parameters in the **Placement** section define where in a cluster Oracle Clusterware places the resource.

    See Also: "Application Placement Policies" on page 5-21 for more information about placement

    The attributes in this section correspond to the attributes described in Appendix B, "Oracle Clusterware Resource Reference"

12. In the **Action Program** section, choose from the **Action Program** drop down whether Oracle Clusterware calls an action script, an agent file, or both to manage the resource. Use Agent File is selected by default, along with a path to an executable, such as *Grid_home*/bin/orarootagent*CRS_EXE_SUFFIX*, where *Grid_home* is the name of the grid home, and *CRS_EXE_SUFFIX* is the Oracle Clusterware executable suffix. To simplify your deployment, use these defaults.

    You must also specify a path to the script, file, or both, depending on what you select from the drop down menu.

    If you choose **Action Script**, then you can click **Create New Action Script** to use the Oracle Enterprise Manager action script template to create an action script for your resource, if you have not yet done so.

13. To further configure the resource, click **Parameters**. On this page, you can configure start, stop, and status parameters, and offline monitoring and any attributes that you define.

14. Click **Advanced Settings** to configure the resource attributes according to instance.

15. Click **Dependencies** to configure start and stop dependencies among the other resources.

16. Click **Submit** when you finish configuring the resource.

Changing Resource Permissions

Oracle Clusterware manages resources based on the permissions of the user who added the resource. The user who first added the resource owns the resource and the resource runs as the resource owner. Certain resources must be managed as `root`. If a user other than `root` adds a resource that must be run as `root`, then the permissions must be changed as `root` so that `root` manages the resource, as follows:

```
# crsctl setperm resource resource_name -o root
```

And as the user who installed Oracle Clusterware, enable the Oracle Database installation owner (`oracle`, in the following example) to run the script:

```
$ crsctl setperm resource resource_name -u user:oracle:r-x
```

Start the resource:

```
$ crsctl start resource resource_name
```

Application Placement Policies

A resource can be started on any server, subject to the placement policies, the resource start dependencies, and the availability of the action script on that server.

The `PLACEMENT` resource attribute determines how Oracle Clusterware selects a server on which to start a resource and where to relocate the resource after a server failure. The `HOSTING_MEMBERS` and `SERVER_POOLS` attributes determine eligible servers to host a resource and the `PLACEMENT` attribute further refines the placement of resources.

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for more information about the `HOSTING_MEMBERS` and `SERVER_POOLS` resource attributes

The value of the PLACEMENT resource attribute determines how Oracle Clusterware places resources when they are added to the cluster or when a server fails. Together with either the HOSTING_MEMBERS or SERVER_POOLS attributes, you can configure how Oracle Clusterware places the resources in a cluster. When the value of the PLACEMENT attribute is:

- balanced: Oracle Clusterware uses any online server for placement. Less loaded servers are preferred to servers with greater loads. To measure how loaded a server is, Oracle Clusterware uses the LOAD resource attribute of the resources that are in an ONLINE state on the server. Oracle Clusterware uses the sum total of the LOAD values to measure the current server load.
- favored: If values are assigned to either the SERVER_POOLS or HOSTING_MEMBERS resource attribute, then Oracle Clusterware considers servers belonging to the member list in either attribute first. If no servers are available, then Oracle Clusterware places the resource on any other available server. If there are values for both the SERVER_POOLS and HOSTING_MEMBERS attributes, then SERVER_POOLS indicates preference and HOSTING_MEMBERS restricts the choices to the servers within that preference.
- restricted: Oracle Clusterware only considers servers that belong to server pools listed in the SEVER_POOLS resource attribute or servers listed in the HOSTING_MEMBERS resource attribute for resource placement. Only one of these resource attributes can have a value, otherwise it results in an error.

See Also: "SERVER_POOLS" on page B-8 for more information

Unregistering Applications and Application Resources

To unregister a resource, use the crsctl delete resource command. You cannot unregister an application or resource that is ONLINE or required by another resource, unless you use the -force option. The following example unregisters the Apache Web server application:

```
$ crsctl delete resource myApache
```

Run the crsctl delete resource command as a clean-up step when a resource is no longer managed by Oracle Clusterware. Oracle recommends that you unregister any unnecessary resources.

Using Oracle Clusterware Commands

This section includes the following topics:

Registering Application Resources

Each application that you manage with Oracle Clusterware is stored as a resource in OCR. Use the crsctl add resource command to register applications in OCR. For

example, enter the following command to register the Apache Web server application from the previous example:

```
$ crsctl add resource myApache -type cluster_resource
-attr "ACTION_SCRIPT=/opt/cluster/scripts/myapache.scr, PLACEMENT=restricted,
SERVER_POOLS=server_pool_list,CHECK_INTERVAL=30,RESTART_ATTEMPTS=2,
START_DEPENDENCIES=hard(appsvip),STOP_DEPENDENCIES=hard(appsvip)"
```

If you modify a resource, then update OCR by running the `crsctl modify resource` command.

Starting Application Resources

To start an application resource that is registered with Oracle Clusterware, use the `crsctl start resource` command. For example:

```
$ crsctl start resource myApache
```

> **See Also:** Appendix E, "CRSCTL Utility Reference" for usage information and examples of CRSCTL command output

The command waits to receive a notification of success or failure from the action program each time the action program is called. Oracle Clusterware can start application resources if they have stopped due to exceeding their failure threshold values. You must register a resource using `crsctl add resource` before you can start it.

Start and stop resources with the `crsctl start resource` and `crsctl stop resource` commands. Manual starts or stops outside of Oracle Clusterware can invalidate the resource status. In addition, Oracle Clusterware may attempt to restart a resource on which you perform a manual stop operation.

Running the `crsctl start resource` command on a resource sets the resource `TARGET` value to `ONLINE`. Oracle Clusterware attempts to change the state to match the `TARGET` by running the action program with the `start` action.

Starting an Application on an Unavailable Server

If a cluster server fails while you are starting a resource on that server, then check the state of the resource on the cluster by using the `crsctl status resource` command.

Relocating Applications and Application Resources

Use the `crsctl relocate resource` command to relocate applications and application resources. For example, to relocate the Apache Web server application to a server named `rac2`, run the following command:

```
# crsctl relocate resource myApache -n rac2
```

Each time that the action program is called, the `crsctl relocate resource` command waits for the duration specified by the value of the `SCRIPT_TIMEOUT` resource attribute to receive notification of success or failure from the action program. A relocation attempt fails if:

- The application has required resources that run on the initial server
- Applications that require the specified resource run on the initial server

To relocate an application and its required resources, use the `-f` option with the `crsctl relocate resource` command. Oracle Clusterware relocates or starts all resources that are required by the application regardless of their state.

Stopping Applications and Application Resources

Stop application resources with the `crsctl stop resource` command. The command sets the resource `TARGET` value to `OFFLINE`. Because Oracle Clusterware always attempts to match the state of a resource to its target, the Oracle Clusterware subsystem stops the application. The following example stops the Apache Web server:

```
# crsctl stop resource myApache
```

You cannot stop a resource if another resource has a hard stop dependency on it, unless you use the force (`-f`) option. If you use the `crsctl stop resource` *`resource_name`* `-f` command on a resource upon which other resources depend, and if those resources are running, then Oracle Clusterware stops the resource *and* all of the resources that depend on the resource you are stopping that are running.

Displaying Clusterware Application and Application Resource Status Information

To display status information about applications and resources that are on cluster servers, use the `crsctl status resource` command. The following example displays the status information for the Apache Web server application:

```
# crsctl status resource myApache

NAME=myApache
TYPE=cluster_resource
TARGET=ONLINE
STATE=ONLINE on server010
```

Enter the following command to view information about *all* applications and resources in tabular format:

```
# crsctl status resource
```

Append a resource name to the preceding command to determine:

- How many times the resource has been restarted
- How many times the resource has failed within the failure interval
- The maximum number of times that a resource can restart or fail
- The target state of the resource and the normal status information

Use the `-f` option with the `crsctl status resource` *`resource_name`* command to view full information of a specific resource.

> **See Also:** Appendix E, "CRSCTL Utility Reference" for detailed information about CRSCTL commands

Managing Automatic Oracle Clusterware Resource Operations for Action Scripts

You can prevent Oracle Clusterware from automatically restarting a resource by setting several action program attributes. You can also control how Oracle Clusterware manages the restart counters for your action programs. In addition, you can customize the timeout values for the `start`, `stop`, and `check` actions that Oracle Clusterware performs on action scripts.

This section includes the following topics:

- Preventing Automatic Restarts
- Automatically Manage Restart Attempts Counter for Resources
- RESTART_ATTEMPTS and CURRENT_RCOUNT Failure Scenarios

Preventing Automatic Restarts

When a server stops and restarts, Oracle Clusterware attempts to start the resources that run on the server as soon as the server starts. Resource startup might fail, however, if system components on which a resource depends, such as a volume manager or a file system, are not running. This is especially true if Oracle Clusterware does not manage the system components on which a resource depends. To manage automatic restarts, use the `AUTO_START` resource attribute to specify whether Oracle Clusterware should automatically start a resource when a server restarts.

Note: Regardless of the value of the `AUTO_START` resource attribute for a resource, the resource can start if another resource has a hard or weak start dependency on it or if the resource has a pullup start dependency on another resource.

See Also:

- "Start Dependencies" on page 5-10 for more information
- Appendix B, "Oracle Clusterware Resource Reference" for more information about the `AUTO_START` resource attribute

Automatically Manage Restart Attempts Counter for Resources

When a resource fails, Oracle Clusterware attempts to restart the resource the number of times specified in the `RESTART_ATTEMPTS` resource attribute, regardless of how often the resource fails. The `crsd` process maintains an internal counter to track how often Oracle Clusterware restarts a resource. The number of times Oracle Clusterware attempts to restart a resource is reflected in the `CURRENT_RCOUNT` resource attribute. Oracle Clusterware can automatically manage the restart attempts counter based on the stability of a resource. Use the `UPTIME_THRESHOLD` resource attribute to indicate resource stability.

RESTART_ATTEMPTS and CURRENT_RCOUNT Failure Scenarios

Some failure scenarios for the `RESTART_ATTEMPTS` and `CURRENT_RCOUNT` resource attributes are:

- A resource keeps restarting: The resource does not meet the uptime threshold criteria and is stopped after restarting for the number of attempts set by the value for `RESTART_ATTEMPTS`.
- A server fails or restarts: Oracle Clusterware resets the value for `CURRENT_RCOUNT` to `0` either when a resource relocates or when it restarts on the same server.
- The `crsd` process fails: Because Oracle Clusterware stores both `CURRENT_RCOUNT` and `RESTART_ATTEMPTS` information in OCR, the behavior is not affected.

A

Cluster Verification Utility Reference

The Cluster Verification Utility (CVU) performs system checks in preparation for installation, patch updates, or other system changes. Using CVU ensures that you have completed the required system configuration and preinstallation steps so that your Oracle grid infrastructure or Oracle Real Application Clusters (Oracle RAC) installation, update, or patch operation completes successfully.

With Oracle Clusterware 11*g* release 2 (11.2), Oracle Universal Installer is fully integrated with CVU, automating many CVU prerequisite checks. Oracle Universal Installer runs all prerequisite checks and associated fixup scripts when you run the installer.

> **See Also:** *Oracle Grid Infrastructure Installation Guide* and *Oracle Real Application Clusters Installation Guide* for information about how to manually install CVU

Note: Check for and download updated versions of CVU on Oracle Technology Network at

`http://www.oracle.com/technology/index.html`

This appendix describes CVU under the following topics:

- About Cluster Verification Utility
  - Overview
  - Operational Notes
  - Special Topics
- Cluster Verification Utility Command Reference
- Troubleshooting and Diagnostic Output for CVU

About Cluster Verification Utility

This section includes topics which relate to using CVU.

- Overview
- Operational Notes
  - Installation Requirements
  - Usage Information
  - CVU Configuration File
  - Privileges and Security
  - Using CVU Help
- Special Topics
  - Entry and Exit Criteria
  - Verbose Mode and UNKNOWN Output
  - CVU Node List Shortcuts

Overview

CVU can verify the primary cluster components during an operational phase or stage. A component can be basic, such as free disk space, or it can be complex, such as checking Oracle Clusterware integrity. For example, CVU can verify multiple Oracle Clusterware subcomponents across Oracle Clusterware layers. Additionally, CVU can check disk space, memory, processes, and other important cluster components. A stage could be, for example, database installation, for which CVU can verify whether your system meets the criteria for an Oracle Real Application Clusters (Oracle RAC) installation. Other stages include the initial hardware setup and the establishing of system requirements through the fully operational cluster setup.

Table A–1 lists verifications you can perform using CVU.

Table A–1 Performing Various CVU Verifications

Verification to Perform	CVU Commands to Use
System requirements verification	`cluvfy comp sys`
Oracle ACFS verification	`cluvfy stage [-pre | -post] cfs`
Storage verifications	▪ `cluvfy comp cfs` ▪ `cluvfy comp space` ▪ `cluvfy comp ssa` ▪ `cluvfy stage [-pre | -post] acfscfg`
Network verification	`cluvfy stage -post hwos`
Connectivity verifications	▪ `cluvfy comp nodecon` ▪ `cluvfy comp nodereach`
Cluster Time Synchronization Services verification	`cluvfy comp clocksync`
User and Permissions verification	`cluvfy comp admprv`
Node comparison and verification	`cluvfy comp peer`
Installation verification	▪ `cluvfy stage -pre dbcfg` ▪ `cluvfy stage -pre dbinst` ▪ `cluvfy stage [-pre | -post] crsinst` ▪ `cluvfy stage [-pre | -post] hacfg` ▪ `cluvfy stage [-pre | -post] nodeadd`
Deletion verification	`cluvfy stage -post nodedel`
Cluster Integrity verification	`cluvfy comp clu`

Table A–1 (Cont.) Performing Various CVU Verifications

Verification to Perform	CVU Commands to Use
Oracle Clusterware and Oracle ASM Component verifications	■ `cluvfy comp asm` ■ `cluvfy comp clumgr` ■ `cluvfy comp crs` ■ `cluvfy comp gns` ■ `cluvfy comp gpnp` ■ `cluvfy comp ha` ■ `cluvfy comp nodeapp` ■ `cluvfy comp ocr` ■ `cluvfy comp ohasd` ■ `cluvfy comp olr` ■ `cluvfy comp scan` ■ `cluvfy comp software` ■ `cluvfy comp acfs`

Operational Notes

This section includes the following topics:

Installation Requirements

CVU installation requirements are:

- At least 30 MB free space for the CVU software on the node from which you run CVU
- A work directory with at least 25 MB free space on each node

> **Note:** When using CVU, the utility attempts to copy any needed information to the CVU work directory. It checks for the existence of the work directory on each node. If it does not find one, then it attempts to create one. Make sure that the CVU work directory either exists on all nodes in your cluster or proper permissions are established on each node for the user running CVU to create that directory. Set this directory using the `CV_DESTLOC` environment variable. If you do not set this variable, then CVU uses `/tmp` as the work directory on Linux and UNIX systems, and `C:\temp` on Windows systems.

Usage Information

CVU includes two scripts: `runcluvfy.sh`, which you use before installing Oracle software, and `cluvfy`, located in the *`Grid_home`*`/bin` directory. The `runcluvfy.sh` script contains temporary variable definitions which enable it to be run before installing Oracle grid infrastructure or Oracle Database. After you install Oracle grid infrastructure, use the `cluvfy` command to check prerequisites and perform other system readiness checks.

> **Note:** Oracle Universal Installer runs `cluvfy` to check all prerequisites during Oracle software installation.

Before installing Oracle software, run `runcluvfy.sh` from the mountpoint path of the software media, as follows:

```
cd /mountpoint
./runcluvfy.sh options
```

In the preceding example, the *`options`* variable represents CVU command options that you select. For example:

```
$ cd /mnt/dvdrom
$ ./runcluvfy.sh comp nodereach -n node1,node2 -verbose
```

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

You can use the `-fixup` flag with certain CVU commands to generate **fixup script**s before installation. Oracle Universal Installer can also generate fixup scripts during installation. The installer then prompts you to run the script as `root` in a separate terminal session. If you generate a fixup script from the command line, then you can run it as `root` after it is generated. When you run the script, it raises kernel values to required minimums, if necessary, and completes other operating system configuration.

Run the CVU command-line tool using the `cluvfy` command. Using `cluvfy` does not adversely affect your cluster environment or your installed software. You can run `cluvfy` commands at any time, even before the Oracle Clusterware installation. In fact, CVU is designed to assist you as soon as your hardware and operating system are operational. If you run a command that requires Oracle Clusterware on a node, then CVU reports an error if Oracle Clusterware is not yet installed on that node.

The node list that you use with CVU commands should be a comma-delimited list of host names without a domain. CVU ignores domains while processing node lists. If a CVU command entry has duplicate node entries after removing domain information, then CVU eliminates the duplicate node entries. Wherever supported, you can use the `-n all` option to verify all of your cluster nodes that are part of a specific Oracle RAC installation.

For network connectivity verification, CVU discovers all of the available network interfaces if you do not specify an interface on the CVU command line. For storage accessibility verification, CVU discovers shared storage for all of the supported storage types if you do not specify a particular storage identification on the command line. CVU also discovers the Oracle Clusterware home if one is available.

CVU Configuration File

You can use the CVU configuration file to define specific inputs for the execution of CVU. The path for the configuration file is `CV_HOME/cv/admin/cvu_config`. You can modify this using a text editor. The inputs to the tool are defined in the form of key entries. You must follow these rules when modifying the CVU configuration file:

- Key entries have the syntax `name=value`
- Each key entry and the value assigned to the key only defines one property
- Lines beginning with the number sign (`#`) are comment lines and are ignored
- Lines that do not follow the syntax `name=value` are ignored

The following is the list of keys supported by CVU:

- `CV_NODE_ALL`: If set, it specifies the list of nodes that should be picked up when Oracle Clusterware is not installed and a `-n` all option has been used in the command line. By default, this entry is commented out.
- `CV_ORACLE_RELEASE`: If set, it specifies the specific Oracle release (`10gR1`, `10gR2`, or `11gR1`) for which the verifications have to be performed. If set, you do not have to use the `-r` *`release`* option wherever it is applicable.
- `CV_RAW_CHECK_ENABLED`—If set to `TRUE`, it enables the check for accessibility of shared disks on RedHat release 3.0. This shared disk accessibility check requires that you install a `cvuqdisk rpm` on all of the nodes. By default, this key is set to `TRUE` and shared disk check is enabled.

- CV_XCHK_FOR_SSH_ENABLED—If set to TRUE, it enables the X-Windows check for verifying user equivalence with ssh. By default, this entry is commented out and X-Windows check is disabled.
- ORACLE_SRVM_REMOTECOPY—If set, it specifies the location for the scp or rcp command to override the CVU default value. By default, this entry is commented out and CVU uses /usr/bin/scp and /usr/sbin/rcp.
- ORACLE_SRVM_REMOTESHELL—If set, it specifies the location for ssh/rsh command to override the CVU default value. By default, this entry is commented out and the tool uses /usr/sbin/ssh and /usr/sbin/rsh.

If CVU does not find a key entry defined in the configuration file, then CVU searches for the environment variable that matches the name of the key. If the environment variable is set, then CVU uses its value, otherwise CVU uses a default value for that entity.

Privileges and Security

CVU assumes that the current user is the user that owns the Oracle software installation, for example, oracle. You do not have to be the root user to use CVU.

Using CVU Help

The cluvfy commands have context sensitive help that shows their usage based on the command-line arguments that you enter. For example, if you enter cluvfy, then CVU displays high-level generic usage text describing the stage and component syntax. The following is a list of context help commands:

- cluvfy -help: CVU displays detailed CVU command information.
- cluvfy comp -list: CVU displays a list of components that can be checked, and brief descriptions of how the utility checks each component.
- cluvfy comp -help: CVU displays detailed syntax for each of the valid component checks.
- cluvfy stage -list: CVU displays a list of valid stages.
- cluvfy stage -help: CVU displays detailed syntax for each of the valid stage checks.

You can also use the -help option with any CVU command. For example, cluvfy stage -pre nodeadd -help returns detailed information for that particular command.

If you enter an invalid CVU command, then CVU shows the correct usage for that command. For example, if you type cluvfy stage -pre dbinst, then CVU shows the correct syntax for the precheck commands for the dbinst stage. Enter the cluvfy -help command to see detailed CVU command information.

Note: CVU only supports an English-based syntax and English online help.

Special Topics

This section includes the following topics:

Using CVU to Determine if Installation Prerequisites are Complete

You can use CVU to determine which system prerequisites for installation are completed. Use this option if you are installing Oracle 11*g* release 2 (11.2) software on a system with a pre-existing Oracle software installation. In using this option, note the following:

- You must run CVU as the user account you plan to use to run the installation. You cannot run CVU as `root`, and running CVU as another user other than the user that is performing the installation does not ensure the accuracy of user and group configuration for installation or other configuration checks.
- Before you can complete a clusterwide status check, SSH must be configured for all cluster nodes. You can use the installer to complete SSH configuration, or you can complete SSH configuration yourself between all nodes in the cluster.
- CVU can assist you by finding preinstallation steps that must be completed, but it cannot perform preinstallation tasks.

Use the following syntax to determine what preinstallation steps are completed, and what preinstallation steps you must perform; running the command with the `-fixup` flag generates a fixup script to complete kernel configuration tasks as needed:

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

In the preceding syntax example, replace the *`node_list`* variable with the names of the nodes in your cluster, separated by commas. On Windows, you must enclose the comma-delimited node list in double quotation marks (`""`).

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

```
$ cd /mnt/dvdrom/
$ ./runcluvfy.sh stage -pre crsinst -fixup -n node1,node2,node3
```

Review the CVU report, and complete additional steps as needed.

> **See Also:** Your platform-specific installation guide for more information about installing your product

Using CVU with Oracle Database 10*g* Release 1 or 2

You can use CVU on the Oracle Database 11*g* release 2 (11.2) media to check system requirements for Oracle Database 10*g* Release 1 (10.1) and later installations. To use CVU to check 10. 2 installations, append the command `-r 10gR2` flag to the standard CVU system check commands.

For example, to perform a verification check for a Cluster Ready Services 10. 2 installation, on a system where the media mountpoint is `/mnt/dvdrom`, and the cluster nodes are `node1`, `node2`, and `node3`, enter the following command:

```
$ cd /mnt/dvdrom
$ ./runcluvfy.sh stage -pre crsinst -n node1,node2,node3 -r 10gR2
```

Note: If you do not specify a release version to check, then CVU checks for 11*g* release 2 (11.2) requirements.

Entry and Exit Criteria

When verifying stages, CVU uses entry and exit criteria. In other words, each stage has entry criteria that define a specific set of verification tasks to be performed before initiating that stage. This check prevents you from beginning a stage, such as installing Oracle Clusterware, unless you meet the Oracle Clusterware stage's prerequisites.

The exit criteria for a stage define another set of verification tasks that you must perform after the completion of the stage. Post-checks ensure that the activities for that stage have been completed. Post-checks identify stage-specific problems before they propagate to subsequent stages.

Verbose Mode and UNKNOWN Output

Although by default CVU reports in nonverbose mode by only reporting the summary of a test, you can obtain detailed output by using the `-verbose` argument. The `-verbose` argument produces detailed output of individual checks and where applicable shows results for each node in a tabular layout.

If a `cluvfy` command responds with `UNKNOWN` for a particular node, then this is because CVU cannot determine whether a check passed or failed. The cause of this could be a loss of reachability or the failure of user equivalence to that node. The cause could also be any system problem that was occurring on that node when CVU was performing a check.

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

- The node is down
- Executables that CVU requires are missing in *`Grid_home`*`/bin` or the *`Oracle home`* directory
- The user account that ran CVU does not have privileges to run common operating system executables on the node
- The node is missing an operating system patch or a required package
- The node has exceeded the maximum number of processes or maximum number of open files, or there is a problem with IPC segments, such as shared memory or semaphores

CVU Node List Shortcuts

You can use the following node list shortcuts:

To provide CVU a list of all of the nodes of a cluster, enter `-n all`. CVU attempts to obtain the node list in the following order:

1. If vendor clusterware is available, then CVU selects all of the configured nodes from the vendor clusterware using the `lsnodes` utility.
2. If Oracle Clusterware is installed, then CVU selects all of the configured nodes from Oracle Clusterware using the `olsnodes` utility.
3. If neither the vendor clusterware nor Oracle Clusterware is installed, then CVU searches for a value for the `CV_NODE_ALL` key in the configuration file.
4. If vendor clusterware and Oracle Clusterware are not installed and no key named `CV_NODE_ALL` exists in the configuration file, then CVU searches for a value for the `CV_NODE_ALL` environmental variable.

If you have not set this variable, then CVU reports an error.

To provide a partial node list, you can set an environmental variable and use it in the CVU command. For example, on Linux or UNIX systems you can enter:

```
setenv MYNODES node1,node3,node5
cluvfy comp nodecon -n $MYNODES [-verbose]
```

Cluster Verification Utility Command Reference

This section lists and describes the following CVU commands:

- `cluvfy comp acfs`
- `cluvfy comp admprv`
- `cluvfy comp asm`
- `cluvfy comp cfs`
- `cluvfy comp clocksync`
- `cluvfy comp clu`
- `cluvfy comp clumgr`
- `cluvfy comp crs`
- `cluvfy comp gns`
- `cluvfy comp gpnp`
- `cluvfy comp ha`
- `cluvfy comp nodeapp`
- `cluvfy comp nodecon`
- `cluvfy comp nodereach`
- `cluvfy comp ocr`
- `cluvfy comp ohasd`
- `cluvfy comp olr`
- `cluvfy comp peer`
- `cluvfy comp scan`
- `cluvfy comp software`
- `cluvfy comp space`
- `cluvfy comp ssa`
- `cluvfy comp sys`
- `cluvfy comp vdisk`
- `cluvfy stage [-pre | -post] cfs`
- `cluvfy stage [-pre | -post] crsinst`
- `cluvfy stage -pre dbcfg`
- `cluvfy stage -pre dbinst`
- `cluvfy stage [-pre | -post] hacfg`
- `cluvfy stage -post hwos`
- `cluvfy stage [-pre | -post] nodeadd`
- `cluvfy stage -post nodedel`
- `cluvfy stage [-pre | -post] acfscfg`

cluvfy comp acfs

Use the `cluvfy comp acfs` component verification command to check the integrity of Oracle Cluster File System on all nodes in a cluster.

Syntax

```
cluvfy comp acfs [-n [node_list] | [all]] [-f file_system] [-verbose]
```

Parameters

Table A–2 cluvfy comp acfs Command Parameters

Parameter	Description
`-n node_list`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-f file_system`	The name of the file system to check.
`-verbose`	CVU prints detailed output.

cluvfy comp admprv

Use the `cluvfy comp admprv` command to verify user accounts and administrative permissions-related issues.

Syntax

```
cluvfy comp admprv [-n node_list] [-verbose] | -o user_equiv [-sshonly] |
-o crs_inst [-orainv orainventory_group] [-fixup [-fixupdir fixup_dir] |]
-o db_inst [-osdba osdba_group] [-fixup [-fixupdir fixup_dir] |]
-o db_config -d oracle_home [-fixup [-fixupdir fixup_dir]]
```

Parameters

Table A–3 cluvfy comp admprv Command Parameters

Parameter	Description
`-n node_list`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.
`-o user_equiv`	Checks user equivalence between the nodes.
`-sshonly`	Check user equivalence for `ssh` setup only.
`-o crs_inst`	Checks administrative privileges for installing Oracle Clusterware.
`-orainv orainventory_group`	The name of the Oracle inventory group. If you do not specify this option, then CVU uses `oinstall` as the inventory group.
`-o db_inst`	Checks administrative privileges for installing Oracle RAC.
`-osdba osdba_group`	The name of the OSDBA group. If you do not specify this option, then CVU uses `dba` as the OSDBA group.
`-o db_config`	Checks administrative privileges for creating or configuring a database.
`-d oracle_home`	The directory where the Oracle software is installed.
`-fixup [-fixupdir fixup_dir]`	Specifies that if the verification fails, then CVU generates fixup instructions, if feasible. Use the `-fixupdir` option to specify a specific directory in which CVU generates the fixup instructions. If you do not specify a directory, CVU uses its work directory.

Usage Notes

- To verify whether user equivalence exists on specific nodes, use the `-o user_equiv` argument. On Linux and UNIX platforms, this command verifies user equivalence first using `ssh` and then using `rsh`, if the `ssh` check fails. To verify the equivalence only through `ssh`, use the `-sshonly` option. By default, the equivalence check does not verify X-Windows configurations, such as whether you have disabled X-forwarding, whether you have the proper setting for the `DISPLAY` environment variable, and so on.
- To verify X-Windows aspects during user equivalence checks, set the `CV_XCHK_FOR_SSH_ENABLED` key to `TRUE` in the configuration file that resides in the `CV_HOME/cv/admin/cvu_config` directory before you run the `admprv -o user_`

`equiv` command. Use the `-o crs_inst` argument to verify whether you have permissions to install Oracle Clusterware.

- Use the `-o db_inst` argument to verify the permissions that are required for installing Oracle RAC and the `-o db_config` argument to verify the permissions that are required for creating an Oracle RAC database or for modifying an Oracle RAC database configuration.

Examples

Example 1: Verifying User Equivalence for All Nodes

You can verify user equivalence for all of the nodes by running the following command:

```
cluvfy comp admprv -n all -o user_equiv -verbose
```

cluvfy comp asm

Use the `cluvfy comp asm` component verification command to check the integrity of Oracle Automatic Storage Management (Oracle ASM) on all nodes in the cluster.

Syntax

```
cluvfy comp asm [-n node_list | all ] [-verbose]
```

Parameters

Table A–4 cluvfy comp asm Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp cfs

Use the `cluvfy comp cfs` component verification command to check the integrity of the OCFS or OCFS2 file system you provide using the `-f` option. CVU checks the sharing of the file system from the nodes in the node list.

Syntax

```
cluvfy comp cfs [-n node_list | all] -f file_system [-verbose]
```

Parameters

Table A–5 cluvfy comp cfs Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-f` *`file_system`*	The name of the file system.
`-verbose`	CVU prints detailed output.

Usage Notes

- This check is supported for OCFS2 version 1.2.1, or higher.

Examples

Example 1: Verifying the Integrity of a Cluster File System on All the Nodes

To verify the integrity of the cluster file system `/oradbshare` on all of the nodes, use the following command:

```
cluvfy comp cfs -f /oradbshare –n all -verbose
```

cluvfy comp clocksync

Use the `cluvfy comp clocksync` component verification command to check Oracle Cluster Time Synchronization Service (CTSS) on all nodes in the node list. If you specify the `-noctss` option, then CVU does not perform a check on CTSS. Instead, CVU checks the platform's native time synchronization service, such as NTP.

Syntax

```
cluvfy comp clocksync [-noctss] [-n node_list | all] [-verbose]
```

Parameters

Table A–6 cluvfy comp clocksync Command Parameters

Parameter	Description
`-noctss`	Checks the integrity of a clock synchronization service native to the platform other than CTSS.
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp clu

Use the `cluvfy comp clu` component verification command to check the integrity of the cluster on all the nodes in the node list.

Syntax

```
cluvfy comp clu [-n node_list | all] [-verbose]
```

Parameters

Table A–7 cluvfy comp clu Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp clumgr

Use the `cluvfy comp clumgr` component verification command to check the integrity of Oracle Cluster Synchronization Services (CSS) on all the nodes in the node list.

Syntax

```
cluvfy comp clumgr [-n node_list | all] [-verbose]
```

Parameters

Table A–8 cluvfy comp clumgr Command Parameters

Parameter	Description
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp crs

Run the `cluvfy comp crs` component verification command to check the integrity of all of Oracle Clusterware.

Syntax

```
cluvfy comp crs [-n node_list | all] [-verbose]
```

Parameters

Table A–9 cluvfy comp crs Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp gns

Use the `cluvfy comp gns` component verification command to verify the integrity of the Oracle Grid Naming Service (GNS) on the cluster.

Syntax

```
cluvfy comp gns [-n node_list] [-verbose]
```

Parameters

Table A–10 cluvfy comp gns Command Parameters

Parameter	Description
`-n` *node_list*	The comma-delimited list of nondomain qualified node names on which to conduct the verification.
`-verbose`	CVU prints detailed output.

cluvfy comp gpnp

Use the `cluvfy comp gpnp` component verification command to check the integrity of Grid Plug and Play on all of the nodes in a cluster.

Syntax

```
cluvfy comp gpnp [-n node_list] [-verbose]
```

Parameters

Table A–11 cluvfy comp gpnp Command Parameters

Parameter	Description
`-n` *`node_list`*	The comma-delimited list of nondomain qualified node names on which to conduct the verification.
`-verbose`	CVU prints detailed output.

cluvfy comp ha

Use the `cluvfy comp ha` component verification command to check the integrity of high availability on a local node.

Syntax

```
cluvfy comp ha [-verbose]
```

Parameters

Table A–12 cluvfy comp ha Command Parameters

Parameter	Description
`-verbose`	CVU prints detailed output.

cluvfy comp nodeapp

Use the component `cluvfy comp nodeapp` command to check for the existence of node applications, namely VIP, ONS, and GSD, on all of the nodes.

Syntax

```
cluvfy comp nodeapp [-n node_list | all] [-verbose]
```

Parameters

Table A–13 cluvfy comp nodeapp Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp nodecon

Use the `cluvfy comp nodecon` component verification command to check the connectivity among the nodes specified in the node list. If you provide an interface list, then CVU checks the connectivity using the given interfaces. If you do not provide an interface list, then CVU discovers available interfaces and checks connectivity using each of them.

Syntax

```
cluvfy comp nodecon -n [node_list | all] [-i interface_list] [-verbose]
```

Parameters

Table A–14 cluvfy comp nodecon Command Parameters

Parameter	Description
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster.
`-i interface_list`	The comma-delimited list of interface names.
`-verbose`	CVU prints detailed output.

Usage Notes

- You can run this command in verbose mode to identify the mappings between the interfaces, IP addresses, and subnets.
- Use the `nodecon` command without the `-i` option and with `-n` set to `all` to use CVU to:
  - Discover all of the network interfaces that are available on the cluster nodes
  - Review the interfaces' corresponding IP addresses and subnets
  - Obtain the list of interfaces that are suitable for use as VIPs and the list of interfaces to private interconnects
  - Verify the connectivity between all of the nodes through those interfaces

Examples

Example 1: Verifying the connectivity between nodes through specific network interfaces:

You can verify the connectivity between the nodes `node1`,`node2`, and `node3`, through interface `eth0` by running the following command:

```
cluvfy comp nodecon -n node1,node2,node3 -i eth0 -verbose
```

Example 2: Discovering all available network interfaces and verifying the connectivity between the nodes in the cluster through those network interfaces:

Use the `nodecon` command without the `-i` option and with `-n` set to `all` to use CVU to discover all of the network interfaces that are available on the cluster nodes. CVU then reviews the interfaces' corresponding IP addresses and subnets. Using this information, CVU obtains a list of interfaces that are suitable for use as VIPs and a list

of interfaces to private interconnects. Finally, CVU verifies the connectivity between all of the nodes in the cluster through those interfaces.

```
cluvfy comp nodecon -n all -verbose
```

cluvfy comp nodereach

Use the `cluvfy comp nodereach` component verification command to check the reachability of specified nodes from a source node. Specify the source node with the `-srcnode` option. If you do not specify a source node, then the node on which you run the command is used as the source node.

Syntax

```
cluvfy comp nodereach -n [node_list | all] [-srcnode node] [-verbose]
```

Parameters

Table A–15 cluvfy comp nodereach Command Parameters

Parameter	Description
`-n` *node_list* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster.
`-srcnode`	The node from which CVU performs the reachability test.
`-verbose`	CVU prints detailed output.

cluvfy comp ocr

Use the `cluvfy comp ocr` component verification command to check the integrity of Oracle Cluster Registry (OCR) on all the nodes in the node list.

Syntax

```
cluvfy comp ocr [-n node_list | all] [-verbose]
```

Parameters

Table A–16 cluvfy comp ocr Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

Examples

Example 1: Verifying the integrity of the local OCR on the local node

To verify the integrity of the local OCR on a local node, run the following command:

```
cluvfy comp ocr
```

cluvfy comp ohasd

Use the `cluvfy comp ohasd` component verification command to check the integrity of the Oracle high availability service daemon.

Syntax

```
cluvfy comp ohasd [-n node_list | all] [-verbose]
```

Parameters

Table A–17 cluvfy comp ohasd Command Parameters

Parameter	Description
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp olr

Use the `cluvfy comp olr` component verification command to check the integrity of Oracle Local Registry (OLR) on a local node.

Syntax

```
cluvfy comp olr [-verbose]
```

Parameters

Table A–18 cluvfu comp olr Command Parameters

Parameter	Description
`-verbose`	CVU prints detailed output.

cluvfy comp peer

Use the `cluvfy comp peer` component verification command to check the compatibility of the nodes in the node list against the reference node you specify in the `-refnode` option. If you do not provide a reference node, then CVU reports values for all the nodes in the node list. If you do not specify an OSDBA group, then CVU uses `dba`. If you do not specify an Oracle inventory group, then CVU uses `oinstall`.

Syntax

```
cluvfy comp peer [-refnode node] -n node_list | all
[-r {10gR1 | 10gR2 | 11gR1 | 11gR2}] [-orainv orainventory_group]
[-osdba osdba_group [-verbose]
```

Parameters

Table A–19 cluvfy comp peer Command Parameters

Parameter	Description
`-refnode`	The node that CVU uses as a reference for checking compatibility with other nodes.
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster.
`-r {10gR1 | 10gR2 | 11gR1 | 11gR2}`	Specifies the Oracle Database release that CVU checks as required for installation of Oracle Clusterware or Oracle RAC. If you do not specify this option, then CVU assumes Oracle Database 11*g* release 2 (11.2).
`-orainv orainventory_group`	The name of the Oracle inventory group. If you do not specify this option, then the utility uses `oinstall` as the inventory group.
`-osdba osdba_group`	The name of the OSDBA group. If you do not specify this option, then the utility uses dba as the OSDBA group.
`-verbose`	CVU prints detailed output.

Usage Notes

You can also run the `comp peer` command with the `-refnode` argument to compare the properties of other nodes against the reference node. If you do not specify a value for `-refnode`, then CVU only reports the values from all the nodes in the node list.

Examples

Example 1: List the values of cluster configuration properties on different nodes:

The following command lists the values of several preselected properties on different nodes from Oracle Database 11*g* release 2 (11.2):

```
cluvfy comp peer -n node1,node2,node4,node7 -verbose
```

cluvfy comp scan

Use the `cluvfy comp scan` component verification command to check the Single Client Access Name (SCAN) configuration.

Syntax

```
cluvfy comp scan [-verbose]
```

Parameters

Table A–20 cluvfy comp scan Command Parameters

Parameter	Description
`-verbose`	CVU prints detailed output.

cluvfy comp software

Use the `cluvfy comp software` component verification command to check the files distributed as part of the overall software distribution across nodes.

Syntax

```
cluvfy comp software [-n node_list | all] [-verbose]
```

Parameters

Table A–21 cluvfy comp software Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy comp space

Use the `cluvfy comp space` component verification command to check for free disk space at the location you specify in the `-l` option on all the nodes in the node list.

Syntax

```
cluvfy comp space [-n node_list | all] -l storage_location -z disk_space
{B | K | M | G} [-verbose]
```

Parameters

Table A–22 cluvfy comp space Command Parameters

Parameter	Description
`-n` *node_list* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-l` *storage_location*	The storage path.
`-z` *disk_space*	The required disk space, in units of bytes (B), kilobytes (K), megabytes (M), or gigabytes (G).
`-verbose`	CVU prints detailed output.

Usage Notes

- The `space` component does not support block or raw devices.

Examples

Example 1: Verifying the availability of free space on all nodes

You can verify the availability of at least 2 GB of free space at the location `/home/dbadmin/products` on all of the cluster nodes by running the following command:

```
cluvfy comp space -n all -l /home/dbadmin/products -z 2G -verbose
```

cluvfy comp ssa

Use the `cluvfy comp ssa` component verification command to check the sharing of the locations you specify in the `-s` option. CVU checks sharing for nodes in the node list.

Syntax

```
cluvfy comp ssa [-n node_list | all] [-s storageID_list]
[-t {software | data | ocr_vdisk}] [-verbose]
```

Parameters

Table A–23 cluvfy comp ssa Command Parameters

Parameter	Description
`-n` *node_list* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-s` *storageID_list*	Checks the sharing of the given storage locations for supported storage types. If you do not provide the `-s` option, then CVU discovers supported storage types and checks sharing for each of them.
`-t {software | data | ocr_vdisk}`	Checks the type of Oracle files stored on the storage device. If you do not provide the `-t` option, then CVU discovers or checks the `data` type.
`-verbose`	CVU prints detailed output.

Usage Notes

- The current release of `cluvfy` has the following limitations on Linux regarding shared storage accessibility check.
  - Currently NAS storage (r/w, no attribute caching) and OCFS2 (version 1.2.1 or higher) are supported.
  - For sharedness checks on NAS, `cluvfy` commands require you to have write permission on the specified path. If the `cluvfy` user does not have write permission, `cluvfy` reports the path as `not shared`.
- To perform discovery and shared storage accessibility checks for SCSI disks on Red Hat Linux 3.0 (or higher) and SUSE Linux Enterprise Server, CVU requires the CVUQDISK package. If you attempt to use CVU and the CVUQDISK package is not installed on all of the nodes in your Oracle RAC environment, then CVU responds with an error. See "Shared Disk Discovery on Red Hat Linux" on page A-50 for information about how to install the CVUQDISK package.

Examples

Example 1: Discovering All of the Available Shared Storage Systems on Your System

To discover all of the shared storage systems available on your system, run the following command:

```
cluvfy comp ssa -n all -verbose
```

Example 2: Verifying the Accessibility of a Specific Storage Location

You can verify the accessibility of a specific storage location, such as `/dev/sda`, across the cluster nodes by running the following command:

```
cluvfy comp ssa -n all -s /dev/sda
```

cluvfy comp sys

Use the `cluvfy comp sys` component verification command to check the minimum system requirement for the product specified in the `-p` option on all the nodes in the node list.

Syntax

```
cluvfy comp sys [-n node_list] -p {crs | ha | database} [-r {10gR1 | 10gR2 |
11gR1 | 11gR2}] [-osdba osdba_group] [-orainv orainventory_group]
[-fixup [-fixupdir fixup_dir]] [-verbose]
```

Parameters

Table A–24 cluvfy comp sys Command Parameters

Parameter	Description
`-n node_list`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you do not specify this option, then CVU checks only the local node.
`-p {crs | ha | database}`	Specifies whether CVU checks the system requirements for Oracle Clusterware, Oracle Restart (HA), or Oracle RAC.
`-r {10gR1 | 10gR2 | 11gR1 | 11gR2}`	Specifies the Oracle Database release that CVU checks as required for installation of Oracle Clusterware or Oracle RAC. If you do not specify this option, then CVU assumes Oracle Database 11*g* release 2 (11.2).
`-osdba osdba_group`	The name of the OSDBA group. If you do not specify this option, then CVU uses `dba` as the OSDBA group.
`-orainv orainventory_group`	The name of the Oracle inventory group. If you do not specify this option, then CVU uses `oinstall` as the inventory group.
`-fixup [-fixupdir fixup_dir]`	Specifies that if the verification fails, then CVU generates fixup instructions, if feasible. Use the `-fixupdir` option to specify a specific directory in which CVU generates the fixup instructions. If you do not specify a directory, CVU uses its work directory.
`-verbose`	CVU prints detailed output.

Examples

Example 1: Verifying the System Requirements for Installing Oracle Clusterware

To verify the system requirements for installing Oracle Clusterware on the cluster nodes known as `node1`,`node2` and `node3`, run the following command:

```
cluvfy comp sys -n node1,node2,node3 -p crs -verbose
```

cluvfy comp vdisk

Use the `cluvfy comp vdisk` component verification command to check the *Udev* settings for Oracle Clusterware voting disks on all nodes in the node list.

Syntax

```
cluvfy comp vdisk [-n node_list | all] [-verbose]
```

Parameters

Table A–25 cluvfy comp vdisk Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster. If you do not specify this option, then CVU checks only the local node.
`-verbose`	CVU prints detailed output.

cluvfy stage [-pre | -post] cfs

Use the `cluvfy stage -pre cfs` stage verification command to perform checks on all nodes in a cluster before setting up the Oracle Automatic Storage Management Cluster File System (Oracle ACFS).

Use the `cluvfy stage -post cfs` stage verification command to perform checks on all nodes in a cluster for the file system you specify with the `-f` option after setting up Oracle ACFS.

Syntax

```
cluvfy stage -pre cfs -n [node_list | all] -s storageID_list [-verbose]

cluvfy stage -post cfs -n [node_list | all] -f file_system [-verbose]
```

Parameters

Table A–26 cluvfy stage [-pre|-post] cfs Command Parameters

Parameter	Description
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster.
`-s storageID_list`	Checks a comma-delimited list of storage locations for supported storage types.
`-f file_system`	The name of the file system to check.
`-verbose`	CVU prints detailed output.

cluvfy stage [-pre | -post] crsinst

Use the `cluvfy stage -pre crsinst` command to check all the nodes in the node list before installing Oracle Clusterware. CVU performs additional checks on OCR and voting disks if you specify the `-c` and `-q` options.

Use the `cluvfy stage -post crsinst` command to check all nodes in the node list after installing Oracle Clusterware.

Syntax

```
cluvfy stage -pre crsinst -n [node_list] [-r {10gR1 | 10gR2 | 11gR1 | 11gR2}]
[-c ocr_location_list] [-q voting_disk_list] [-osdba osdba_group]
[-orainv orainventory_group] [-asm -asmgrp asmadmin_group]
[-asm -asmdev asm_device_list] [-fixup [-fixupdir fixup_dir] [-verbose]]

cluvfy stage -post crsinst -n node_list [-verbose]
```

Parameters

Table A–27 cluvfy stage [-pre|-post] crsinst Command Parameters

Parameter	Description
`-n` *node_list*	The comma-delimited list of nondomain qualified node names on which to conduct the verification.
`-r {10gR1 | 10gR2 | 11gR1 | 11gR2}`	Specifies the Oracle Database release that CVU checks as required for installation of Oracle Clusterware. If you do not specify this option, then CVU assumes Oracle Database 11*g* release 2 (11.2).
`-c` *ocr_location_list*	The directory or file system where the OCR is located.
`-q` *voting_disk_list*	The comma-delimited list of directory paths for voting disks.
`-osdba` *osdba_group*	The name of the OSDBA group. If you do not specify this option, then CVU uses `dba` as the OSDBA group.
`-orainv` *orainventory_group*	The name of the Oracle inventory group. If you do not specify this option, then CVU uses `oinstall` as the inventory group.
`-asm -asmgrp` *asmadmin_group*	The name of the Oracle ASM group. If you do not specify this option, then CVU uses `dba` as the Oracle ASM group.
`-asm -asmdev` *asm_device_list*	The list of devices you plan for Oracle ASM to use. If you do not specify this option, then CVU uses an internal operating system-dependent value.
`-fixup [-fixupdir` *fixup_dir*`]`	Specifies that if the verification fails, then CVU generates fixup instructions, if feasible. Use the `-fixupdir` option to specify a specific directory in which CVU generates the fixup instructions. If you do not specify a directory, CVU uses its work directory.
`-verbose`	CVU prints detailed output.

cluvfy stage -pre dbcfg

Use the `cluvfy stage -pre dbcfg` command to check all the nodes in the node list before configuring an Oracle RAC database to verify whether your system meets all of the criteria for creating a database or for making a database configuration change.

Syntax

```
cluvfy stage -pre dbcfg -n [node_list] -d Oracle_home [-fixup [-fixupdir fixup_
dir]]
[-verbose]
```

Parameters

Table A–28 cluvfy stage -pre dbcfg Command Parameters

Parameter	Description
`-n node_list`	The comma-delimited list of nondomain qualified node names on which to conduct the verification.
`-d Oracle_home`	The Oracle home location for the database that is being checked.
`-fixup [-fixupdir fixup_dir]`	Specifies that if the verification fails, then CVU generates fixup instructions, if feasible. Use the `-fixupdir` option to specify a specific directory in which CVU generates the fixup instructions. If you do not specify a directory, CVU uses its work directory.
`-verbose`	CVU prints detailed output.

cluvfy stage -pre dbinst

Use the `cluvfy stage -pre dbinst` command to check the nodes in the node list before installing an Oracle RAC database to verify that your system meets all of the criteria for an Oracle RAC installation.

Syntax

```
cluvfy stage -pre dbinst -n [node_list] [-r {10gR1 | 10gR2 | 11gR1 | 11gR2}]
[-osdba osdba_group] [-fixup [-fixupdir fixup_dir] [-verbose]
```

Parameters

Table A–29 cluvfy stage -pre dbinst Command Parameters

Parameter	Description
`-n node_list`	The comma-delimited list of nondomain qualified node names on which to conduct the verification.
`-r {10gR1 | 10gR2 | 11gR1 | 11gR2}`	Specifies the Oracle Database release that CVU checks as required for installation of Oracle RAC. If you do not specify this option, then CVU assumes Oracle Database 11*g* release 2 (11.2).
`-osdba osdba_group`	The name of the OSDBA group. The name of the OSDBA group. If you do not specify this option, then CVU uses `dba` as the OSDBA group.
`[-fixup [-fixupdir fixup_dir`	The name of the Oracle inventory group. If you do not specify this option, then CVU uses oinstall as the inventory group. If you do not specify a directory, CVU uses its work directory.
`-verbose`	CVU prints detailed output.

cluvfy stage [-pre | -post] hacfg

Use the `cluvfy stage -pre hacfg` command to check a local node before configuring a high availability installation.

Syntax

```
cluvfy stage -pre hacfg [-osdba osdba_group] [-orainv orainventory_group]
[-fixup [-fixupdir fixup_dir]] [-verbose]

cluvfy stage -post hacfg [-verbose]
```

Parameters

Table A–30 cluvfy stage [-pre\|-post] hacfg Command Parameters

Parameter	Description
`-osdba` *osdba_group*	The name of the OSDBA group. If you do not specify this option, then CVU uses `dba` as the OSDBA group.
`-orainv` *orainventory_group*	The name of the Oracle inventory group. If you do not specify this option, then CVU uses `oinstall` as the inventory group.
`-fixup -fixupdir` *fixup_dir*	Specifies that if the verification fails, then CVU generates fixup instructions, if feasible. Use the `-fixupdir` option to specify a specific directory in which CVU generates the fixup instructions. If you do not specify a directory, CVU uses its work directory.
`-verbose`	CVU prints detailed output.

cluvfy stage -post hwos

Use the `cluvfy stage -post hwos` stage verification command to perform network and storage verifications on all the nodes in the cluster.

Syntax

```
cluvfy stage -post hwos -n [node_list | all] [-s storageID_list] [-verbose]
```

Parameters

Table A–31 cluvfy stage -post hwos Command Parameters

Parameter	Description
`-n` *`node_list`* | `all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster.
`-s` *`storageID_list`*	Checks a comma-delimited list of storage locations for supported storage types. If you do not provide the `-s` option, then CVU discovers supported storage types and checks sharing for each of them.
`-verbose`	CVU prints detailed output.

cluvfy stage [-pre | -post] nodeadd

Use the `cluvfy stage -pre nodeadd` command to check the nodes that you want to add to an existing cluster, and to verify the integrity of the cluster before you add the nodes.

This command verifies that the system configuration, such as the operating system version, software patches, packages, and kernel parameters, for the nodes that you want to add, is compatible with the existing cluster nodes, and that the clusterware is successfully operating on the existing nodes. Run this node on any node of the existing cluster.

Use the `cluvfy stage -post nodeadd` command to verify that any number of specific nodes has been successfully added to the cluster at the network, shared storage, and clusterware levels.

Syntax

```
cluvfy stage -pre nodeadd -n [node_list] [-fixup [-fixupdir fixup_dir]] [-verbose]

cluvfy stage -post nodeadd -n [node_list] [-verbose]
```

Parameters

Table A–32 cluvfy stage [-pre | -post] nodeadd Command Parameters

Parameter	Description
`-n` *node_list*	A comma-delimited list of nondomain qualified node names on which to conduct the verification. These are nodes you are adding to the cluster.
`-fixup [-fixupdir` *fixup_dir*`]`	Specifies that if the verification fails, then CVU generates fixup instructions, if feasible. Use the `-fixupdir` option to specify a specific directory in which CVU generates the fixup instructions. If you do not specify a directory, CVU uses its work directory.
`-verbose`	CVU prints detailed output.

cluvfy stage -post nodedel

Use the `cluvfy stage -post nodedel` command to verify that specific nodes have been successfully deleted from a cluster. Typically, this command verifies that the node-specific interface configuration details have been removed, the nodes are no longer a part of cluster configuration, and proper Oracle ASM cleanup has been performed.

Syntax

```
cluvfy stage -post nodedel -n [node_list | all] [-verbose]
```

Parameters

Table A–33 cluvfy stage [-pre | -post] nodedel Command Parameters

Parameter	Description
`-n node_list | all`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you specify `all`, then CVU checks all of the nodes in the cluster.
`-verbose`	CVU prints detailed output.

cluvfy stage [-pre | -post] acfscfg

Use the `cluvfy stage -pre acfscfg` command to check an existing cluster before you configure Oracle ACFS.

Use the `cluvfy stage -post acfscfg` to check an existing cluster after you configure Oracle ACFS.

Syntax

```
cluvfy stage -pre acfscfg [-n node_list] -asmdev asm_device_list [-verbose]

cluvfy stage -post acfscfg -n [node_list] [-verbose]
```

Parameters

Table A–34 cluvfy stage [-pre|-post] acfscfg Command Parameters

Parameter	Description
`-n node_list`	The comma-delimited list of nondomain qualified node names on which to conduct the verification. If you do not specify this option, then CVU checks only the local node.
`-asmdev asm_device_list`	The list of devices you plan for Oracle ASM to use.
`-asmgroup asmadmin_group(s)`	The comma-delimited list of Oracle ASM disk groups to be verified.
`-verbose`	CVU prints detailed output.

Troubleshooting and Diagnostic Output for CVU

This section describes the following troubleshooting topics for CVU:

- Enabling Tracing
- Known Issues for the Cluster Verification Utility

Enabling Tracing

You can enable tracing by setting the environment variable `SRVM_TRACE` to true. For example, in `tcsh` an entry such as `setenv SRVM_TRACE true` enables tracing. The CVU trace files are created in the `CV_HOME/cv/log` directory. Oracle Database automatically rotates the log files and the most recently created log file has the name `cvutrace.log.0`. You should remove unwanted log files or archive them to reclaim disk place if needed. CVU does not generate trace files unless you enable tracing.

To choose the location in which CVU generates the trace files, set the `CV_TRACELOC` environment variable to the absolute path of the desired trace directory.

Known Issues for the Cluster Verification Utility

This section describes the following known limitations for CVU:

- Database Versions Supported by Cluster Verification Utility
- Linux Shared Storage Accessibility (ssa) Check Reports Limitations
- Shared Disk Discovery on Red Hat Linux

Database Versions Supported by Cluster Verification Utility

The current CVU release supports only Oracle Database 10*g* or higher, Oracle RAC, and Oracle Clusterware and CVU is not backward compatible. In other words, CVU cannot check or verify Oracle Database products before Oracle Database 10*g*.

Linux Shared Storage Accessibility (ssa) Check Reports Limitations

The current release of `cluvfy` has the following limitations on Linux regarding shared storage accessibility check.

- OCFS2 (version 1.2.1 or higher) are supported.
- For sharedness checks on NAS, `cluvfy` commands require you to have write permission on the specified path. If the `cluvfy` user does not have write permission, `cluvfy` reports the path as `not shared`.

Shared Disk Discovery on Red Hat Linux

To perform discovery and shared storage accessibility checks for SCSI disks on Red Hat Linux 4.0 (or higher) and SUSE Linux Enterprise Server, CVU requires the CVUQDISK package. If you attempt to use CVU and the CVUQDISK package is not installed on all of the nodes in your Oracle RAC environment, then CVU responds with an error.

Perform the following procedure to install the CVUQDISK package:

1. Login as the `root` user.
2. Copy the `rpm`, `cvuqdisk-1.0.6-1.rpm`, to a local directory. You can find this rpm in the `rpm` subdirectory of the top-most directory in the Oracle Clusterware installation media. For example, you can find `cvuqdisk-1.0.6-1.rpm` in the directory `/`*`mountpoint`*`/clusterware/rpm/` where *`mountpoint`* is the mounting point for the disk on which the directory is located.
3. Set the `CVUQDISK_GRP` environment variable to a group that should own the CVUQDISK package binaries. If `CVUQDISK_GRP` is not set, then, by default, the `oinstall` group is the owner's group.
4. Determine whether previous versions of the CVUQDISK package are installed by running the command `rpm -q cvuqdisk`. If you find previous versions of the CVUQDISK package, then remove them by running the command `rpm -e cvuqdisk` *`previous_version`* where *`previous_version`* is the identifier of the previous CVUQDISK version.
5. Install the latest CVUQDISK package by running the command `rpm -iv cvuqdisk-1.0.6-1.rpm`.

B

Oracle Clusterware Resource Reference

This appendix is a reference for Oracle Clusterware resources. It includes descriptions and usage examples of all resource attributes and a detailed description and examples of action scripts.

This appendix includes the following topics:

Resource Attributes

This section lists and describes attributes used when you register applications as resources in Oracle Clusterware. Use these attributes with the `crsctl add resource` command, as follows:

```
$ crsctl add resource resource_name -type resource_type
{[-attr "attribute_name='attribute_value', attribute_name='attribute_value'
, ..."] | [-file file_name]}
```

List attribute-value pairs in a comma-delimited list after the `-attr` flag and enclose the value of each attribute in single quotation marks (`''`). Some resource attributes you cannot configure and are read only.

Alternatively, you can create a text file that contains the attribute-value pairs. For example:

```
PLACEMENT=favored
HOSTING_MEMBERS=node1 node2 node3
RESTART_ATTEMPTS@CARDINALITYID(1)=0
RESTART_ATTEMPTS@CARDINALITYID(2)=0
FAILURE_THRESHOLD@CARDINALITYID(1)=2
FAILURE_THRESHOLD@CARDINALITYID(2)=4
FAILURE_INTERVAL@CARDINALITYID(1)=300
FAILURE_INTERVAL@CARDINALITYID(2)=500
CHECK_INTERVAL=2
CARDINALITY=2
```

This section includes the following topics:

Configurable Resource Attributes

This section describes the following resource attributes that you can configure when registering an application as a resource in Oracle Clusterware:

> **Note:** Values for the all attributes must be in lowercase. Attribute names must be in uppercase.

- ACL
- ACTION_SCRIPT
- ACTIVE_PLACEMENT
- AGENT_FILENAME
- AUTO_START
- CARDINALITY
- CHECK_INTERVAL
- DEGREE
- DESCRIPTION
- ENABLED
- FAILURE_INTERVAL
- FAILURE_THRESHOLD
- HOSTING_MEMBERS
- LOAD
- NAME
- OFFLINE_CHECK_INTERVAL
- PLACEMENT
- RESTART_ATTEMPTS
- SCRIPT_TIMEOUT
- SERVER_POOLS
- START_DEPENDENCIES
- START_TIMEOUT
- STOP_DEPENDENCIES
- STOP_TIMEOUT
- TYPE
- UPTIME_THRESHOLD

ACL

Defines the owner of a resource and the access privileges granted to various operating system users and groups. The resource owner defines the operating system user of the owner and its privileges. You configure this optional attribute when you create a resource. If you do not configure this attribute, then the value is based on the identity

of the process creating a resource. You can change the value of the attribute if such a change is allowed based on the existing privileges of the resource.

In the string:

- `owner`: The operating system user that owns a resource and the user under which the action script or application-specific agent run, followed by the privileges of the owner.
- `pgrp`: The operating system group that is the primary group of the owner of a resource, followed by the privileges of members of the primary group.
- `other`: Followed by privileges of others.
- `r`: This access option is the read option and gives the ability to only see a resource, its state, and configuration
- `w`: This access option gives the ability to modify a resource's attributes and to delete the resource
- `x`: This access option gives the ability to start, stop, and relocate a resource

By default, the identity of the client that creates a resource is the `owner`. Also by default, `root`, and the user specified in `owner` have full privileges. You can grant required operating system users and operating system groups their privileges by adding the following lines to the `ACL` attribute:

```
user:user_name:rwx
group:group_name:rwx
```

Usage Example

```
ACL=owner:user_1:rwx,pgrp:osdba:rwx,other::r-
```

ACTION_SCRIPT

An absolute file name that includes the path and file name of an action script. The agent specified in the `AGENT_FILENAME` attribute calls the script specified in the `ACTION_SCRIPT` attribute.

Usage Example

```
ACTION_SCRIPT=fully_qualified_path_to_action_script
```

ACTIVE_PLACEMENT

When set to `1`, Oracle Clusterware uses this attribute to reevaluate the placement of a resource during addition or restart of a cluster server. For resources where `PLACEMENT=favored`, Oracle Clusterware may relocate running resources if the resources run on a non-favored server when a favored one joins the cluster.

Usage Example

```
ACTIVE_PLACEMENT=1
```

AGENT_FILENAME

A fully qualified file name of an agent program that a resource type uses to manage its resources. Every resource type must have an agent program to manage its resources. Resource types use agent programs by either specifying a value for this attribute or inheriting it from their base resource type. There are two script agents included with Oracle Clusterware 11*g* release 2 (11.2): `application` and `scriptagent`. Oracle

Clusterware uses the `application` script agent for resources of the deprecated `application` resource type. The default value for this attribute is `scriptagent`.

Usage Example

```
AGENT_FILENAME=%Grid_home%/bin/application
```

AUTO_START

Indicates whether Oracle Clusterware automatically starts a resource after a cluster server restart. Valid `AUTO_START` values are:

- `always`: Restarts the resource when the server restarts regardless of the state of the resource when the server stopped.
- `restore`: Restores the resource to the same state that it was in when the server stopped. Oracle Clusterware attempts to restart the resource if the value of `TARGET` was `ONLINE` before the server stopped.
- `never`: Oracle Clusterware never restarts the resource regardless of the state of the resource when the server stopped.

CARDINALITY

The number of servers on which a resource can run, simultaneously. This is the upper limit for resource cardinality.

Usage Example

```
CARDINALITY=1
```

CHECK_INTERVAL

The time interval, in seconds, between repeated executions of the `check` action. Shorter intervals enable more frequent checks but also increase resource consumption if you use the script agent. Use an application-specific agent to reduce resource consumption.

Usage Example

```
CHECK_INTERVAL=60
```

DEGREE

The number of instances of a cluster resource that can run on a single server.

Usage Example

```
DEGREE=1
```

DESCRIPTION

Enter a description of the resource you are adding.

Usage Example

```
DESCRIPTION=Apache Web server
```

ENABLED

Oracle Clusterware uses this attribute to manage the state of the resource. Oracle Clusterware does not attempt to manage a disabled (`ENABLED=0`) resource either

directly or because of a dependency to another resource. A disabled resource cannot be started but it can be stopped.

Oracle Clusterware does not actively monitor disabled resources, meaning that Oracle Clusterware does not check their state. However, when Oracle Clusterware starts, it does query the state of disabled resources.

Usage Example

```
ENABLED=1
```

FAILURE_INTERVAL

The interval, in seconds, during which Oracle Clusterware applies the `FAILURE_THRESHOLD` attribute. If the value is zero (`0`), then tracking of failures is disabled.

Usage Example

```
FAILURE_INTERVAL=30
```

FAILURE_THRESHOLD

The number of failures detected within a specified `FAILURE_INTERVAL` for a resource before Oracle Clusterware marks the resource as unavailable and no longer monitors it. If a resource fails the specified number of times, then Oracle Clusterware stops the resource. If the value is zero (`0`), then tracking of failures is disabled. The maximum value is `20`.

Usage Example

```
FAILURE_THRESHOLD=3
```

HOSTING_MEMBERS

A space-separated, ordered list of cluster server names that can host a resource. This attribute is required only when using administrator management, and when the value of the `PLACEMENT` attribute is set to `favored` or `restricted`. When registering applications as `Oracle Clusterware` resources, use the `SERVER_POOLS` attribute, instead.

Note: For resources of `application` type, Oracle Clusterware places servers listed in the `HOSTING_MEMBERS` attribute in the GENERIC server pool.

See Also: "Understanding Server Pools" on page 2-13 for more information about the GENERIC server pool

To obtain a list of candidate node names, run the `olsnodes` command to display a list of your server names.

Usage Example

```
HOSTING_MEMBERS=server1 server2 server3
```

LOAD

Oracle Clusterware interprets the value of this attribute along with that of the `PLACEMENT` attribute. When the value of `PLACEMENT` is `balanced`, the value of `LOAD` determines where best to place a resource. A nonnegative, numeric value that

quantitatively represents how much server capacity an instance of a resource consumes relative to other resources. Oracle Clusterware attempts to place resources on servers with the least total load of running resources.

Usage Example

```
LOAD=1
```

NAME

A case-sensitive, alphanumeric string that names the resource. Oracle recommends a naming convention is to that starts with an alphanumeric prefix, such as `sky1`, and complete the name with an identifier to describe it. A resource name can contain any platform-supported characters except the exclamation point (!) and the tilde (~). A resource name cannot begin with a period (.) nor with the string *ora*.

Usage Example

```
NAME=myApache
```

OFFLINE_CHECK_INTERVAL

Controls offline monitoring of a resource. The value represents the interval (in seconds) that Oracle Clusterware monitors a resource when its state is `OFFLINE`. Monitoring is disabled if the value is `0`.

Usage Example

```
OFFLINE_CHECK_INTERVAL=30
```

PLACEMENT

Specifies how Oracle Clusterware selects a cluster server on which to start a resource. Valid values are `balanced`, `favored`, or `restricted`.

If you set the `PLACEMENT` attribute to `favored` or `restricted`, then you must also assign values to the `SERVER_POOLS` and `HOSTING_MEMBERS` attributes. If you set the value of the `PLACEMENT` attribute to `balanced`, then the `HOSTING_MEMBERS` attribute is not required.

> **See Also:** "Application Placement Policies" on page 5-21 for more information about the `PLACEMENT` attribute

Usage Example

```
PLACEMENT=favored
```

RESTART_ATTEMPTS

The number of times that Oracle Clusterware attempts to restart a resource on the resource's current server before attempting to relocate it. A value of `1` indicates that Oracle Clusterware only attempts to restart the resource once on a server. A second failure causes Oracle Clusterware to attempt to relocate the resource. A value of `0` indicates that there is no attempt to restart but Oracle Clusterware always tries to fail the resource over to another server.

Usage Example

```
RESTART_ATTEMPTS=2
```

SCRIPT_TIMEOUT

The maximum time (in seconds) for an action to run. Oracle Clusterware returns an error message if the action script does not complete within the time specified. The timeout applies to all actions (`start`, `stop`, `check`, and `clean`).

Usage Example

```
SCRIPT_TIMEOUT=45
```

SERVER_POOLS

This attribute creates an affinity between a resource and one or more server pools regarding placement, and is dependent on the value of the `PLACEMENT` attribute.

If a resource can run on any server in a cluster, then use the default value, `*`. Only cluster administrators can specify `*` as the value for this attribute. Otherwise, you must specify in the `SERVER_POOLS` attribute a space-separated list of the server pools to which a particular resource can belong.

- Use the `PLACEMENT` attribute with the `SERVER_POOLS` attribute, as follows: If you set the value of the `PLACEMENT` attribute to either `restricted` or `favored`, then you must also provide a value for the `SERVER_POOLS` attribute when using policy management for the resource.
- If the value for `PLACEMENT` is set to `balanced`, then no value for the `SERVER_POOLS` attribute is required.

> **See Also:** "Understanding Server Pools" on page 2-13 for more information about server pools and "Role-separated Management" on page 2-18 for more information about cluster administrators

Usage Example

```
SERVER_POOLS=pool1 pool2 pool3
```

START_DEPENDENCIES

Specifies a set of relationships that Oracle Clusterware considers when starting a resource. You can specify a space-separated list of dependencies on several resources and resource types on which a particular resource can depend.

Syntax

```
START_DEPENDENCIES=dependency(resource_set) [dependency(resource_set)] [...]
```

In the preceding syntax example the variables are defined, as follows:

- *`dependency`*: Possible values are `hard`, `weak`, `attraction`, `pullup`, and `dispersion`. You can specify each dependency only once, except for `pullup`, which you can specify multiple times.
- *`resource_set`*: A comma-delimited list of resource entities—either individual resources or resource types—enclosed in parentheses `()`, in the form of `res1[, res2[, ...]]`, upon which the resource you are configuring depends.

  Each resource entity is defined, as follows:

  ```
  [modifier1:[modifier2:]] {resource_name | type:resource_type}
  ```

  In the preceding syntax example, *`resource_name`* is the name of a specific resource and `type:`*`resource_type`* is the name of a specific resource type. The resource type must be preceded by `type:`.

Optionally, you can specify modifiers to further configure resource entity dependencies. You can modify each dependency by prefixing the following modifiers to the resource entity:

- `hard([intermediate:][global:]{`*`resource_name`* `| type:`*`resource_type`*`})`: Specify a `hard` start dependency for a resource when you want the resource to start only when a particular resource or resource of a particular type starts.

  Use `intermediate` to specify that Oracle Clusterware can start this resource if a resource on which it depends is in either the `ONLINE` or `INTERMEDIATE` state. If not specified, then resources *must* be in the `ONLINE` state for Oracle Clusterware to start this resource.

  Use `global` to specify that resources are *not* required to reside on the same server as a condition to Oracle Clusterware starting this resource. If not specified, then resources must reside on the same server for Oracle Clusterware to start this resource.

  If you specify the `hard` dependency on a resource type for a resource, then the resource can start if any resource of that particular type is running.

  Note: Oracle recommends that resources with `hard` start dependencies also have `pullup` start dependencies.

- `weak([concurrent:][global:][uniform:]{`*`resource_name`* `| type:`*`resource_type`*`})`: Specify a `weak` start dependency for a resource when you want that resource to start despite whether named resources are running, or not. An attempt to start this resource also attempts to start any resources on which this resource depends if they are not running.

  Use `concurrent` to specify that Oracle Clusterware can start a dependent resource while a resource on which it depends is in the process of starting. If not specified, then resources must complete startup before Oracle Clusterware can start the dependent resource.

  Use `global` to specify that resources are *not* required to reside on the same server as a condition to Oracle Clusterware starting the dependent resource.

  Use `uniform` to start all instances of the resource everywhere the resource can run. If you do not specify a modifier (the default), then the resource starts on the same server as the resource on which it depends.

  If you specify the `weak` start dependency on a resource type for a resource, then the resource can start if any resource of that particular type is running.

- `attraction([intermediate:]{`*`resource_name`* `| type:`*`resource_type`*`})`: Use the `attraction` start dependency when you want this resource to run on the same server with a particular named resource or any resource of a particular type.

  Use `intermediate` to specify that this resource is attracted to resource entities on which it depends that are in the `INTERMEDIATE` state. If not specified, then resources must be in the `ONLINE` state to attract the dependent resource.

  If you specify the `attraction` dependency on a resource type for a resource, then any resource of that particular type attracts the dependent resource.

- `pullup[:always]([intermediate:][global:]{`*`resource_name`* `| type:`*`resource_type`*`})`: When you specify the `pullup` start dependency for a resource, then this resource starts as a result of named resources starting.

  Use the `always` modifier for `pullup` so that Oracle Clusterware starts this resource despite the value of its `TARGET` attribute, whether that value is `ONLINE` or `OFFLINE`. Otherwise, if you do not specify the `always` modifier, then Oracle Clusterware starts this resource only if the value of the `TARGET` attribute is `ONLINE` for the resources on which it depends.

  Use `intermediate` to specify that Oracle Clusterware can start this resource if a resource on which it depends is in either the `ONLINE` or `INTERMEDIATE` state. If not specified, then resources must be in the `ONLINE` state for Oracle Clusterware to start this resource.

  Use `global` to specify that resources on which this resource depends are *not* required to reside on the same server as a condition to Oracle Clusterware starting this resource. If not specified, then resources on which this resource depends must reside on the same server for Oracle Clusterware to start this resource.

  If you specify the `pullup` dependency on a resource type for a resource, then, when any resource of that particular type starts, Oracle Clusterware can start this resource.

  Note: Oracle recommends that resources with `hard` start dependencies also have `pullup` start dependencies.

- `dispersion[:active]([intermediate:]{`*`resource_name`* `| type:`*`resource_type`*`})`: Specify the `dispersion` start dependency for a resource that you want to run on a server that is different from the named resources or resources of a particular type. Resources may still end up running on the same server, depending on availability of servers.

  Use the `active` modifier to configure the `dispersion` dependency so that Oracle Clusterware attempts to relocate the dependent resource to another server if it is co-located with another resource and another server comes online. Oracle Clusterware does not relocate resources to newly available servers unless you specify the `active` modifier.

  Use `intermediate` to specify that Oracle Clusterware can relocate the dependent resource if a resource is in either the `ONLINE` or `INTERMEDIATE` state. If not specified, then resources must be in the `ONLINE` state for dispersion of the dependent resource to occur.

  See Also: "Start Dependencies" on page 5-10 for more details about start dependencies

START_TIMEOUT

The maximum time (in seconds) in which a start action can run. Oracle Clusterware returns an error message if the action does not complete within the time specified. If you do not specify a value for this attribute or you specify `0` seconds, then Oracle Clusterware uses the value of the `SCRIPT_TIMEOUT` attribute.

Usage Example

```
START_TIMEOUT=30
```

STOP_DEPENDENCIES

Specifies a set of relationships that Oracle Clusterware considers when stopping a resource.

Syntax

```
STOP_DEPENDENCIES=dependency(resource_set) [dependency(resource_set)] ...
```

In the preceding syntax example the variables are defined, as follows:

- *dependency*: The only possible value is `hard`.
- *resource_set*: A comma-delimited list, in the form of `res1[, res2 [,...]]`, of resource entities—either individual resources or resource types—upon which the resource you are configuring depends.

  Each resource entity is defined, as follows:

  ```
  [modifier1:[modifier2:][modifier3:]] resource_name | type:resource_type
  ```

  In the preceding syntax example, *resource_name* is the name of a specific resource and `type:`*resource_type* is the name of a specific resource type. The resource type must be preceded by `type:`.

  Optionally, you can specify modifiers to further configure resource entity dependencies. You can modify each dependency by prefixing the following modifiers to the resource entity:

  `hard([intermediate:][global:][shutdown:]{`*resource_name* | `type:`*resource_type*`})`: Specify a `hard` stop dependency for a resource that you want to stop when named resources or resources of a particular resource type stop.

  Use `intermediate` to specify that the dependent resource can remain in an `ONLINE` state if a resource is in either the `ONLINE` or `INTERMEDIATE` state. If not specified, then Oracle Clusterware stops the dependent resource unless resources are in the `ONLINE` state.

  Use `global` to specify that the dependent resource remains in an `ONLINE` state if a resource is in an `ONLINE` state on any node in the cluster. If not specified, then when resources residing on the same server go offline, Oracle Clusterware stops the dependent resource.

  Use `shutdown` to apply this dependency when the Oracle Clusterware stack is shut down. This is a convenient way to affect the order of stopping resources when stopping the stack, without having any affect on planned or unplanned events on the individual resources. This dependency, when used with the `shutdown` modifier, does not go into effect if somebody stops the resource directly, but only when the stack is shut down.

  See Also: "Stop Dependencies" on page 5-12 for more details about stop dependencies

STOP_TIMEOUT

The maximum time (in seconds) in which a stop or clean action can run. Oracle Clusterware returns an error message if the action does not complete within the time specified. If you do not specify this attribute or if you specify `0` seconds, then Oracle Clusterware uses the value of the `SCRIPT_TIMEOUT` attribute.

Usage Example

```
STOP_TIMEOUT=30
```

TYPE

The type of resource indicated when you create a resource. This attribute is required when creating a resource.

Usage Example

```
crsctl add resource resource_name -type resource_type
```

See Also: "Resource Type" on page 5-5 for details of resource types

UPTIME_THRESHOLD

The value for `UPTIME_THRESHOLD` represents the length of time that a resource must be up before Oracle Clusterware considers the resource to be stable. By setting a value for the `UPTIME_THRESHOLD` attribute, you can indicate the stability of a resource.

Enter values for this attribute as a number followed by a letter that represents seconds (s), minutes (m), hours (h), days (d), or weeks (w). For example, a value of `7h` represents an uptime threshold of seven hours.

After the time period you specify for `UPTIME_THRESHOLD` elapses, Oracle Clusterware resets the value for `CURRENT_RCOUNT` to `0`. Oracle Clusterware can alert you when the value for `CURRENT_RCOUNT` reaches the value that you set for `RESTART_ATTEMPTS`.

Note: Oracle Clusterware writes an alert to the clusterware alert log file when the value for `CURRENT_RCOUNT` reaches the value that you set for `RESTART_ATTEMPTS`.

Read-Only Resource Attributes

You can view these attributes when you run the `crsctl status resource` command on a particular resource. Oracle Clusterware sets these attributes when you register resources.

- ACTION_FAILURE_EVENT_TEMPLATE
- LAST_SERVER
- PROFILE_CHANGE_EVENT_TEMPLATE
- CURRENT_RCOUNT
- STATE_CHANGE_EVENT_TEMPLATE
- STATE_DETAILS
- TARGET

ACTION_FAILURE_EVENT_TEMPLATE

This is an internally-managed attribute that you can view only when you run the `crsctl status resource` command on an `ora` resource. You cannot edit this attribute.

CURRENT_RCOUNT

The Oracle Clusterware daemon counts the number of attempts to restart a resource, starting from zero up to the value specified in the `RESTART_ATTEMPTS` attribute.

LAST_SERVER

For `cluster_resource`-type resources, this is an internally managed, read-only attribute that contains the name of the server on which the last start action for the resource succeeded.

For `local_resource`-type resources, this is the name of the server to which the resource instance is pinned.

PROFILE_CHANGE_EVENT_TEMPLATE

This is an internally-managed attribute that you can view only when you run the `crsctl status resource` command on an `ora` resource. You cannot edit this attribute.

STATE_CHANGE_EVENT_TEMPLATE

This is an internally-managed attribute that you can view only when you run the `crsctl status resource` command on an `ora` resource. You cannot edit this attribute.

STATE_DETAILS

An internally managed, read-only attribute that contains details about the state of a resource.

The four resource states—`ONLINE`, `OFFLINE`, `UNKNOWN`, and `INTERMEDIATE`—may map to different resource-specific values, such as mounted, unmounted, and open. Resource agent developers can use the `STATE_DETAILS` attribute to provide a more detailed description of this mapping, resource to the resource state.

Providing details is optional. If details are not provided, then Oracle Clusterware uses only the four possible resource states. Additionally, if the agent cannot provide these details (as may also happen to the value of the resource state), then Oracle Clusterware sets the value of this attribute to provide minimal details about why the resource is in its current state.

TARGET

An internal, read-only attribute that describes the desired state of a resource. Using the `crsctl start` *`resource_name`* or `crsctl stop` *`resource_name`* commands, however, can affect the value of this attribute.

Third-Party Applications Using the Script Agent

This section includes examples of third-party applications using script agents.

Example B–1 shows an action script that fails over the Apache Web server.

Example B–1 Apache Action Script

```
#!/bin/sh

HTTPDCONFLOCATION=/etc/httpd/conf/httpd.conf
WEBPAGECHECK=http://<MyVIP>:80/icons/apache_pb.gif

case $1 in
'start')
    /usr/sbin/apachectl -k start -f $HTTPDCONFLOCATION
   RET=$?
    ;;
'stop')
    /usr/sbin/apachectl -k stop
   RET=$?
    ;;
'clean')
    /usr/sbin/apachectl -k stop
   RET=$?
    ;;
'check')
    /usr/bin/wget -q --delete-after $WEBPAGECHECK
   RET=$?
    ;;
*)
   RET=0
    ;;
esac
# 0: success; 1 : error
if [ $RET -eq 0 ]; then
exit 0
else
exit 1
fi
```

Example B–2 shows the **xclock** script, which is a simple action script using `xclock` available as a default binary on all Linux and UNIX platforms.

Example B–2 xclock Action Script

```
#!/bin/bash
# start/stop/check script for xclock example
# To test this change BIN_DIR to the directory where xclock is based
# and set the DISPLAY variable to a server within your network.

BIN_DIR=/usr/X11R6/bin
LOG_DIR=/tmp
BIN_NAME=xclock
DISPLAY=yourhost.domain.com:0.0
export DISPLAY

if [ ! -d $BIN_DIR ]
then
```

```
        echo "start failed"
        exit 2
fi

PID1=`ps -ef | grep $BIN_NAME | grep -v grep | grep -v xclock_app | awk '{ print
$2 }'`
case $1 in
'start')
        if [ "$PID1" != "" ]
        then
           status_p1="running"
        else
           if [ -x $BIN_DIR/$BIN_NAME ]
           then
             umask 002
             ${BIN_DIR}/${BIN_NAME} & 2>${LOG_DIR}/${BIN_NAME}.log
             status_p1="started"
           else
             echo `basename $0`": $BIN_NAME: Executable not found"
           fi
        fi

         echo "$BIN_NAME: $status_p1"
        ;;

'stop')
        if [ "${PID1}" != "" ]
        then
           kill -9 ${PID1} && echo "$BIN_NAME daemon killed"
        else
           echo "$BIN_NAME: no running Process!"
        fi
        ;;
'check')
        if [ "$PID1" != "" ]
        then
           echo "running"
           exit 0
        else
           echo "not running"
           exit 1
        fi
        ;;*)
        echo "Usage: "`basename $0`" {start|stop|check}"
        ;;
esac
```

Example B–3 shows an example of a shell script for an agent to monitor a file. When the agent is started, it creates the file (which is specified through an attribute) and when it is stopped, it deletes the file. The CHECK action consists of merely checking if the file exists or not. The variables with the _CRS_ prefix are attribute values that are provided to the script in its environment.

Example B–3 Action Script Example

```
#!/bin/sh
TOUCH=/bin/touch
RM=/bin/rm
PATH_NAME=/tmp/$_CRS_NAME
```

```
#
# These messages go into the CRSD agent log file.
echo " *******   `date` ********** "
echo "Action script '$_CRS_ACTION_SCRIPT' for resource[$_CRS_NAME] called for
action $1"
#

case "$1" in
  'start')
     echo "START entry point has been called.."
     echo "Creating the file: $PATH_NAME"
     $TOUCH $PATH_NAME
     exit 0
     ;;

  'stop')
     echo "STOP entry point has been called.."
     echo "Deleting the file: $PATH_NAME"
     $RM $PATH_NAME
     exit 0
     ;;

  'check')
    echo "CHECK entry point has been called.."
    if [ -e $PATH_NAME ]; then
        echo "Check -- SUCCESS"
        exit 0
    else
        echo "Check -- FAILED"
        exit 1
    fi
    ;;

  'clean')
     echo "CLEAN entry point has been called.."
     echo "Deleting the file: $PATH_NAME"
     $RM -f $PATH_NAME
     exit 0
     ;;

esac
```

C

OLSNODES Command Reference

This appendix describes the syntax and command options for the `olsnodes` command.

This appendix contains the following topics:

Using OLSNODES

This section contains topics which relate to using the OLSNODES command.

- Overview
- Operational Notes

Overview

The `olsnodes` command provides the list of nodes and other information for all nodes participating in the cluster.

You can use this command to quickly check that your cluster is operational, and all nodes are registered as members of the cluster. This command also provides an easy method for obtaining the node numbers.

Operational Notes

Usage Information

This command is used by the Cluster Verification Utility (CLUVFY) to obtain a list of node names when the `-n all` option is used.

This command utility is located in the `$ORA_CRS_HOME/bin` directory. You can only use this command if the CRS daemon is started.

Privileges and Security

You must run this command as the `root` user.

Summary of the OLSNODES Command

The `olsnodes` command does not use keywords, but accepts one or more options. The available options are described in Table C–1.

Syntax

```
olsnodes [node_name] [-g] [-i] [-l] [-n] [-p] [-s] [-t] [-v]
```

If you issue the `olsnodes` command without any command parameters, the command returns a listing of the nodes in the cluster:

```
[root@node1]# olsnodes
node1
node2
node3
node4
```

Table C–1 OLSNODES Command Options

Command	Description
node_name	Displays information for a particular node
`-g`	Logs cluster verification information with more details
`-i`	Lists all nodes participating in the cluster and includes the Virtual Internet Protocol (VIP) address assigned to each node
`-l`	Displays information for the local node
`-n`	Lists all nodes participating in the cluster and includes the assigned node numbers
`-p`	Lists all nodes participating in the cluster and includes the private interconnect assigned to each node
`-s`	Displays the status of the node: `active` or `inactive`
`-t`	Displays node type: pinned or unpinned
`-v`	Logs cluster verification information in verbose mode

Usage Notes

-

Examples

Include here the most common uses of this command. For example:

Example 1: List the VIP addresses for all nodes currently in the cluster

To list the VIP addresses for each node that is currently a member of the cluster, use the command:

```
[root@node1]# olsnodes -i
node1    168.92.1.1
node2   168.192.2.1
node3   168.192.3.1
```

```
node4   168.192.4.1
```

Example 2: List the node names and node numbers for cluster members

To list the node name and the node number for each node in the cluster, use the command:

```
[root@node1]# olsnodes -n
node1    1
node2    2
node3    3
node4    4
```

D

Oracle Interface Configuration Tool (OIFCFG) Command Reference

The Oracle Interface Configuration Tool (OIFCFG) command-line interface helps you to define and administer network interfaces. You can use OIFCFG commands Oracle Clusterware environments to:

- Allocate and deallocate network interfaces to components
- Direct components to use specific network interfaces
- Retrieve component configuration information

This appendix includes the following topics:

Starting the OIFCFG Command-Line Interface

Before you invoke OIFCFG, ensure that you have started Oracle Clusterware on at least the local node and preferably on all nodes if you intend to include the `-global` option on the command.

> **Note:** To change the global network interface, Oracle Clusterware must be running on all cluster nodes.

Run OIFCFG from the *`Grid_home`*`/bin/` directory as the user who installed the Oracle Clusterware software. For example:

```
$ ./oifcfg
```

Run the `oifcfg -help` command to display online help for OIFCFG.

```
$ ./oifcfg -help

Name:  oifcfg - Oracle Interface Configuration Tool.

Usage:  oifcfg iflist [-p [-n]]
        oifcfg setif {-node node_name | -global} {interface_name
 /subnet:interface_type}...
        oifcfg getif [-node node_name | -global] [ -if interface_name[/subnet]
 [-type interface_type]]
        oifcfg delif [{-node node_name | -global} [interface_name[/subnet]]]
        oifcfg [-help]

 node_name       - name of the host, as known to a communications network
 interface_name  - name by which the interface is configured in the system
 subnet          - subnet address of the interface
 interface_type  - type of the interface {cluster_interconnect | public}
```

Summary of the OIFCFG Usage

This section contains the following topics:

OIFCFG Command Format

```
oifcfg iflist [-p [-n]]
oifcfg setif {-node node_name | -global} {interface_name/subnet:interface_name}...
oifcfg getif [-node node_name | -global] [ -if interface_name[/subnet] [-type
interface_type]]
oifcfg delif [-node node_name | -global] [interface_name[/subnet]]
oifcfg [-help]
```

OIFCFG Commands

You can enter any of the OIFCFG commands listed in Table D–1.

Table D–1 OIFCFG Commands

Command	Description
`oifcfg iflist [-p [-n]]`	Shows the available interfaces that you can configure with `setif`. The `iflist` command queries the operating system to find which network interfaces are present on this node. You can specify two options with this command: ■ `-p`: Displays a heuristic assumption of the interface type (PRIVATE, PUBLIC, or UNKNOWN) ■ `-n`: Displays the netmask
`oifcfg setif`	Sets an interface type (public or cluster interconnect) for an interface.
`oifcfg getif`	Displays the interfaces for which an interface type has been defined with the `setif` command, along with the type for that interface.
`oifcfg delif`	Deletes the stored network configuration for global or node-specific interfaces.

OIFCFG Command Parameters

This section lists the parameters for the OIFCFG commands. Note that some parameters are optional, depending on which command you run.

-node *node_name*

The name of the Oracle Clusterware node as listed in the output from the `olsnodes` command. Appendix C, "OLSNODES Command Reference" describes the `OLSNODES` command.

-global

A network interface can be stored as a *global interface* (as reported by the `iflist` command) or as a *node-specific interface*:

- An interface is stored as a global interface when all of the nodes of an Oracle Real Application Clusters (Oracle RAC) cluster have the same interface connected to the same subnet. The global interface (and configuring all nodes with the same network interface for each public subnet and the same network interface for each private subnet) is not only the recommended configuration, but it is also the default installation configuration.
- An interface can be stored as a node-specific (local) interface.

> **Note:** Oracle currently does not support having different network interfaces for each node in the cluster. The best practice is to configure all nodes with the same network interface for each public subnet and the same network interface for each private subnet.

-if *interface_name*
The name by which the interface is configured in the system. Interface names can contain wildcard characters, for example, an asterisk (*) matches any string. However, interface names that contain wildcards should be surrounded with quotes.

> **Note:** If you use wildcards on pre-11.2 databases, then Oracle resolves the interface name by expanding the wildcard on the local node. Therefore, using wildcards is not recommended on clusters with pre-11.2 databases. If you use wildcards on pre-11.2 databases, then those databases must use the `CLUSTER_INTERCONNECTS` parameter instead.

subnet
The subnet number of the interface.

-type *interface_type*
The type of interface: `public` or `cluster_interconnect`.

-help
Display online help for OIFCFG commands.

OIFCFG Usage Notes

- A network interface specification takes the following form:

  interface_name/*subnet*:*interface_type*

  The specification uniquely identifies the network interface using the:

  – Interface name
  – Associated subnet
  – Interface type

    The interface type indicates the purpose for which the network is configured. The supported interface types are:

    * `public`—An interface that can be used for communication with components external to Oracle RAC instances, such as Oracle Net and Virtual Internet Protocol (VIP) addresses.
    * `cluster_interconnect`—A private interface used for the cluster interconnect to provide interinstance or Cache Fusion[1] communication.

If you set the interface type to `cluster_interconnect`, then it affects instances as they start and changes do not take effect until you restart the instances.

For example, the following specification identifies `qfe0` as a cluster interconnect located at the address 204.152.65.0:

```
qfe0/204.152.65.0:cluster_interconnect
```

- The Oracle Universal Installer uses OIFCFG to identify and display available interfaces.
- The effect of changing the interface names depends on which name you are changing, and whether you are also changing the IP address. In cases where you change only the interface names, the ramifications are minor. If you change the name for the public interface that is stored in the Oracle Cluster Registry (OCR), you must modify the nodeapps for each node. Therefore, you must stop the nodeapps for this change to take effect.
- You must restart Oracle Clusterware on all members of the cluster when you make global changes. For local changes, you need only to perform a node restart. Interconnect changes for the database occur at instance startup. However, the interconnect for Oracle Clusterware might be different.
- Because interconnects are chosen when instances start, just issuing OIFCFG commands does not have an immediate effect on the running system. Instead, changes take effect after restarting the component that might be affected by the command.

OIFCFG Examples

The following examples show some common uses for the OIFCFG commands.

Example 1 Listing the Names of Network Interfaces

You can use OIFCFG to list the interface names and the subnets of all of the interfaces available on the local node by executing the `iflist` keyword, as shown in this example:

```
oifcfg iflist
hme0     139.185.141.0
qfe0     204.152.65.0
```

Example 2 Retrieving Network Information

You can also retrieve specific OIFCFG information with a `getif` command.

```
oifcfg getif [ [-global | -node node_name] [-if interface_name[/subnet]]
[-type interface_type]]
```

For example, after you install Oracle Clusterware, you can verify that the public and cluster interconnect have been set to the desired values by entering the following commands as `root`:

```
$ oifcfg getif
```

This command should return values for global `public` and global `cluster_interconnect`. For example:

[1] Cache Fusion is a diskless cache coherency mechanism that provides copies of blocks directly from a holding instance's memory cache to a requesting instance's memory cache.

```
en0 144.25.68.0 global public
hme0 139.185.141.0 global cluster_interconnect
```

Example 3 Storing a Global Interface

To store an interface, use the `setif` keyword. For example, to store the interface `hme0`, with the subnet 139.185.141.0, as a global interface (to be used as an interconnect for all of the Oracle RAC instances in your cluster and Oracle Clusterware), use the command:

```
oifcfg setif -global hme0/139.185.141.0:cluster_interconnect
```

Note: Ensure that all nodes are running when you run the `setif` command because Oracle cannot update Grid Plug and Play profiles on nodes that are not running.

Example 4 Deleting the Stored Interface

Use the `oifcfg delif` command to delete the stored configuration for global or node-specific interfaces. A specific node-specific or global interface can be deleted by supplying the interface name, with an optional subnet, on the command line. Without the `-node` or `-global` options, the `delif` keyword deletes either the given interface or all of the global and node-specific interfaces on all of the nodes in the cluster.

For example, the following command deletes the global interface named `qfe0` for the subnet 204.152.65.0:

```
oifcfg delif -global qfe0/204.152.65.0
```

The following command deletes all of the global interfaces assigned with OIFCFG:

```
oifcfg delif -global
```

E

CRSCTL Utility Reference

This appendix describes how to administer Oracle Clusterware using the Oracle Clusterware Control (CRSCTL) utility.

> **Note:** Do not use CRSCTL commands on Oracle entities (such as resources, resource types, and server pools) that have names beginning with *ora* unless you are directed to do so by Oracle Support. The Server Control utility (SRVCTL) is the correct utility to use on Oracle entities.

This appendix includes the following topics:

CRSCTL Overview

CRSCTL is an interface between you and Oracle Clusterware, parsing and calling Oracle Clusterware APIs for Oracle Clusterware objects.

Oracle Clusterware 11*g* release 2 (11.2) introduces cluster-aware commands with which you can perform check, start, and stop operations on the cluster. You can run these commands from any node in the cluster on another node in the cluster, or on all nodes in the cluster, depending on the operation.

You can use CRSCTL commands to perform several operations on Oracle Clusterware, such as:

- Starting and stopping Oracle Clusterware resources
- Enabling and disabling Oracle Clusterware daemons
- Checking the health of the cluster
- Managing resources that represent third-party applications
- Integrating Intelligent Platform Management Interface (IPMI) with Oracle Clusterware to provide failure isolation support and to ensure cluster integrity
- Debugging Oracle Clusterware components

Clusterized (Cluster Aware) Commands

You can run clusterized commands on one node to perform operations on another node in the cluster. These are referred to as remote operations. This simplifies administration because, for example, you no longer have to log in to each node to check the status of the Oracle Clusterware on all of your nodes.

Clusterized commands are completely operating system independent; they rely on the OHASD (Oracle High Availability Service Daemon). If this daemon is running, then you can perform remote operations, such as the starting, stopping, and checking the status of remote nodes.

Clusterized commands include the following:

- crsctl check cluster
- crsctl start cluster
- crsctl stop cluster

Operational Notes

Usage Information

- The CRSCTL utility is located in the `Grid_home/bin` directory. To run CRSCTL commands, type in `crsctl` at the operating system prompt followed by the command and arguments, as shown in the following example:

  ```
  crsctl stop crs
  ```

- There are three categories of CRSCTL commands:
  - Those that you use in either the Oracle Real Application Clusters (Oracle RAC) environment or in the Oracle Restart environment
  - Those that you use in the Oracle RAC environment, only
  - Those that you use in the Oracle Restart environment, only
- Many CRSCTL commands use the `-f` option to force the command to run and ignore any checks.

  For example, if you specify the force option for the `crsctl stop resource` command on a resource that is running and has dependent resources that are also running, then the force option omits the error message and instead stops or relocates all the dependent resources before stopping the resource you reference in the command.
- *Do not* use versions of CRSCTL earlier than 11*g* release 2 (11.2) to manage Oracle Clusterware 11*g* release 2 (11.2).

Using CRSCTL Help

To print the help information for CRSCTL, use the following command:

```
crsctl -help
```

If you want help for a specific command, such as `start`, then enter the command and append `-help` to the end, as shown in the following example:

```
crsctl start -help
```

You can also use the abbreviations `-h` or `-?` (this option functions in Linux, UNIX, and Windows environments) instead of `-help`.

Deprecated Subprograms or Commands

The following commands are deprecated in Oracle Clusterware 11*g* release 2 (11.2):

- `crs_stat`
- `crs_register`
- `crs_unregister`
- `crs_start`
- `crs_stop`
- `crs_getperm`
- `crs_profile`
- `crs_relocate`
- `crs_setperm`
- `crsctl check crsd`
- `crsctl check cssd`
- `crsctl check evmd`
- `crsctl debug log`
- `crsctl set css votedisk`
- `crsctl start resources`
- `crsctl stop resources`

CRSCTL Command Reference

This section is separated into three categories of CRSCTL commands:

- Dual Environment CRSCTL Commands
- Oracle RAC Environment CRSCTL Commands
- Oracle Restart Environment CRSCTL Commands

Dual Environment CRSCTL Commands

You can use the following commands in either the Oracle RAC or the Oracle Restart environments:

- `crsctl add resource`
- `crsctl add type`
- `crsctl check css`
- `crsctl delete resource`
- `crsctl delete type`
- `crsctl get hostname`
- `crsctl getperm resource`
- `crsctl getperm type`
- `crsctl modify resource`
- `crsctl modify type`
- `crsctl setperm resource`
- `crsctl setperm type`
- `crsctl start resource`
- `crsctl status resource`
- `crsctl status type`
- `crsctl stop resource`

crsctl add resource

Use the `crsctl add resource` command to register a resource to be managed by Oracle Clusterware. A resource could be an application process, a database, a service, a listener, and so on.

Syntax

```
crsctl add resource resource_name -type resource_type [-file file_path |
-attr "attribute_name=attribute_value,attribute_name=attribute_value,..."]
[-i] [-f]
```

Parameters

Table E–1 crsctl add resource Command Parameters

Parameter	Description
resource_name	A short, descriptive name for the resource.
`-type` *resource_type*	The type of resource that you are adding preceded by the `-type` flag.
`-file` *file_path*	Path name (either absolute or relative) for a text file containing line-separated attribute name-value pairs that define the resource.

Table E–1 (Cont.) crsctl add resource Command Parameters

Parameter	Description

`-attr "`*`attribute_name=attribute_value`*	You can specify attributes for a resource you are adding in two different ways:
	■ Following the `-attr` flag, you can specify one or more comma-delimited attribute name-value pairs enclosed in double quotations marks (`""`). For example:
	`-attr "CHECK_INTERVAL=30,START_TIMEOUT=25"`
	■ Additionally, you can specify attribute values for resource instances with a particular cardinality value, and with a particular degree value. This method can be useful for applications that are tied to a particular server. Following the `-attr` flag, the syntax is as follows:
	`attribute_name``{@SERVERNAME(`*`server_name`*`) [@DEGREEID(`*`did`*`)] | @CARDINALITYID(`*`cid`*`) [@DEGREEID(`*`did`*`)]}=`*`attribute_value`*
	If you specify the `@SERVERNAME(`*`server_name`*`)` syntax, then the attribute value you specify for the attribute you specify is limited to resource instances residing on the server you specify.
	Alternatively, if you specify the `@CARDINALITYID(`*`cid`*`)` syntax, then the attribute value you specify for the attribute you specify is limited to resource instances with a specific cardinality ID (*`cid`*).
	Optionally, you can combine the `@DEGREEID(`*`did`*`)` syntax with either the `SERVERNAME` or `CARDINALITYID` syntax, or both, to limit the attribute value to resources with the specific `DEGREE`.
	Examples:
	`CHECK_INTERVAL@SERVERNAME(node1)=45`
	`STOP_TIMEOUT@CARDINALITYID(2)=65`
	`STOP_TIMEOUT@SERVERNAME(node1)@DEGREEID(2)=65`
	`STOP_TIMEOUT@CARDINALITYID(3)@DEGREEID(2)=65`

`-i`	If you specify `-i`, then the command returns an error if processing this command requires waiting for Oracle Clusterware to unlock the resource or its dependents. Sometimes, Oracle Clusterware locks resources or other objects to prevent commands from interfering with each other.
`-f`	Use the force option: ■ To add a resource that has dependencies on other resources that do not yet exist. The force option overrides checks that would prevent a command from being completed. ■ To add a resource if the resource has hard dependencies on other resources and the owner of the resources does not execute permissions on one or more of the dependencies. If you do not specify the force option in this case, an error displays. ■ To add resources of `application` type because you may need to move servers into the GENERIC server pool. If the servers currently host resources that must be stopped, then the force option is required

> **See Also:** Appendix B, "Oracle Clusterware Resource Reference" for more information about resources and resource attributes

Usage Notes

- Both the *resource_name* and `-type` *resource_type* parameters are required. You can create an associated resource type using the crsctl add type command.
- Any user can create a resource but only clusterware administrators can create resources of type `local_resource` or resources of type `cluster_resource` that have `SERVER_POOLS=*`.

  Once a resource is defined, its ACL controls who can perform particular operations with it. The Oracle Clusterware administrator list is no longer relevant.

  On Windows, a Windows administrator has full control over everything.

  > **See Also:** "crsctl setperm resource" on page E-17 for more information about setting ACLs

- If an attribute value for an attribute name-value pair contains commas, then the value must be enclosed in single quotation marks (`''`).
- Following is an example of an attribute file:

```
PLACEMENT=favored
HOSTING_MEMBERS=node1 node2 node3
RESTART_ATTEMPTS@CARDINALITYID(1)=0
RESTART_ATTEMPTS@CARDINALITYID(2)=0
FAILURE_THRESHOLD@CARDINALITYID(1)=2
FAILURE_THRESHOLD@CARDINALITYID(2)=4
FAILURE_INTERVAL@CARDINALITYID(1)=300
FAILURE_INTERVAL@CARDINALITYID(2)=500
CHECK_INTERVAL=2
CARDINALITY=2
```

- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources.

Example

Example 1

To register a VIP as a resource with Oracle Clusterware:

```
$ crsctl add resource app.appvip -type app.appvip.type \
-attr "RESTART_ATTEMPTS=2,\
START_TIMEOUT=100,STOP_TIMEOUT=100,CHECK_INTERVAL=10,\
USR_ORA_VIP=172.16.0.0,\
START_DEPENDENCIES=hard(ora.net1.network)pullup(ora.net1.network),\
STOP_DEPENDENCIES=hard(ora.net1.network)"
```

Example 2

To register a resources based on the `test_type1` resource type:

```
$ crsctl add resource r1 -type test_type1 -attr "PATH_NAME=/tmp/r1.txt"
$ crsctl add resource r1 -type test_type1 -attr "PATH_NAME=/tmp/r2.txt"
```

crsctl add type

Use the `crsctl add type` command to create a resource type in Oracle Clusterware.

Syntax

```
crsctl add type type_name -basetype base_type_name {-file file_path |
 -attr "ATTRIBUTE=attribute_name,TYPE={string | int}
 [,DEFAULT_VALUE=default_value][,FLAGS=[READONLY][|REQUIRED]]"
 [-attr ...]}
```

Parameters

Table E–2 crsctl add type Command Parameters

Parameter	Description
type_name	A name for the resource type in the form of *xxx.yyy*.type. Resource type names must be unique and cannot be changed after the resource type is registered.
-basetype *base_type_name*	The name of an existing base type. Any resource type that you create must either have `local_resource` or `cluster_resource` as its base resource type.
-file *file_path*	Path name (either absolute or relative) for a text file containing line-separated attribute name-value pairs that define the resource type.
-attr	You can specify the resource type attributes using the -attr argument. Enter a comma-delimited description of a resource type attribute enclosed in double quotation marks (" "). The descriptors for an attribute include: ■ `ATTRIBUTE`: Specify a name for the attribute. The name is case-sensitive and cannot contain spaces. ■ `TYPE`: Specify whether the attribute type is `integer` or `string`. ■ `DEFAULT_VALUE`: (Optional) If the attribute is required, then a default value is not required. For attributes that are not required, you must specify a default value that Oracle Clusterware uses when you create resources based on this resource type. ■ `FLAGS`: (Optional) Specify whether the attribute is `READONLY` or `REQUIRED`. `READONLY` means that after you register a resource with this resource type, you cannot modify this attribute. `REQUIRED` means that you must specify the name and value of this attribute when you create a resource that is based on this resource type. If you specify that this attribute is not required, then Oracle Clusterware uses the default value of this attribute that you specify. You can use multiple `-attr` arguments to define multiple arguments for the resource type.

See Also: "Resource Type" on page 5-5 for more information about resource types

Usage Notes

- Both the *type_name* and *base_type_name* parameters are required

- You can either specify a file containing the type information or you can specify the type information on the command line
- Do not use this command for any resource types with names that begin with *ora* because these resource types are Oracle resource types
- You must have read permissions on the base type

Example

To create a resource type for `demoActionScript`:

```
# crsctl add type test_type1 -basetype cluster_resource \
 -attr "ATTRIBUTE=PATH_NAME,TYPE=string,DEFAULT_VALUE=default.txt"\
 -attr "ATTRIBUTE=ACTION_SCRIPT,TYPE=string,DEFAULT_VALUE=/u01/grid/crs/demo
/demoActionScript"
```

crsctl check css

Use the `crsctl check css` command to check the status of Cluster Synchronization Services. This command is most often used when Oracle Automatic Storage Management (Oracle ASM) is installed on the local server.

Syntax

```
crsctl check css
```

Usage Notes

-

Example

The `crsctl check css` command returns output similar to the following:

```
CRS-4529: Cluster Synchronization Services is online
```

crsctl delete resource

Use the `crsctl delete resource` command to remove resources from the Oracle Clusterware configuration.

Syntax

```
crsctl delete resource resource_name [-i] [-f]
```

Parameters

Table E–3 crsctl delete resource Command Parameters

Parameter	Description
resource_name	Specify the name of the resource you want to remove.
`-i`	If you specify `-i`, then the command returns an error if processing this command requires waiting for Oracle Clusterware to unlock the resource or its dependents. Sometimes, Oracle Clusterware locks resources or other objects to prevent commands from interfering with each other.
`-f`	Use the force option to remove either running resources, or remove this resource even though other resources have a hard dependency on it.

Usage Notes

- The *resource_name* parameter is required
- You must have read and write permissions to delete the specified resources
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources

Example

To delete a resource from Oracle Clusterware:

```
# crsctl delete resource myResource
```

crsctl delete type

Use the `crsctl delete type` command to remove a resource type from the Oracle Clusterware configuration.

Syntax

```
crsctl delete type type_name [-i]
```

Usage Notes

- The *type_name* parameter is required
- If you specify `-i`, then the command fails if Oracle Clusterware cannot process the request immediately
- Do not use this command for any resource types with names that begin with *ora* because these resource types are Oracle resource types

Example

To delete a resource type, run the following command as who has write permissions on the resource type:

```
$ crsctl delete type app.appvip.type
```

crsctl get hostname

Use the `crsctl get hostname` command to retrieve the host name of the local server.

Syntax

```
crsctl get hostname
```

Example

Oracle Clusterware returns the host name of the local server:

```
$ crsctl get hostname
node2
```

crsctl getperm resource

Use the `crsctl getperm resource` command to display the user and group permissions for the specified resource.

Syntax

```
crsctl getperm resource resource_name [ {-u user_name | -g group_name} ]
```

See Also: Appendix B, "Oracle Clusterware Resource Reference" for more information about resources and resource attributes

Parameters

Table E–4 crsctl getperm resource Command Parameters

Parameter	Description
resource_name	Specify the name of the resource for which you want to obtain permissions.
-u *user_name*	If you specify -u, then Oracle Clusterware obtains permissions for a particular user.
-g *group_name*	If you specify -g, then Oracle Clusterware obtains permissions for a particular group.

Usage Notes

- The *resource_name* parameter is required
- You must have read permission on the specified resources to obtain their permissions
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources

Example

The `crsctl getperm resource` command returns output similar to the following, depending on the command option you choose:

```
$ crsctl getperm resource app.appvip

Name: app.appvip
owner:root:rwx,pgrp:oinstall:rwx,other::r--

$ crsctl getperm resource app.appvip -u oracle

Name: app.appvip
rwx

$ crsctl getperm resource app.appvip -g dba

Name: app.appvip
r--
```

crsctl getperm type

Use the `crsctl getperm type` command to obtain permissions for a particular resource type.

Syntax

```
crsctl getperm type resource_type  [-u user_name] | [-g group_name]
```

See Also: "Resource Type" on page 5-5 for more information about resource types

Parameters

Table E–5 crsctl getperm type Command Parameters

Parameter	Description
resource_type	Specify the resource type for which you want to obtain permissions.
-u *user_name*	If you specify -u, then Oracle Clusterware obtains permissions for a particular user.
-g *group_name*	If you specify -g, then Oracle Clusterware obtains permissions for a particular group.

Usage Notes

- The *resource_type* parameter is required
- Do not use this command for any resource types with names that begin with *ora* because these resource types are Oracle resource types

Example

The `crsctl getperm type` command returns output similar to the following:

```
$ crsctl getperm type app.appvip.type

Name: app.appvip.type
owner:root:rwx,pgrp:oinstall:rwx,other::r--
```

crsctl modify resource

Use the `crsctl modify resource` command to modify the attributes of a particular resource in Oracle Clusterware.

Syntax

```
crsctl modify resource resource_name -attr "attribute_name=attribute_value"
[-i] [-f] [-delete]
```

Parameters

Table E–6 crsctl modify resource Command Parameters

Parameter	Description
resource_name	The name of the resource you want to modify.

Table E–6 (Cont.) crsctl modify resource Command Parameters

Parameter	Description
`-attr "attribute_name=attribute_value"`	You can specify attributes for a resource you want to modify in two different ways: ■ Following the `-attr` flag, you can specify one or more comma-delimited attribute name-value pairs to modify enclosed in double quotations marks (`""`). For example: `-attr "CHECK_INTERVAL=30, START_TIMEOUT=25"` ■ Alternatively, you can specify attribute values for resources on a particular server, with a particular cardinality value, and with a particular degree value. This method can be useful for applications that are somehow tied to a particular server. Following the `-attr` flag, the syntax is as follows: *attribute_name*{@SERVERNAME(*server_name*) [@DEGREEID(*did*)] | @CARDINALITYID(*cid*) [@DEGREEID(*did*)]}=*attribute_value* If you specify the @SERVERNAME(*server_name*) syntax, then the attribute value you specify for the attribute you specify is limited to resources residing on the server you specify. Alternatively, if you specify the @CARDINALITYID(*cid*) syntax, then the attribute value you specify for the attribute you specify is limited to resource instances with a specific cardinality ID (*cid*). Optionally, you can combine the @DEGREEID(*did*) syntax with either the SERVERNAME or CARDINALITYID syntax, or both, to limit the attribute value to resources with the specific DEGREE. Examples: CHECK_INTERVAL@SERVERNAME(node1)=45 STOP_TIMEOUT@CARDINALITYID(2)=65 STOP_TIMEOUT@SERVERNAME(node1)@DEGREEID(2)=65 STOP_TIMEOUT@CARDINALITYID(3)@DEGREEID(2)=65
`-i`	If you specify `-i`, then the command returns an error if processing this command requires waiting for Oracle Clusterware to unlock the resource or its dependents. Sometimes, Oracle Clusterware locks resources or other objects to prevent commands from interfering with each other.
`-f`	Use the `-f` option when: ■ The resource has a hard dependency on a non-existing resource ■ The owner of the resource does not have execute permissions on one or more hard dependencies ■ The modification results in servers being moved into the Generic pool and resources being stopped or relocated to accomplish the server move
`-delete`	If you specify the `-delete` option, then Oracle Clusterware deletes the named attribute.

See Also: Appendix B, "Oracle Clusterware Resource Reference" for more information about resources and resource attributes

Usage Notes

- The *resource_name* parameter is required
- If an attribute value for an attribute name-value pair contains commas, then the value must be enclosed in single quotation marks (''). For example:

```
"START_DEPENDENCIES='hard(res1,res2,res3)'"
```

- You must have read and write permissions on the specified resources to modify them
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources

Example

To modify the attributes of the `appsvip` resource:

```
$ crsctl modify resource appsvip -attr USR_ORA_VIP=10.1.220.17 -i
```

crsctl modify type

Use the `crsctl modify type` command to modify an existing resource type.

Syntax

```
crsctl modify type type_name -attr "ATTRIBUTE=attribute_name,
TYPE={string | int} [,DEFAULT_VALUE=default_value]
[,FLAGS=[READONLY][| REQUIRED]]" [-i] [-f]
```

Parameters

Table E–7 crsctl modify type Command Parameters

Parameter	Description
type_name	Specify the name of the resource type you want to modify. You cannot modify resource type names.
-attr	You can modify the following resource type attributes: ■ ATTRIBUTE ■ TYPE ■ DEFAULT_VALUE ■ FLAGS **See Also:** Table E–2, " crsctl add type Command Parameters" for descriptions of these attributes
-i	If you specify the -i option, then the command fails if Oracle Clusterware cannot process the request immediately.

See Also: "Resource Type" on page 5-5 for more information about resource types

Usage Notes

- The *type_name* parameter is required
- Do not use this command for any resource types with names that begin with *ora* because these resource types are Oracle resource types

Example

To modify an existing resource type:

```
$ crsctl modify type myType.type -attr "ATTRIBUTE=myAttrName,TYPE='string',
DEFAULT_VALUE='myDefault'"
```

crsctl setperm resource

Use the `crsctl setperm resource` command to set permissions for a particular resource.

Syntax

```
crsctl setperm resource resource_name {-u acl_string | -x acl_string |
-o user_name | -g group_name}
```

Parameters

Table E–8 crsctl setperm resource Command Parameters

Parameter	Description
resource_name	Specify the name of the resource for which you want to set permissions.
{-u | -x | -o | -g}	You can set only one of the following permissions for a resource: ■ `-u` *acl_string*: You can update the access control list (ACL) for a resource ■ `-x` *acl_string*: You can delete the ACL for a resource ■ `-o` *user_name*: You can change the owner of a resource by entering a user name ■ `-g` *group_name*: You can change the primary group of a resource by entering a group name Specify a user, group, or other ACL string, as follows: `user:`*user_name*`[:`*readPermwritePermexecPerm*`]` | `group:`*group_name*`[:`*readPermwritePermexecPerm*`]` | `other[::`*readPermwritePermexecPerm*`]` ■ `user`: User ACL ■ `group`: Group ACL ■ `other`: Other ACL ■ `readPerm`: Read permission for the resource; the letter `r` grants a user, group, or other read permission, the minus sign (`-`) denies read permission ■ `writePerm`: Write permission for the resource; the letter `w` grants a user, group, or other write permission, the minus sign (`-`) denies write permission ■ `execPerm`: Execute permission for the resource; the letter `x` grants a user, group, or other execute permission, the minus sign (`-`) denies execute permission

See Also: Appendix B, "Oracle Clusterware Resource Reference" for more information about resources and resource attributes

Usage Notes

- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources.
- You must have read and write permissions on the specified resources to set their permissions

Example

To grant read, write, and execute permissions on a resource for user Scott:

```
$ crsctl setperm resource myResource -u user:scott:rwx
```

crsctl setperm type

Use the `crsctl setperm type` command to set permissions resources of a particular resource type.

Syntax

```
crsctl setperm type resource_type_name {-u acl_string | -x acl_string |
-o user_name | -g group_name}
```

Parameters

Table E–9 crsctl setperm type Command Parameters

Parameter	Description
resource_type_name	Specify the name of the resource type for which you want to set permissions.

Table E–9 (Cont.) crsctl setperm type Command Parameters

Parameter	Description
`{-u | -x | -o | -g}`	You can specify only one of the following parameters for a resource type: ■ `-u acl_string`: You can update the access control list (ACL) for a resource type ■ `-x acl_string`: You can delete the ACL for a resource type ■ `-o user_name`: You can change the owner of a resource type by entering a user name ■ `-g group_name`: You can change the primary group of a resource type by entering a group name Specify a user, group, or other ACL string, as follows: `user:user_name[:readPermwritePermexecPerm] | group:group_name[:readPermwritePermexecPerm] | other[::readPermwritePermexecPerm]` ■ `user`: User ACL ■ `group`: Group ACL ■ `other`: Other ACL ■ `readPerm`: Read permission for the resource type; the letter `r` grants a user, group, or other read permission, the minus sign (`-`) denies read permission ■ `writePerm`: Write permission for the resource type; the letter `w` grants a user, group, or other write permission, the minus sign (`-`) denies write permission ■ `execPerm`: Execute permission for the resource type; the letter `x` grants a user, group, or other execute permission, the minus sign (`-`) denies execute permission

Usage Notes

- The *resource_type_name* parameter is required
- You must have read and write permissions on the specified resources to set their permissions
- Do not use this command for any resource types with names that begin with *ora* because these resource types are Oracle resource types

Example

To grant read, write, and execute permissions on a resource type for user Scott:

```
$ crsctl setperm type resType -u user:scott:rwx
```

crsctl start resource

Use the `crsctl start resource` command to start many idle resources on a particular server in the cluster.

Syntax

```
crsctl start resource {resource_name [...] | -w filter | -all} [-n server_name]
[-k cid] [-d did] [-env "env1=val1,env2=val2,..."] [-i] [-f]
```

Parameters

Table E–10 crsctl start resource Command Parameters

Parameter	Description
resource_name [...]	One or more space-delimited resource names to start.
-w *filter*	Specify a resource filter that Oracle Clusterware uses to match resources.
-all	Use this option to start all resources in the cluster.
-n *server_name*	Specify the name of the server on which the resources you want to start reside. If you do not specify a server, then Oracle Clusterware starts the resources on the best server according to the attribute profile of each resource.
-k *cid*	Specify the resource cardinality ID. If you specify this parameter, then Oracle Clusterware starts the resource instances that have the cardinality you specify.
-d *did*	Specify the resource degree ID. If you specify this parameter and the degree ID is greater than 1, then Oracle Clusterware starts all resource instances that meet this criteria. **Note:** You cannot use the -d option without specifying the -k option.
-env "*env1=val1*, *env2=val2*,..."	You can optionally override one or more resource profile attribute values for this command. If you specify multiple environment name-value pairs, then you must separate each pair with a comma and enclose the entire list in double quotation marks (").
-i	If you specify -i, then the command returns an error if processing this command requires waiting for Oracle Clusterware to unlock the resource or its dependents. Sometimes, Oracle Clusterware locks resources or other objects to prevent commands from interfering with each other.
-f	Use the -f option to relocate a resource running on another server on which the resource you want to start has a hard start dependency. If you do not specify the force option in this case, then the start command fails.

Usage Notes

- Any one of the three following options is required to specify which resources you want to start:
  - You can specify one or more resources to start
  - You can specify a resource filter that Oracle Clusterware uses to match resources to start
  - You can specify the -all option to start all resources on the specified server
- You must have read and execute permissions on the specified resources to start them
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources.

Example

To start a resource:

```
# crsctl start resource myResource -n server1
```

crsctl status resource

Use the `crsctl status resource` command to obtain the status and configuration information of many particular resources.

Syntax

```
crsctl status resource {resource_name [...] | -w "filter"}  [-p | -v [-e]] |
[-f | -l | -g] [[-k cid | -n server_name] [-d did]] | [-s -k cid [-d did]] [-t]
```

Parameters

Table E–11 crsctl status resource Command Parameters

Parameter	Description
resource_name `[...]` | `-w "`*filter*`"`	One or more space-delimited resource names of which you want to check the status. Or you can specify a resource filter that Oracle Clusterware uses to limit the number of resources displayed. The filter must be enclosed in double quotation marks (`""`). Values that contain parentheses or spaces must be enclosed in single quotation marks (`''`). Operators must be surrounded by spaces. Examples of resource filters include: ■ `"TYPE == cluster_resource"`: This filter limits the display to only resources of `cluster_resource` type. ■ `"CHECK_INTERVAL > 10"`: This filter limits the display to resources that have a value greater than 10 for the `CHECK_INTERVAL` resource attribute ■ `"(CHECK_INTERVAL > 10) AND (NAME co 2)"`: This filter limits the display to resources that have a value greater than 10 for the `CHECK_INTERVAL` resource attribute *and* the name of the resource contains the number `2`. ■ `"START_DEPENDENCIES = 'hard(appsvip)'"`: This filter limits the display to resources that have a hard start dependency on the `appsvip` resource. **See Also:** "Filters" on page F-5 for more information about filters
`[-p | -v [-e]] | [-f | -l | -g]`	You can specify one of two options: `[-p | -v [-e]]` or `[-f | -l | -g]`, where: ■ Specify the `-p` parameter to display the static configuration of the resource or specify the `-v` parameter to display the runtime configuration of the resource. Use the `-e` parameter with the `-v` parameter to evaluate the special values of the resource instance. ■ Specify the `-f` parameter to display the full configuration of the resource; or specify the `-l` parameter to display all cardinal and degree values of the resource; or specify the `-g` parameter to check whether the specified resources are registered

Table E–11 (Cont.) crsctl status resource Command Parameters

Parameter	Description
[-k *cid* | -n *server_name*] [-d *did* | [-s -k cid [-d *did*]]]	You can specify one of two options: [-k *cid* | -n *server_name*] or [-s -k *cid* [-d *did*]], where: ■ Specify the -k *cid* parameter to specify a cardinality ID of the resources you want to query. Or you can specify the -n parameter to specify a particular server on which to check resources. Optionally, you can specify the -d parameter with the -n parameter to specify the degree ID of resources you want to check. If you specify a degree ID greater than 1, then Oracle Clusterware checks all resource instances on the server that meet this criteria. ■ Specify the -s parameter with the -k parameter to obtain a list of target servers for relocation. You can further limit the output by specifying a degree ID with the -d parameter.
-t	Specify the -t parameter to display the output in tabular form.

Usage Notes

- Either a space-delimited list of resources or a resource filter is required
- You must have read permissions on the specified resources to obtain their status
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources

Example

The `crsctl status resource` command returns output similar to the following:

```
$ crsctl status resource ora.staii14.vip

NAME=ora.staii14.vip
TYPE=ora.cluster_vip_net1.type
TARGET=ONLINE
STATE=ONLINE on staii14
```

crsctl status type

Use the `crsctl status type` command to obtain the configuration information of one or more particular resource types.

Syntax

```
crsctl status type resource_type_name [...]] [-g] [-p] [-f]
```

Parameters

Table E–12 crsctl status type Command Parameters

Parameter	Description
[*resource_type_name* [...]	Specify one or more space-delimited resource type names of which you want to check the status.

Table E–12 (Cont.) crsctl status type Command Parameters

Parameter	Description
`-g] [-p] [-f`	You can specify the following parameters as options when Oracle Clusterware checks the status of specific server pools: ■ `-g`: Use this parameter to check if the specified resource types are registered ■ `-p`: Use this parameter to display static configuration of the specified resource types ■ `-f`: Use this parameter to display the full configuration of the resource types

Usage Notes

- The *`resource_type_name`* parameter or a filter is required

Example

The `crsctl status type` command returns output similar to the following:

```
$ crsctl status type ora.network.type

TYPE_NAME=ora.network.type
BASE_TYPE=ora.local_resource.type
```

crsctl stop resource

Use the `crsctl stop resource` command to stop running resources.

Syntax

```
crsctl stop resource {resource_name [...] | -w "filter" | -all} [-n server_name]
[-k cid] [-d did] [-env "env1=val1,env2=val2,..."] [-i] [-f]
```

Parameters

Table E–13 crsctl stop resource Command Parameters

Parameter	Description
`resource_name` `[...]`	One or more space-delimited resource names to stop.
`-w "`*`filter`*`"`	Specify a resource filter that Oracle Clusterware uses to limit the number of resources stopped. The filter must be enclosed in double quotation marks (`""`). Examples of resource filters include: ■ `"TYPE == cluster_resource"`: This filter limits Oracle Clusterware to stop only resources of `cluster_resource` type ■ `"CHECK_INTERVAL > 10"`: This filter limits Oracle Clusterware to stop resources that have a value greater than 10 for the `CHECK_INTERVAL` resource attribute ■ `"(CHECK_INTERVAL > 10) AND (NAME co 2)"`: This filter limits Oracle Clusterware to stop resources that have a value greater than 10 for the `CHECK_INTERVAL` resource attribute *and* the name of the resource contains the number `2`
`-all`	Use this option to stop all resources in the cluster.

Table E–13 (Cont.) crsctl stop resource Command Parameters

Parameter	Description
`-n server_name`	Specify the name of the server on which the resource instances you want to stop reside. If you do not specify a server, then Oracle Clusterware stops all instances of the resource.
`-k cid`	Specify the resource cardinality ID. If you specify this parameter, then Oracle Clusterware stops the resource instances that have the cardinality you specify.
`-d did`	Specify the resource degree ID. If you specify this parameter and the degree ID is greater than 1, then Oracle Clusterware stops all resource instances that meet this criteria.
`-env "env1=val1, env2=val2,..."`	You can optionally override one or more resource profile attribute values for this command. If you specify multiple environment name-value pairs, then you must separate each pair with a comma and enclose the entire list in double quotation marks ("").
`-i`	If you specify `-i`, then the command returns an error if processing this command requires waiting for Oracle Clusterware to unlock the resource or its dependents. Sometimes, Oracle Clusterware locks resources or other objects to prevent commands from interfering with each other.
`-f`	Specify the `-f` option to force the stopping of the resource when it has other resources running that depend on it. Dependent resources are relocated or stopped when you use this option.

Usage Notes

- Any one of the three following options is required to specify which resources you want to stop:
  - You can specify one or more resources to stop
  - You can specify a resource filter that Oracle Clusterware uses to match resources to stop
  - You can specify the `-all` option with the `-n server_name` option to stop all resources on a particular server
- You must have read and execute permissions on the specified resources to stop them
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources.

Example

To stop a resource:

```
$ crsctl stop resource -n node1 -k 2
```

Oracle RAC Environment CRSCTL Commands

The commands listed in this section manage the Oracle Clusterware stack in an Oracle RAC environment, which consists of the following:

- Oracle Clusterware, the member nodes and server pools
- Oracle ASM (if installed)
- Cluster Synchronization Services
- Cluster Time Synchronization Services

You can use the following commands only in an Oracle RAC environment:

- `crsctl add crs administrator`
- `crsctl add css votedisk`
- `crsctl add serverpool`
- `crsctl check cluster`
- `crsctl check crs`
- `crsctl check resource`
- `crsctl check ctss`
- `crsctl config crs`
- `crsctl delete crs administrator`
- `crsctl delete css votedisk`
- `crsctl delete node`
- `crsctl delete serverpool`
- `crsctl disable crs`
- `crsctl enable crs`
- `crsctl get css`
- `crsctl get css ipmiaddr`
- `crsctl get nodename`
- `crsctl getperm serverpool`
- `crsctl lsmodules`
- `crsctl modify serverpool`
- `crsctl pin css`
- `crsctl query crs administrator`
- `crsctl query crs activeversion`
- `crsctl query crs releaseversion`
- `crsctl query crs softwareversion`
- `crsctl query css ipmidevice`
- `crsctl query css votedisk`
- `crsctl relocate resource`

- crsctl relocate server
- crsctl replace discoverystring
- crsctl replace votedisk
- crsctl set css
- crsctl set css ipmiaddr
- crsctl set css ipmiadmin
- crsctl setperm serverpool
- crsctl start cluster
- crsctl start crs
- crsctl status server
- crsctl status serverpool
- crsctl stop cluster
- crsctl stop crs
- crsctl unpin css
- crsctl unset css

crsctl add crs administrator

Use the `crsctl add crs administrator` command to add a user to the list of cluster administrators.

Syntax

```
crsctl add crs administrator -u user_name [-f]
```

Parameters

Table E–14 crsctl add crs administrator Command Parameters

Parameter	Description
`-u` *user_name*	The name of the user to whom you want to give Oracle Clusterware administrative privileges.
`-f`	Use this option to override the user name validity check.

Usage Notes

- You must run this command as `root` or a cluster administrator, or an administrator on Windows systems
- By default, `root`, the user that installed Oracle Clusterware, and the `*` wildcard are members of the list of users who have Oracle Clusterware administrative privileges. Run the `crsctl delete crs administrator` command to remove the wildcard and enable role-separated management of Oracle Clusterware.

  See Also: "Role-separated Management" on page 2-18 for more information

Example

To add a user to the list of Oracle Clusterware administrators:

```
# crsctl add crs administrator -u scott
```

crsctl add css votedisk

Use the crsctl add css votedisk command to add one or more voting disks to the cluster on storage devices or to ASM diskgroup with redundancy normal or high.

> **Note:** if disk group redundancy is set to external, then you can only create one voting disk in the ASM disk group. If you try to add multiple voting disks, then Oracle returns an error.

Use the `crsctl add css votedisk` command to add one or more voting disks to the cluster on storage devices or to an Oracle ASM disk group with normal or high redundancy.

Syntax

```
crsctl add css votedisk path_to_voting_disk [path_to_voting_disk ...] [-purge]
```

Parameters

Table E–15 crsctl add css votedisk Command Parameters

Parameter	Description
path_to_voting_disk	A fully qualified path to the voting disk you want to add. To add multiple voting disks, separate each path with a space.
-purge	Removes all existing voting disks at once. You can replace the existing set of voting files in one operation.

Usage Notes

- You should have at least three voting disks, unless you have a storage device, such as a disk array, that provides external redundancy. Oracle recommends that you do not use more than 5 voting disks. The maximum number of voting disks that is supported is 15.

  See Also: "Adding, Deleting, or Migrating Voting Disks" on page 2-24 for more information

Example

To add a voting disk to the cluster:

```
$ crsctl add css votedisk /stor/grid/ -purge
```

crsctl add serverpool

Use the `crsctl add serverpool` command to add a server pool to Oracle Clusterware.

Syntax

```
crsctl add serverpool server_pool_name {-file file_path |
                  -attr "attr_name=attr_value[,attr_name=attr_value[,...]]"}
                  [-i] [-f]
```

Parameters

Table E–16 crsctl add serverpool Command Parameters

Parameter	Description
server_pool_name	A short, descriptive name for the server pool.
`-file` *file_path*	Fully-qualified path to an attribute file to define the server pool.
attribute_name	The name of a server pool attribute Oracle Clusterware uses to manage the server pool preceded by the `-attr` flag. The available attribute names include: ▪ IMPORTANCE ▪ MIN_SIZE ▪ MAX_SIZE ▪ SERVER_NAMES ▪ PARENT_POOLS ▪ EXCLUSIVE_POOLS ▪ ACL ▪ ACTIVE_SERVERS
attribute_value	A value for the server pool attribute. **Note:** The *attribute_name* and *attribute_value* parameters must be enclosed in double quotation marks (`""`) and separated by commas. For example: `-attr "MAX_SIZE=30, IMPORTANCE=3"`
`-i`	If you specify `-i`, then the command fails if Oracle Clusterware cannot process the request immediately.
`-f`	If you specify the `-f` option, then Oracle Clusterware stops resources running on a server in another server pool and relocates that server into the server pool you are adding. If you do not specify the `-f` option, then Oracle Clusterware checks whether the creation of the server pool results in stopping any resources on a server in another server pool that is going to give up a server to the server pool you are adding. If so, then Oracle Clusterware rejects the `crsctl add serverpool` command.

See Also: "Understanding Server Pools" on page 2-13 for more information about server pools and server pool attributes

Usage Notes

- The *server_pool_name* parameter is required
- If an attribute value for an attribute name-value pair contains commas, then the value must be enclosed in single quotation marks (`''`)
- Do not use this command for any server pools with names that begin with *ora* because these server pools are Oracle server pools
- Running this command may result in Oracle Clusterware relocating other servers between server pools to comply with the new configuration
- You must run this command as `root` or a cluster administrator

Example

Example 1

To add a server pool named `testsp` with a maximum size of 5 servers, run the following command as `root` or the Oracle Clusterware installation owner:

```
# crsctl add serverpool testsp -attr "MAX_SIZE=5"
```

Example 2

Create the `sp1_attr` file with the attribute values for the `sp1` serverpool, each on its own line, as shown in the following example:

```
IMPORTANCE=1
MIN_SIZE=1
MAX_SIZE=2
SERVER_NAMES=node3 node4 node5
PARENT_POOLS=Generic
EXCLUSIVE_POOLS=testsp
ACL=owner:oracle:rwx,pgrp:oinstall:rwx,other::r--
```

Use the following command to create the `sp1` server pool using the `sp1_attr` file as input:

```
$ crsctl add serverpool sp1 -file /tmp/sp1_attr
```

crsctl check cluster

Use the `crsctl check cluster` command on any node in the cluster to check the status of the Oracle Clusterware stack.

Syntax

```
crsctl check cluster [-all | [-n server_name [...]]
```

Usage Notes

- You can check the status of the Oracle Clusterware stack on all nodes in the cluster with the `-all` option or you can specify one or more space-delimited nodes. If you do not specify either option, Oracle Clusterware checks the status of the Oracle Clusterware stack on the local server.
- You can use this cluster-aware command on any node in the cluster.

Example

The `crsctl check cluster` command returns output similar to the following:

```
$ crsctl check cluster -all
**************************************************************
node1:
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
**************************************************************
node2:
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
**************************************************************
```

crsctl check crs

Use the `crsctl check crs` command to check the status of Oracle High Availability Services and the Oracle Clusterware stack on the local server.

Syntax

```
crsctl check crs
```

Example

To check the health of Oracle Clusterware on the local server:

```
$ crsctl check crs
CRS-4638: Oracle High Availablity Services is online
CRS-4537: Cluster Ready Services is onlin
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
```

crsctl check resource

Use the `crsctl check resource` command to initiate the check action inside the application-specific agent of a particular resource. Oracle Clusterware only provides output if something prevents the system from issuing the check request, such as a bad resource name.

Syntax

```
crsctl check resource {resource_name [...] | -w "filter" }
      [-n node_name] [-k cardinality_id] [-d degree_id] }
```

Parameters

Table E–17 crsctl check resource Command Parameters

Parameter	Description
resource_name	Specify a particular resource. You can check multiple resources by entering multiple resource names, with each name separated by a space.
-w "*filter*"	Specify a resource filter that Oracle Clusterware uses to limit the number of resources checked. The filter must be enclosed in double quotation marks (""). Examples of resource filters include: ■ "TYPE == cluster_resource": This filter limits Oracle Clusterware to check only resources of cluster_resource type ■ "CHECK_INTERVAL > 10": This filter limits Oracle Clusterware to check resources that have a value greater than 10 for the CHECK_INTERVAL resource attribute ■ "(CHECK_INTERVAL > 10) AND (NAME co 2)": This filter limits Oracle Clusterware to check resources that have a value greater than 10 for the CHECK_INTERVAL resource attribute *and* the name of the resource contains the number 2
-n *node_name*	Check the resource instance on a specific node. If you do not specify the -n option, then Oracle Clusterware checks the resource instances only on the local server.
-k *cardinality_id*	Specify the resource cardinality ID.

Table E–17 (Cont.) crsctl check resource Command Parameters

Parameter	Description
`-d degree_id`	Specify the resource degree ID.

Usage Notes

- You must have read and execute permissions on the specified resources to check them
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources
- If this command is successful, it only means that a check was issued; it does not mean the CHECK action has been completed

Example

To initiate the check action inside the application-specific agent of a particular resource:

```
$ crsctl check resource appsvip
```

crsctl check ctss

Use the `crsctl check ctss` command to check the status of the Cluster Time Synchronization services.

Syntax

```
crsctl check ctss
```

Example

The `crsctl check ctss` command returns output similar to the following:

```
CRS-4700: The Cluster Time Synchronization Service is in Observer mode.
```

or

```
CRS-4701: The Cluster Time Synchronization Service is in Active mode.
CRS-4702: Offset from the reference node (in msec): 100
```

crsctl config crs

Use the `crsctl config crs` command to display Oracle High Availability Services automatic startup configuration.

Syntax

```
crsctl config crs
```

Example

The `crsctl config crs` command returns output similar to the following:

```
CRS-4622: Oracle High Availability Services autostart is enabled.
```

crsctl delete crs administrator

Use the `crsctl delete crs administrator` command to remove a user from the Oracle Clusterware administrator list.

Syntax

```
crsctl delete crs administrator -u user_name [-f]
```

Parameters

Table E–18 crsctl delete crs administrator Command Parameters

Parameter	Description
`-u user_name`	The name of the user whose Oracle Clusterware administrative privileges you want to remove. By default, the list of users with Oracle Clusterware administrative privileges consists of the user who installed Oracle Clusterware, `root`, and `*`. The user who installed Oracle Clusterware and `root` are permanent members this list. The `*` value gives Oracle Clusterware administrative privileges to all users and must be removed to enable role-separated management. **See Also:** "Role-separated Management" on page 2-18 for more information
`-f`	Use this option to override the user name validity check.

Usage Notes

- The *user_name* parameter is required
- You must run this command as `root` or a cluster administrator, or an administrator on Windows systems
- To enable role-separated management, you must remove the `*` value enclosed in double quotation marks (`" "`)

Example

To remove a user from the list of cluster administrators:

```
# crsctl delete crs administrator -u scott
```

crsctl delete css votedisk

Use the `crsctl delete css votedisk` to remove a voting disk from the Oracle Clusterware configuration.

Syntax

```
crsctl delete css votedisk voting_disk_GUID [voting_disk_GUID [...]]
```

Parameters

Table E–19 crsctl delete css votedisk Command Parameters

Parameter	Description
voting_disk_GUID	Enter the file universal identifier (GUID) of the voting disk you want to remove. Specify multiple GUIDs in a space-delimited list.

Usage Notes

- You can use this command only to remove voting disks from non-Oracle ASM storage devices

- You can obtain the file universal identifiers of each current voting disk by running the `crsctl query css votedisk` command

Example

To remove a voting disk:

```
$ crsctl delete css votedisk 26f7271ca8b34fd0bfcdc2031805581e
```

crsctl delete node

Use the `crsctl delete node` to remove a node from the cluster.

Syntax

```
crsctl delete node -n node_name
```

Usage Notes

- The *node_name* parameter is required

Example

To delete the node named `node06` from the cluster, run the following command as `root` or the Oracle Clusterware installation owner:

```
# crsctl delete node -n node06
```

crsctl delete serverpool

Use the `crsctl delete serverpool` command to remove a server pool from the Oracle Clusterware configuration.

Syntax

```
crsctl delete serverpool server_pool_name [server_pool_name [...]] [-i]
```

> **See Also:** "Understanding Server Pools" on page 2-13 for more information about server pools and server pool attributes

Usage Notes

- The *server_pool_name* parameter is required
- If you specify `-i`, then the command fails if Oracle Clusterware cannot process the request immediately
- Do not use this command for any server pools with names that begin with *ora* because these server pools are Oracle server pools
- While you can use this command in either environment, it is only useful in the Oracle RAC environment

Example

To delete a server pool, run the following command as `root` or the Oracle Clusterware installation owner:

```
# crsctl delete serverpool sp1
```

crsctl disable crs

Use the `crsctl disable crs` command to prevent the automatic startup of Oracle High Availability Services when the server boots.

Syntax

```
crsctl disable crs
```

Usage Notes

- This command only affects the local server
- If you disable Oracle High Availability Services automatic startup, you must use the crsctl start crs command to start Oracle High Availability Services

Example

The `crsctl disable crs` command returns output similar to the following:

```
CRS-4621: Oracle High Availability Services autostart is disabled.
```

crsctl enable crs

Use the `crsctl enable crs` command to enable automatic startup of Oracle High Availability Services when the server boots.

Syntax

```
crsctl enable crs
```

Usage Notes

- This command only affects the local server

Example

The `crsctl enable crs` command returns output similar to the following:

```
CRS-4622: Oracle High Availability Services autostart is enabled.
```

crsctl get css

Use the `crsctl get css` command to obtain the value of a specific Cluster Synchronization Services parameter.

Syntax

```
crsctl get css parameter
```

Usage Notes

- Cluster Synchronization Services parameters include:

```
clusterguid
diagwait
disktimeout
misscount
reboottime
priority
logfilesize
```

- This command only affects the local server

Example

To display the value of the `disktimeout` parameter for CSS, use the following command:

```
$ crsctl get css disktimeout
200
```

crsctl get css ipmiaddr

Use the `crsctl get css ipmiaddr` command to get the address of the local Intelligent Platform Management Interface (IPMI) device, or the Baseboard Management Controller (BMC), as specified in the Oracle Cluster Registry.

Syntax

```
crsctl get css ipmiaddr
```

Usage Notes

- This command only obtains the BMC IP address for the local server

Example

To obtain the IPMI device IP address:

```
$ crsctl get css ipmiaddr
```

crsctl get nodename

Use the `crsctl get nodename` command to obtain the name of the local node.

Syntax

```
crsctl get nodename
```

Example

The `crsctl get nodename` command returns output similar to the following:

```
node2
```

crsctl getperm serverpool

Use the `crsctl getperm serverpool` command to obtain permissions for a particular server pool.

Syntax

```
crsctl getperm serverpool server_pool_name  [-u user_name | -g group_name]
```

See Also: "Understanding Server Pools" on page 2-13 for more information about server pools and server pool attributes

Parameters

Table E–20 crsctl getperm serverpool Command Parameters

Parameter	Description
server_pool_name	Specify the name of the server pool for which you want to obtain permissions.
-u *user_name*	If you specify -u, then Oracle Clusterware obtains permissions for a particular user.
-g *group_name*	If you specify -g, then Oracle Clusterware obtains permissions for a particular group.

Usage Notes

- The *server_pool_name* parameter is required
- Do not use this command for any server pools with names that begin with *ora* because these server pools are Oracle server pools
- While you can use this command in either environment, it is only useful in the Oracle RAC environment

Example

The `crsctl getperm serverpool` command returns output similar to the following:

```
$ crsctl getperm serverpool sp1
NAME: sp1
owner:root:rwx,pgrp:root:r-x,other::r--
```

crsctl lsmodules

Use the `crsctl lsmodules` command to list the components of the modules that you can debug.

> **See Also:** "Dynamic Debugging" on page E-57 for more information about debugging

Syntax

```
crsctl lsmodules { crs | css | evm }
```

Usage Notes

- You can specify either `crs` (Oracle Clusterware), `css` (Cluster Synchronization Services), or `evm` (Event Manager)

Example

The `crsctl lsmodules` command returns output similar to the following:

```
$ crsctl lsmodules evm
List EVMD Debug Module: CLSVER
List EVMD Debug Module: CLUCLS
List EVMD Debug Module: COMMCRS
List EVMD Debug Module: COMMNS
List EVMD Debug Module: CRSOCR
List EVMD Debug Module: CSSCLNT
List EVMD Debug Module: EVMAGENT
```

```
List EVMD Debug Module: EVMAPP
...
```

crsctl modify serverpool

Use the `crsctl modify serverpool` command to modify an existing server pool.

Syntax

```
crsctl modify serverpool server_pool_name -attr "attr_name=attr_value
                     [,attr_name=attr_value[, ...]]" [-i] [-f]
```

Parameters

Table E–21 crsctl modify serverpool Command Parameters

Parameter	Description
server_pool_name	The name of the server pool you want to modify.
attr_name	The name of a server pool attribute you want to modify preceded by the `-attr` flag.
attr_value	A value for the server pool attribute. **Note:** The *attr_name* and *attr_value* parameters must be enclosed in double quotation marks (`""`) and separated by commas. For example: `-attr "CHECK_INTERVAL=30,START_TIMEOUT=25"`
`-i`	If you specify `-i`, then the command fails if Oracle Clusterware cannot process the request immediately.
`-f`	If you specify the `-f` option, then Oracle Clusterware stops resources running on a server in another server pool and relocates that server into the server pool you are adding. If you do not specify the `-f` option, then Oracle Clusterware checks whether the creation of the server pool results in stopping any resources on a server in another server pool that is going to give up a server to the server pool you are adding. If so, then Oracle Clusterware rejects the `crsctl add serverpool` command.

See Also: "Understanding Server Pools" on page 2-13 for more information about server pools and server pool attributes

Usage Notes

- The *server_pool_name* parameter is required
- If an attribute value for an attribute name-value pair contains commas, then the value must be enclosed in single quotation marks (`''`). For example:

  ```
  "START_DEPENDENCIES='hard(res1,res2,res3)'"
  ```

- Running this command may result in Oracle Clusterware relocating other servers between server pools to comply with the new configuration
- Do not use this command for any server pools with names that begin with *ora* because these server pools are Oracle server pools
- While you can use this command in either environment, it is only useful in the Oracle RAC environment

Example

To modify an existing server pool, run the following command as `root` or the Oracle Clusterware installation owner:

```
# crsctl modify serverpool sp1 -attr "MAX_SIZE=7"
```

crsctl pin css

Use the `crsctl pin css` command to pin many specific nodes. Pinning a node means that the association of a node name with a node number is fixed. If a node is not pinned, its node number may change if the lease expires while it is down. The lease of a pinned node never expires.

Syntax

```
crsctl pin css -n node_name [ node_name [..]]
```

Usage Notes

- You can specify a space-delimited list of servers
- Any pre-11*g* release 2 (11.2) Oracle software must reside on a pinned server.
- A node may be unpinned with crsctl unpin css.
- Deleting a node with the crsctl delete node command implicitly unpins the node.

Example

To pin the node named `node2`:

```
# crsctl pin css -n node2
```

crsctl query crs administrator

Use the `crsctl query crs administrator` command to display the list of users with Oracle Clusterware administrative privileges.

Syntax

```
crsctl query crs administrator
```

Example

The `crsctl query crs administrator` command returns output similar to the following:

```
CRS Administrator List: scott
```

crsctl query crs activeversion

Use the `crsctl query crs activeversion` command to display the active version, or the binary version, of the Oracle Clusterware software on the local node.

Syntax

```
crsctl query crs activeversion
```

Example

The `crsctl query crs activeversion` command returns output similar to the following:

```
Oracle Clusterware active version on the cluster is [11.2.0.1.0]"
```

crsctl query crs releaseversion

Use the `crsctl query crs releaseversion` command to display the release version of the Oracle Clusterware software.

Syntax

```
crsctl query crs releaseversion
```

Example

The `crsctl query crs releaseversion` command returns output similar to the following:

```
Oracle High Availablity Services release version on the local node is [11.2.0.1.0]
```

crsctl query crs softwareversion

Use the `crsctl query crs softwareversion` command to display the software version, or the lowest Oracle Clusterware software version running on a particular server in the cluster.

Syntax

```
crsctl query crs softwareversion node_name
```

Usage Notes

- If you do not provide a node name, then Oracle Clusterware displays the version of Oracle Clusterware running on the local server.

Example

The `crsctl query crs softwareversion` command returns output similar to the following:

```
Oracle Clusterware version on node [node1] is [11.2.0.1.0]
```

crsctl query css ipmidevice

Use the `crsctl query css ipmidevice` command to determine the presence of the Intelligent Platform Management Interface (IPMI) driver on the local system.

Syntax

```
crsctl query css ipmidevice
```

Usage Notes

- This command was implemented to perform a pre-check during installation, and is normally issued only by the installer.
- There are no special privileges required to run this command.
- This command performs a perfunctory check and a success return code from the command does not guarantee that the baseboard management controller (BMC) hardware is fully configured for use.

Example

The `crsctl query crs ipmidevice` command returns output similar to the following:

```
CRS-4231: IPMI device successfully found and is configured

or

CRS-4128: IPMI device not found
```

crsctl query css votedisk

Use the `crsctl query css votedisk` command to display the voting disks used by Cluster Synchronization Services, the status of the voting disks, and the location of the disks, whether they are stored on Oracle ASM or elsewhere.

Syntax

```
crsctl query css votedisk
```

Usage Notes

-

Example

The `crsctl query css votedisk` command returns output similar to the following:

```
$ crsctl query css votedisk
##  STATE    File Universal Id                File Name Disk group
--  -----    -----------------                --------- ---------
1. ONLINE   296641fd201f4f3fbf3452156d3b5881 (/ocfs2/host09_vd3) []
2. ONLINE   8c4a552bdd9a4fd9bf93e444223146f2 (/netapp/ocrvf/newvd) []
3. ONLINE   8afeee6ae3ed4fe6bfbb556996ca4da5 (/ocfs2/host09_vd1) []
Located 3 voting disk(s).
```

crsctl relocate resource

Use the `crsctl relocate resource` command to relocate resources to another server in the cluster.

Syntax

```
crsctl relocate resource {resource_name | resource_name | -all -s source_server |
-w "filter"} [-n destination_server] [-k cid] [-env "env1=val1,env2=val2,..."]
[-i] [-f]
```

Parameters

Table E–22 crsctl relocate resource Command Parameters

Parameter	Description
resource_name	The name of a resource you want to relocate.
resource_name | -all -s *source_server*	Specify one particular or all resources located on a particular server *from* which you want to relocate those resources.

Table E–22 (Cont.) crsctl relocate resource Command Parameters

Parameter	Description
`-w "filter"`	Specify a resource filter that Oracle Clusterware uses to limit the number of resources relocated. The filter must be enclosed in double quotation marks (""). Examples of resource filters include: ■ `"TYPE == cluster_resource"`: This filter limits Oracle Clusterware to relocate only resources of `cluster_resource` type ■ `"CHECK_INTERVAL > 10"`: This filter limits Oracle Clusterware to relocate resources that have a value greater than 10 for the `CHECK_INTERVAL` resource attribute ■ `"(CHECK_INTERVAL > 10) AND (NAME co 2)"`: This filter limits Oracle Clusterware to relocate resources that have a value greater than 10 for the `CHECK_INTERVAL` resource attribute *and* the name of the resource contains the number `2`
`-n destination_server`	Specify the name of the server *to* which you want relocate resources. If you do not specify a destination server, then Oracle Clusterware relocates the resources to the best server according to the attribute profile of each resource.
`-k cid`	Specify the resource cardinality ID. If you specify this parameter, then Oracle Clusterware relocates the resource instance that have the cardinality you specify.
`-env "env1=val1, env2=val2,..."`	You can optionally override one or more resource profile attribute values for this command. If you specify multiple environment name-value pairs, then you must separate each pair with a comma and enclose the entire list in double quotation marks ("").
`-i`	If you specify `-i`, then the command returns an error if processing this command requires waiting for Oracle Clusterware to unlock the resource or its dependents. Sometimes, Oracle Clusterware locks resources or other objects to prevent commands from interfering with each other.
`-f`	Specify the `-f` option to force the relocating of the resource when it has other resources running that depend on it. Dependent resources are relocated or stopped when you use this option. **Note:** When you are relocating resources that have cardinality greater than 1, you must use either `-k` or `-s` to narrow down which resource instances are to be relocated.

Usage Notes

- Any one of the three following options is required to specify which resources you want to relocate:
  - You can specify one particular resource to relocate.
  - Or you can specify one particular or all the resources to relocate from a particular source server.
  - Thirdly, you can specify a resource filter that Oracle Clusterware uses to match resources to relocate.
- If a resource has a degree ID greater than 1, then Oracle Clusterware relocates all instances of the resource.

- You must have read and execute permissions on the specified resources to relocate them
- Do not use this command for any resources with names that begin with *ora* because these resources are Oracle resources.

Example

To relocate one particular resource from one server to another:

```
# crsctl relocate resource myResource1 -s node1 -n node3
```

crsctl relocate server

Use the `crsctl relocate server` command to relocate a server to a different server pool.

Syntax

```
crsctl relocate server server_name [...] -c server_pool_name [-i] [-f]
```

Parameters

Table E–23 crsctl relocate server Command Parameters

Parameter	Description
server_name	The name of the server you want to relocate. You can provide a space-delimited list of servers if you want to relocate multiple servers.
`-c` *server_pool_name*	Specify the name of the server pool *to* which you want relocate the servers.
`-i`	If you specify `-i`, then the command fails if Oracle Clusterware cannot process the request immediately.
`-f`	If you specify the `-f` option, then Oracle Clusterware stops resources running on the servers in another server pool and relocates that server into the server pool you specified. If you do not specify the `-f` option, then Oracle Clusterware checks for resources that must be stopped on the servers that are being relocated. If it finds any, then Oracle Clusterware rejects the `crsctl relocate server` command.

Usage Notes

- The *server_name* and `-c` *server_pool_name* parameters are required

Example

To move the `node6` and `node7` servers into the `sp1` server pool without disrupting any active resources on those nodes, use the following command:

```
$ crsctl relocate server node6 node7 -c sp1
```

crsctl replace discoverystring

Use the `crsctl replace discoverystring` command to replace the existing discovery string used to locate voting disk files.

Syntax

```
crsctl replace discoverystring 'absolute_path[,...]'
```

Parameters

Table E–24 crsctl replace discoverystring Command Parameters

Parameter	Description
absolute_path	Specify one or more comma-delimited absolute paths that match one or more voting disk file locations. Wildcards may be used. The list of paths must be enclosed in quotes.

Usage Notes

- You must be `root`, the Oracle Clusterware installation owner, or a Windows administrator to run this command.
- You can run this command on any node in the cluster.

Example

Assume the current discovery string is `/oracle/css1/*`. To also use voting disk files in the `/oracle/css2/` directory, replace the current discovery string using the following command:

```
# crsctl replace discoverystring "/oracle/css1/*,/oracle/css2/*"
```

crsctl replace votedisk

Use the `crsctl replace votedisk` command to move or replace the existing voting disks. This command creates voting disks in the specified locations, either in Oracle ASM or some other storage option. Oracle Clusterware copies existing voting disk information into the new locations and removes the voting disks from the former locations.

Syntax

```
crsctl replace votedisk [+asm_disk_group | path_to_voting_disk [...]]
```

Parameters

Table E–25 crsctl replace votedisk Command Parameters

Parameter	Description
+asm_disk_group	Specify the disk group in Oracle ASM where you want to locate the voting disk.
path_to_voting_disk [...]	A space-delimited list of voting disk file paths for voting disk files that reside outside of Oracle ASM.

Usage Notes

- You must be `root`, the Oracle Clusterware installation owner, or a Windows administrator to run this command.
- Specify to replace a voting disk in either an Oracle ASM disk group or in some other storage device.
- You can run this command on any node in the cluster.

Example

Example 1

To replace a voting disk that is located within Oracle ASM:

```
$ crsctl replace votedisk +diskgroup1
```

Example 2

To replace a voting disk that is located on a shared file system:

```
$ crsctl replace votedisk /mnt/nfs/disk1 /mnt/nfs/disk2
```

crsctl set css

Use the `crsctl set css` command to set the value of a Cluster Synchronization Services parameter.

Syntax

```
crsctl set css parameter value
```

Usage Notes

- Cluster Synchronization Services parameters include:

  ```
  diagwait
  disktimeout
  misscount
  reboottime
  ```

Example

To set the value of a Cluster Synchronization Services parameter:

```
$ crsctl set css diagwait 30
```

crsctl set css ipmiaddr

Use the `crsctl set css ipmiaddr` command to store the address of the local Intelligent Platform Management Interface (IPMI) device, or the Baseboard Management Controller (BMC), in the Oracle Cluster Registry.

Syntax

```
crsctl set css ipmiaddr ip_address
```

Usage Notes

- Run the command under the user account used to install Oracle Clusterware
- Obtain the BMC IP address for the local server with the `crsctl get css ipmiaddr` command, or using the appropriate management utility for the local server (`ipmiutil`, `ipmitool`)
- Oracle Clusterware stores IP address for the local BMC in the configuration store, and distributes the address as required
- This command only stores the BMC IP address on the server from which you run it

Example

To store the BMC IP address on a local server and distribute it to other cluster nodes:

```
$ crsctl set css ipmiaddr 192.0.2.244
```

crsctl set css ipmiadmin

Use the `crsctl set css ipmiadmin` command to store in the Oracle Registry the login information of an Intelligent Platform Management Interface (IPMI) administrator configured on the resident baseboard management controller (BMC) of the local server.

Syntax

```
crsctl set css ipmiadmin ipmi_administrator_name
```

Usage Notes

- This command must be run under the user account that installed Oracle Clusterware.
- When prompted, provide the new password to associate with the new administrator account name. Oracle Clusterware stores the name and password for the local baseboard management controller (BMC) in the configuration store, and distributes the new credentials as required.
- This command only modifies the IPMI administrator on the server from which you run it.
- This command fails if another server cannot access the local BMC at the supplied address.

Example

To modify the IPMI administrator `scott`:

```
$ crsctl set css ipmiadmin scott
```

crsctl setperm serverpool

Use the `crsctl setperm serverpool` command to set permissions for a particular server pool.

Syntax

```
crsctl setperm serverpool server_pool_name {-u acl_string | -x acl_string |
-o user_name | -g group_name}
```

Parameters

Table E–26 crsctl setperm serverpool Command Parameters

Parameter	Description
server_pool_name	Specify the name of the server pool for which you want to set permissions.

Table E–26 (Cont.) crsctl setperm serverpool Command Parameters

Parameter	Description
`{-u | -x | -o | -g}`	You can specify only one of the following parameters for a server pool: ■ `-u` *`acl_string`*: You can update the access control list (ACL) for a server pool ■ `-x` *`acl_string`*: You can delete the ACL for a server pool ■ `-o` *`user_name`*: You can change the owner of a server pool by entering a user name ■ `-g` *`group_name`*: You can change the primary group of a server pool by entering a group name Specify a user, group, or other ACL string, as follows: `user:`*`user_name`*`[:`*`readPermwritePermexecPerm`*`] | group:`*`group_name`*`[:`*`readPermwritePermexecPerm`*`] | other[::`*`readPermwritePermexecPerm`*`]` ■ `user`: User ACL ■ `group`: Group ACL ■ `other`: Other ACL ■ `readPerm`: Read permission for the server pool; the letter `r` grants a user, group, or other read permission, the minus sign (`-`) denies read permission ■ `writePerm`: Write permission for the server pool; the letter `w` grants a user, group, or other write permission, the minus sign (`-`) denies write permission ■ `execPerm`: Execute permission for the server pool; the letter `x` grants a user, group, or other execute permission, the minus sign (`-`) denies execute permission

Usage Notes

- The *`server_pool_name`* parameter is required
- Do not use this command for any server pools with names that begin with *ora* because these server pools are Oracle server pools
- While you can use this command in either environment, it is only useful in the Oracle RAC environment

Example

To grant read, write, and execute permissions on a server pool for user Scott Tiger:

```
crsctl setperm serverpool sp3 -u user:scott.tiger:rwx
```

crsctl start cluster

Use the `crsctl start cluster` command on any node in the cluster to start the Oracle Clusterware stack.

Syntax

```
crsctl start cluster [-all | -n server_name [...]]
```

Usage Notes

- You can choose to start the Oracle Clusterware stack on all servers in the cluster, on one or more named servers in the cluster (separate multiple server names by a space), or the local server, if you do not specify either `-all` or `-n`.
- You can use this cluster-aware command on any node in the cluster.

Example

To start the Oracle Clusterware stack on two named servers run the following command as `root` or the owner of the Oracle Clusterware installation:

```
# crsctl start cluster -n node1 node2
```

crsctl start crs

Use the `crsctl start crs` command to start Oracle High Availability Services on the local server.

Syntax

```
crsctl start crs
```

Usage Notes

- This command starts Oracle High Availability Services only on the local server

Example

To start Oracle High Availability Services on the local server, run the following command as `root` or the owner of the Oracle Clusterware installation:

```
# crsctl start crs
```

crsctl status server

Use the `crsctl status server` command to obtain the status and configuration information of one or more particular servers.

Syntax

```
crsctl status server [-p | -v | -f]

crsctl status server { server_name [...] | -w "filter"} [-g | -p | -v | -f]
```

Parameters

Table E–27 crsctl status server Command Parameters

Parameter	Description
server_name `[...]`	Specify one or more space-delimited server names
-w "*filter*"	Specify a filter to determine which servers are displayed. The filter must be enclosed in double quotation marks (`""`). Values that contain parentheses or spaces must be enclosed in single quotation marks (`''`). For example, `"STATE = ONLINE"` limits the display to servers that are online. **See Also:** "Filters" on page F-5 for more information about filters

Table E–27 (Cont.) crsctl status server Command Parameters

Parameter	Description
`-g | -p | -v | -f`	You can specify one of the following parameters when Oracle Clusterware checks the status of specific servers: ■ `-g`: Use this parameter to check if the specified servers are registered ■ `-p`: Use this parameter to display static configuration of the specified servers ■ `-v`: Use this parameter to display the runtime configuration of the specified servers ■ `-f`: Use this parameter to display the full configuration of the specified servers

Example

Example 1

The `crsctl status server` command returns output similar to the following:

```
NAME=node1
STATE=ONLINE

NAME=node2
STATE=ONLINE
```

Example 2

To display the full configuration of a specific server, enter a command similar to the following:

```
$ crsctl status server node2 -f
NAME=node2
STATE=ONLINE
ACTIVE_POOLS=ora.orcl Generic
STATE_DETAILS=
```

crsctl status serverpool

Use the `crsctl status serverpool` command to obtain the status and configuration information of one or more particular server pools.

Syntax

```
crsctl status serverpool [-p | -v | -f]

crsctl status serverpool [server_pool_name [...]] [-g | -p | -v | -f]
```

Parameters

Table E–28 crsctl status serverpool Command Parameters

Parameter	Description
[*server_pool_name* [...]	Specify one or more space-delimited server pool names.

Table E–28 (Cont.) crsctl status serverpool Command Parameters

Parameter	Description
`[-g | -p | -v | -f]`	You can optionally specify one of the following parameters: ■ `-g`: Use this parameter to check if the specified server pools are registered ■ `-p`: Use this parameter to display static configuration of the specified server pools ■ `-v`: Use this parameter to display the runtime configuration of the specified server pools ■ `-f`: Use this parameter to display the full configuration of the specified server pools

Usage Notes

- The *`server_pool_name`* parameter or a filter is required
- Do not use this command for any server pools with names that begin with *ora* because these server pools are Oracle server pools
- While you can use this command in either environment, it is only useful in the Oracle RAC environment

Example

Example 1

To display the full configuration of the server pool sp1:

```
$ crsctl status serverpool sp1 -f
NAME=spl
IMPORTANCE=1
MIN_SIZE=0
MAX_SIZE=-1
SERVER_NAMES=node3 node4 node5
PARENT_POOLS=Generic
EXCLUSIVE_POOLS=
ACL=owner:oracle:rwx,pgrp:oinstall:rwx,other::r--
ACTIVE_SERVERS=node3 node4
```

Example 2

To display all the server pools and the servers associated with them, use the following command:

```
$ crsctl status serverpool
NAME=Free
ACTIVE_SERVERS=

NAME=Generic
ACTIVE_SERVERS=node1 node2

NAME=ora.orcl
ACTIVE_SERVERS=node1 node2

NAME=sp1
ACTIVE_SERVERS=node3 node4
```

crsctl stop cluster

Use the `crsctl stop cluster` command on any node in the cluster to stop the Oracle Clusterware stack on all servers in the cluster or specific servers.

Syntax

```
crsctl stop cluster [-all | -n server_name [...]] [-f]
```

Usage Notes

- If you do not specify `-all` or one or more space-delimited server names, then Oracle Clusterware stops the Oracle Clusterware stack on the local server.
- You can use this cluster-aware command on any node in the cluster.
- This command attempts to gracefully stop resources managed by Oracle Clusterware while attempting to stop the Oracle Clusterware stack.

  If any resources that Oracle Clusterware manages are still running after you run the `crsctl stop cluster` command, then the command fails. Use the `-f` option to unconditionally stop all resources and stop the Oracle Clusterware stack.

Example

To stop the Oracle Clusterware stack on a particular server:

```
# crsctl stop cluster -n node1
```

crsctl stop crs

Use the `crsctl stop crs` command to stop Oracle High Availability Services on the local server.

Syntax

```
crsctl stop crs [-f]
```

Usage Notes

- This command attempts to gracefully stop resources managed by Oracle Clusterware while attempting to stop Oracle High Availability Services on the local server.

  If any resources that Oracle Clusterware manages are still running after you run the `crsctl stop crs` command, then the command fails. Use the `-f` option to unconditionally stop all resources and stop Oracle High Availability Services on the local server.

Example

To stop Oracle High Availability Services on the local server:

```
# crsctl stop crs
```

crsctl unpin css

Use the `crsctl unpin css` command to unpin many servers. If a node is not pinned, its node number may change if the lease expires while it is down.

Syntax

```
crsctl unpin css -n node_name [ node_name [..]]
```

Usage Notes

- You can specify a space-delimited list of nodes.
- Unpinned servers that stop for longer than a week are no longer reported by `olsnodes`. These servers are dynamic when they leave the cluster, so you do not need to explicitly remove them from the cluster.
- Deleting a node with the crsctl delete node command implicitly unpins the node.
- During upgrade of Oracle Clusterware, all servers are pinned, whereas after a fresh installation of Oracle Clusterware 11*g* release 2 (11.2), all servers you add to the cluster are unpinned.
- You *cannot* unpin a server that has an instance of Oracle RAC that is older than 11*g* release 2 (11.2) if you installed Oracle Clusterware 11*g* release 2 (11.2) on that server.

Example

To unpin two nodes:

```
$ crsctl unpin css node1 node4
```

crsctl unset css

Use the `crsctl unset css` command to restore the value of a Cluster Synchronization Services parameter to its default value.

Syntax

```
crsctl unset css parameter
```

Usage Notes

- There are four Cluster Synchronization Services parameters you can specify:
  - `diagwait`:
  - `disktimeout`:
  - `misscount`:
  - `reboottime`:

Example

To restore the `reboottime` Cluster Synchronization Services parameter to its default value:

```
$ crsctl unset css reboottime
```

Oracle Restart Environment CRSCTL Commands

The commands listed in this section control Oracle High Availability Services. These commands manage the Oracle High Availability Services stack in the Oracle Restart environment, which consists of the Oracle High Availability Services daemon (`ohasd`), Oracle ASM (if installed), and Cluster Synchronization Services (if Oracle ASM is installed). These commands only affect the local server on which you run them.

Each server in the cluster is in one of two possible states:

- The whole stack is up, which means that Oracle High Availability Services is active
- The whole stack is down, which means that Oracle High Availability Services is inactive

You can use the following commands in the Oracle Restart environment, only:

- `crsctl check has`
- `crsctl config has`
- `crsctl disable has`
- `crsctl enable has`
- `crsctl query has releaseversion`
- `crsctl query has softwareversion`
- `crsctl start has`
- `crsctl stop has`

crsctl check has

Use the `crsctl check has` command to check the status of `ohasd`.

Syntax

```
crsctl check has
```

Usage Notes

-

Example

The `crsctl check has` command returns output similar to the following:

```
CRS-4638: Oracle High Availability Services is online
```

crsctl config has

Use the `crsctl check has` command to display the automatic startup configuration of the Oracle High Availability Services stack on the server.

Syntax

```
crsctl config has
```

Usage Notes

-

Example

The `crsctl config has` command returns output similar to the following:

```
CRS-4622 Oracle High Availability Services autostart is enabled.
```

crsctl disable has

Use the `crsctl disable has` command to disable automatic startup of the Oracle High Availability Services stack when the server boots up.

Syntax

```
crsctl disable has
```

Usage Notes

-

Example

The `crsctl disable has` command returns output similar to the following:

```
CRS-4621 Oracle High Availability Services autostart is disabled.
```

crsctl enable has

Use the `crsctl enable has` command to enable automatic startup of the Oracle High Availability Services stack when the server boots up.

Syntax

```
crsctl enable has
```

Usage Notes

-

Example

The `crsctl enable has` command returns output similar to the following:

```
CRS-4622 Oracle High Availability Services autostart is enabled.
```

crsctl query has releaseversion

Use the `crsctl query crs releaseversion` command to display the release version of the Oracle Clusterware software on the local node.

Syntax

```
crsctl query has releaseversion
```

Usage Notes

-

Example

The `crsctl query has releaseversion` command returns output similar to the following:

```
Oracle High Availability Services release version on the local node is
```

```
[11.2.0.0.2]
```

crsctl query has softwareversion

Use the `crsctl query crs softwareversion` command to display the software version on the local node.

Syntax

```
crsctl query has softwareversion server_name
```

Usage Notes

- If you do not provide a server name, then Oracle Clusterware displays the version of Oracle Clusterware running on the local server.

Example

The `crsctl query has softwareversion` command returns output similar to the following:

```
Oracle High Availability Services version on the local node is [11.2.0.0.2]
```

crsctl start has

Use the `crsctl start has` command to start Oracle High Availability Services on the local server.

Syntax

```
crsctl start has
```

Usage Notes

-

Example

To start Oracle High Availability Services on the local server:

```
# crsctl start has
```

crsctl stop has

Use the `crsctl stop has` command to stop Oracle High Availability Services on the local server.

Syntax

```
crsctl stop has [-f]
```

Usage Notes

- This command attempts to gracefully stop resources managed by Oracle Clusterware while attempting to stop Oracle High Availability Services.

  If any resources that Oracle Clusterware manages are still running after you run the `crsctl stop has` command, then the command fails. Use the `-f` option to unconditionally stop all resources and stop Oracle High Availability Services.

Example

To stop Oracle High Availability Services on the local server:

```
# crsctl stop has
```

Troubleshooting and Diagnostic Output

You can use `crsctl set log` commands as the `root` user to enable dynamic debugging for Cluster Ready Services (CRS), Cluster Synchronization Services (CSS), and the Event Manager (EVM), and the clusterware subcomponents. You can dynamically change debugging levels using `crsctl debug` commands. Debugging information remains in the Oracle Cluster Registry for use during the next startup. You can also enable debugging for resources.

This section covers the following topics:

- Dynamic Debugging
- Component Level Debugging
- Enabling Debugging for Oracle Clusterware Resources
- Enabling Additional Tracing for Oracle Clusterware High Availability

Dynamic Debugging

This section includes the following CRSCTL commands that aid in debugging:

- crsctl set log
- crsctl set trace

crsctl set log

Use the `crsctl set log` command to set log levels for Oracle Clusterware.

Syntax

```
crsctl set log {[crs | css | evm "component_name=log_level, [...]"] |
[all=log_level]}
```

You can also set log levels for the agents of specific resources, as follows:

```
crsctl set log res "resource_name=log_level, [...]"
```

Usage Notes

- You can set log levels for various components of the three modules, CRS, CSS, and EVM. If you choose the `all` option, then you can set log levels for all components of one module with one command. Use the `crsctl lsmodules` command to obtain a list of components for each module.
- Enter a comma-delimited list of component name-log level pairs enclosed in double quotation marks (`" "`).

> **Note:** Separate component name-log level pairs with an equals sign (=) in Oracle Clusterware 11*g* release 2 (11.2). Previous Oracle Clusterware versions used a colon (`:`).

- The *`log_level`* is a number from `1` to `5` that sets the log level for the component or resource, where 1 is the least amount of log output and 5 provides the most detailed log output.
- To set log levels for resources, specify the name of a particular resource, or a comma-delimited list of resource name-log level pairs enclosed in double quotation marks (`" "`).

Examples

To set log levels for the CRSRTI and CRSCOMM components of the CRS module:

```
$ crsctl set log crs "CRSRTI=1,CRSCOMM=2"
```

To set log levels for all components of the EVM module:

```
$ crsctl set log evm all=2
```

To set a log level for a resource:

```
$ crsctl set log res "myResource1=3"
```

crsctl set trace

Use the `crsctl set trace` command to set tracing levels for Oracle Clusterware.

Syntax

```
crsctl set trace {[crs | evm "component_name=tracing_level, [...]"] |
["all=tracing_level"]
```

Usage Notes

- You can set tracing levels for the components of two modules: CRS and EVM. Use the `crsctl lsmodules` command to obtain a list of components for each module. If you choose the `all` option, then you can set tracing levels for all components of one module with one command.
- Enter a comma-delimited list of component name-tracing level pairs enclosed in double quotation marks (`" "`).

> **Note:** Separate component name-tracing level pairs with an equals sign (=) in Oracle Clusterware 11*g* release 2 (11.2). Previous Oracle Clusterware versions used a colon (`:`).

- The *`tracing-level`* is a number from `1` to `5` that sets the tracing level for the component, where 1 is the least amount of tracing output and 5 provides the most detailed tracing output.

Examples

To set tracing levels for the CRSCCL and CRSEVT components of the CRS module:

```
$ crsctl set trace crs "CRSCCL=1,CRSEVT=2"
```

Component Level Debugging

You can use `crsctl set log` and `crsctl set trace` commands as the `root` user to enable dynamic debugging for the Oracle Clusterware Cluster Ready Services (CRS), Cluster Synchronization Services (CSS), and the Event Manager (EVM).

This section includes the following topics:

- Enabling Debugging for CRS, CSS, and EVM Modules
- Creating an Initialization File to Contain the Debugging Level

Enabling Debugging for CRS, CSS, and EVM Modules

You can enable debugging for the CRS, CSS, and EVM modules and their components, and for resources, by setting environment variables or by issuing `crsctl set log` commands, using the following syntax:

```
crsctl set {log | trace} module_name
 "component:debugging_level[,component:debugging_level][...]"
```

Run the `crsctl set` command as the `root` user, and supply the following information:

- *`module_name`*—The name of the module: CRS, CSS, or EVM.
- *`component`*—The name of a component for the CRS, CSS, or EVM module. See Table E–29 for a list of all of the components.
- *`debugging_level`*—A number from `1` to `5` to indicate the level of detail you want the debug command to return, where 1 is the least amount of debugging output and 5 provides the most detailed debugging output.

  You can dynamically change the debugging level in the `crsctl` command or you can configure an initialization file for changing the debugging level, as described in "Creating an Initialization File to Contain the Debugging Level" on page 62.

The following commands show examples of how to enable debugging for the various modules:

- To enable debugging for Oracle Clusterware:

  ```
  crsctl set log crs "CRSRTI:1,CRSCOMM:2"
  ```

- To enable debugging for OCR:

  ```
  crsctl set log crs "CRSRTI:1,CRSCOMM:2,OCRSRV:4"
  ```

- To enable debugging for EVM:

  ```
  crsctl set log evm "EVMCOMM:1"
  ```

- To enable debugging for resources

  ```
  crsctl debug log res "resname:1"
  ```

To obtain a list of components that can be used for debugging, run the `crsctl lsmodules` command, as follows:

```
crsctl lsmodules {crs | css | evm}
```

Note: You do not have to be the `root` user to run the `crsctl lsmodulues` command.

Table E–29 shows the components for the CRS, CSS, and EVM modules, respectively. Note that some component names are common between the CRS, EVM, and CSS daemons and may be enabled on that specific daemon. For example, `COMMNS` is the NS layer and because each daemon uses the NS layer, you can enable this specific module component on any of the daemons to get specific debugging information.

Table E–29 Components for the CRS, CSS, and EVM Modules

CRS Components[1]	CSS Components[2]	EVM Components[3]
CRSUI	CSSD	EVMD
CRSCOMM	COMMCRS	EVMDMAIN
CRSRTI	COMMNS	EVMCOMM
CRSMAIN		EVMEVT
CRSPLACE		EVMAPP
CRSAPP		EVMAGENT
CRSRES		CRSOCR
CRSCOMM		CLUCLS
CRSOCR		CSSCLNT
CRSTIMER		COMMCRS
CRSEVT		COMMNS
CRSD		
CLUCLS		
CSSCLNT		
COMMCRS		
COMMNS		

[1] Obtain the list of CRS components using the `crsctl lsmodules crs` command.
[2] Obtain the list of CSS components using the `crsctl lsmodules css` command.
[3] Obtain the list of EVM components using the `crsctl lsmodules evm` command.

Example 1

To set debugging levels on all cluster nodes, include the `-all` keyword, as follows:

```
crsctl debug log crs "CRSRTI:1,CRSCOMM:2" -all
```

Example 2

To set debugging levels on specific cluster nodes, include the `-nodelist` keyword and the names of the nodes, as follows:

```
crsctl debug log crs "CRSRTI:1,CRSCOMM:2" -nodelist node1,node2
```

Table E–30 describes the Cluster Synchronization Services modules.

Table E–30 Cluster Synchronization Services (CSS) Modules and Functions

Module	Description
CSS	CSS client component
CSSD	CSS daemon component

Table E–31 describes the function of each communication (COMM) module.

Table E–31 Communication (COMM) Modules and Functions

Module	Description
COMMCRS	Clusterware communication layer
COMMNS	NS communication layer

Table E–32 describes the functions performed by each CRS module.

Table E–32 Oracle Clusterware (CRS) Modules and Functions

Module	Descriptions
CRSUI	User interface module
CRSCOMM	Communication module
CRSRTI	Resource management module
CRSMAIN	Main module/driver
CRSPLACE	CRS placement module
CRSAPP	CRS application
CRSRES	CRS resources
CRSOCR	Oracle Cluster Registry interface
CRSTIMER	Various timers related to CRS
CRSEVT	CRS EVM/event interface module
CRSD	CRS daemon

Using the `crsctl set log crs` command, you can debug the OCR components listed in Table E–33. The components listed in Table E–33 can also be used for the Oracle Local Registry (OLR) except for OCRMAS and OCRASM. You can also use them for the OCR and OLR clients, except for OCRMAS and OCRSRV. Some of the OCR/OLR clients are OCRCONFIG, OCRDUMP, and so on.

Table E–33 Oracle Cluster Registry (OCR) Component Names

Module	Description
OCRAPI	OCR abstraction component
OCRCLI	OCR client component
OCRSRV	OCR server component
OCRMAS	OCR master thread component
OCRMSG	OCR message component
OCRCAC	OCR cache component
OCRRAW	OCR raw device component
OCRUTL	OCR util component
OCROSD	OCR operating system dependent (OSD) layer
OCRASM	OCR ASM component

Table E–34 describes the OCR tool modules.

Table E–34 OCRCONFIG Modules and Functions

Module	Description
OCRCONFIG	OCRCONFIG component for configuring the OCR
OCRDUMP	OCRDUMP component that lists the Oracle Cluster Registry contents
OCRCHECK	OCRCHECK component that verifies all of the configured OCRs

Creating an Initialization File to Contain the Debugging Level

This section describes how to specify the debugging level in an initialization file. This debugging information is stored for use during the next startup.

For each process to debug, you can create an initialization file that contains the debugging level.

The initialization file name includes the name of the process that you are debugging (*process_name*.ini). The file is located in the *Grid_home*/log/*host_name*/admin/ directory. For example, the name for the CLSCFG debugging initialization file on node1 would be:

Grid_home/log/node1/admin/clscfg.ini

You can also use an initialization file when using OCR utilities. The initialization file for ocrconfig, ocrdump, and ocrcheck is:

Grid_home/srvm/admin/ocrlog.ini

The format of the initialization file is as follows:

```
mesg_logging_level=2
comploglvl="OCRAPI:0;OCRSRV:0"
comptrclvl="OCRAPI:0;OCRSRV:0"
```

You can specify component names, logging, and tracing levels.

> **See Also:** "Enabling Debugging for CRS, CSS, and EVM Modules" on page 59 for information about dynamically changing debugging levels by specifying the level number (from 1 to 5) on the crsctl command

Enabling Additional Tracing for Oracle Clusterware High Availability

Oracle Support may ask you to enable tracing to capture additional information. Because the procedures described in this section may affect performance, only perform these activities with the assistance of Oracle Support.

Enabling Debugging for Oracle Clusterware Resources

You can enable debugging for Oracle Clusterware resources by issuing `crsctl set log` and `crsctl set trace` commands, using the following syntax:

```
crsctl set {log | trace} resource "resource_name=debugging_level"
```

Run the `crsctl set` command as the `root` user, and supply the following information:

- *`resource_name`*—The name of the resource to debug.
- *`debugging_level`*—A number from `1` to `5` to indicate the level of detail you want the debug command to return, where 1 is the least amount of debugging output and 5 provides the most detailed debugging output.

  You can dynamically change the debugging level in the `crsctl` command or you can configure an initialization file for changing the debugging level, as described in "Creating an Initialization File to Contain the Debugging Level" on page 62.

  Note: You must run this `crsctl set log` or `crsctl set trace` command as the `root` user.

To obtain a list of resources that can be used for debugging, run the `crsctl status resource` command.

Example 1

To generate a debugging log for the VIP resource on `node1`, issue the following command:

```
crsctl set log resource "ora.node1.vip:1"
```

Example 2

To generate a trace file for a SCAN listener, use the following command:

```
crsctl set trace resource "ora.LISTENER_SCAN1.lsnr=3"
```

F

Oracle Clusterware C Application Program Interfaces

This appendix describes the Oracle Clusterware C application program interfaces (APIs). This appendix contains the following topics:

- About the Programming Interface (C API) to Oracle Clusterware
  - Overview
  - Operational Notes
  - Deprecated CLSCRS APIs
- Interactive CLSCRS APIs
- Non-Interactive CLSCRS APIs

> **See Also:** Chapter 5, "Making Applications Highly Available Using Oracle Clusterware" for detailed information about using Oracle Clusterware to make applications highly available

About the Programming Interface (C API) to Oracle Clusterware

This section contains information about using the programming interface (C API) to Oracle Clusterware (CLSCRS.

Overview

CLSCRS is a set of C-based APIs for Oracle Clusterware. The CLSCRS APIs enable you to manage the operation of entities that are managed by Oracle Clusterware. These entities include resources, resource types, servers, and server pools. You use the APIs to register user applications with Oracle Clusterware so that the clusterware can manage them and maintain high availability. Once an application is registered, you can manage it and query the application's status. If you no longer need the application, then you can stop it and unregister it from Oracle Clusterware.

Oracle Clusterware services are provided by Cluster Ready Services that runs as part of Oracle Clusterware. The CLSCRS API uses a context that is explicitly named in all function calls. The API does not store anything at the process or thread level. You can use the callbacks for diagnostic logging.

Note: You can install the Oracle Clusterware high availability API from the Oracle Database client installation media.

Operational Notes

This section includes the following topics:

Context Initialization and Persistence

To use the CLSCRS APIs, you must first initialize the `clscrs` context. The calls to create and terminate this context are:

- `clscrs_init_crs`: Initializes the `clscrs` context
- `clscrs_term_crs`: Terminates the `clscrs` context

The caller is responsible for terminating the context when it is no longer needed.

Threading Support

None of the CLSCRS APIs spawn threads. Every CLSCRS API function executes in the context of the calling thread. APIs are not reentrant and no thread-affinity on the part of the client is required.

CLSCRS API Data Structures

The following entities are passed into the API calls and contain return values from the API call:

- `clscrs_sp`: A stringpair (`sp`) contains a name and a value string. The value can be NULL. It is created and destroyed, and its contents can be examined and the value replaced. A stringpair can be a member of exactly one stringpair list (`splist`).
- `clscrs_splist`: A stringpair list (`splist`) is a list of zero or more stringpairs used in various contexts. An API can add stringpairs to or remove them from a stringpair list, or the API can iterate stringpairs.
- `clscrs_res`: A resource instance (`res`) represents an Oracle Clusterware entity, which contains the name and additional data appropriate to the context in which the Oracle Clusterware entity is used. Sometimes a resource instance contains Oracle Clusterware entity attribute data and other times it carries status and return messages about an operation. A single resource instance can be a member of exactly one `clscrs_reslist`.
- `clscrs_reslist`: A resource list (`reslist`) is a data structure that contains zero or more instances of `clscrs_res`. An API can add resources to or remove them from a resource list, or the API can iterate resources.

Memory Management

The CLSCRS APIs work on elements and lists. The elements are added to lists. The memory for both elements and lists is allocated and released through explicit API calls. It is the caller's responsibility to release the memory that they allocate. However, when elements are added to lists, only the list must be destroyed: the destruction of the list destroys its elements implicitly. The elements must be destroyed when they are not added to any list. For recursive lists, destroying the parent list also destroys any lists contained within it. The `clscrs_sp` and `clscrs_res` elements must be destroyed by the caller. If they are part of a `clscrs_splist` or `clscrs_reslist`, destroying the list destroys the respective `clscrs_sp` and `clscrs_res` entities.

For example, when a resource is created and added to a resource list, only the resource list must be destroyed, but not the individual resource. Destroying the resource list releases the memory for the individual resource, too.

Memory is allocated by the API through the following calls:

```
clscrs_sp_create()
clscrs_res_create()
clscrs_serverpool_create()
clscrs_type_create()
clscrs_splist_create()
clscrs_reslist_create()
clscrs_entity_id_create()
```

Each of the calls in the preceding list has a corresponding `clscrs_*_destroy()` call.

Error Handling and Tracing

Interactive and non-interactive CLSCRS APIs each use a different error-handling mechanism.

For non-interactive CLSCRS APIs, the error code is returned as the return value of the function call. For example:

```
clscrsret clscrs_sp_get_value(clscrs_sp *sp, oratext **value);
```

The error code is returned as a `clscrsret` value.

For interactive CLSCRS APIs, the output result is represented, as follows:

1. The return value of the function call provides a high-level output of the request. Did the request reach the server? Was it completely successful, or completely or only partially unsuccessful? A successful return value means the request was received, processed, and the outcome was successful for all entities requested.
2. For each entity on which the request operated, there is a programmatic completion code stored in the `op_status` list. If the value is not `success`, it indicates the high-level type of the problem specific to processing the request for the particular object.
3. Optionally, the API might indicate that it wants to receive localized, human-readable error, warning, or status messages by using the callback mechanism. Each invocation of the callback provides the message, message type (severity), and the ID of the object to which the callback invocation pertains.

For example:

```
CLSCRS_STAT clscrs_register_resource2(clscrs_reslist *in_reslist, uword flags,
                                      clscrs_msgf2 msgf, void *msgarg,
                                      clscrs_reslist *op_status);
```

1. The function returns an error code of value `CLSCRS_STAT`.
2. The `crsd` sends error messages, warning messages, and progress messages back to the client through the `clscrs_msgf2` callback. The client must implement the callback to process these messages returned by the `crsd`.
3. In previous Oracle Clusterware releases, the API also contained results of each operation on the Oracle Clusterware entities as part of the `op_status` list. You can access that information using the following API:

   ```
   clscrsret clscrs_res_get_op_status(clscrs_res *res, CLSCRS_STAT *status,
                                      oratext **msg);
   ```

   The `status` argument contains a status code about the `crsd` operation on the Oracle Clusterware entity. Additionally, the `msg` argument contains a message from the `crsd` about the result of the operation. Though the `op_status` list continues to contain the results of the `crsd` operation for each Oracle Clusterware entity in the `msg` argument, usage of the `msg` argument to get the error codes and messages has now been deprecated and is not supported for any use of the API on a new entity. Only pre-existing use cases (for acting on resources, specifically) are supported. Use the callback function to process any messages returned by the `crsd`.

Callback Mechanism

Interactive CLSCRS APIs provide a callback mechanism that the clients can use to process error messages, warning messages, and progress messages sent by the `crsd`.

The signature of the callback mechanism is:

```
typedef  void (*clscrs_msgf2)(void *usrp, const oratext *id, const oratext *msg,
               clscrs_msgtype msgtype);
```

In the preceding syntax:

- `usrp`: Is a user-supplied pointer that probably contains the context of the call
- `id`: Is the identifier of the entity to which the message corresponds
- `msg`: Is the output text
- `msgtype`: Is the type of the message; either error, warning, or progress

Example F–1 describes an example of the callback mechanism.

Example F–1 Callback Mechanism

```
void myCallback(void *arg, const oratext *pId, const oratext *pMsg,
                clscrs_msgtype msgType)
{
    if (pMsg != NULL)
   {
       cout << pMsg << endl;
    }
}
```

Example F–2 describes how to use the callback mechanism in an interactive API.

Example F–2 Using the Callback Mechanism In an Interactive API

```
clscrs_start_resource2(pResIdList, NULL,
                       env, myCallback, NULL,
                       0, pOpStatus);
```

You can also print debug trace messages for the API, itself by passing the `CLSCRS_FLAG_TRACE` flag when creating the context. The signature for context creation is:

```
CLSCRS_STAT clscrs_init_crs(clscrs_ctx **ctx, clscrs_msgf2 errf, void *errCtx,
                            ub4 flags);
```

For the trace messages to work, you must specify both the `CLSCRS_FLAG_TRACE` flag and a `clscrs_msgf2` callback mechanism in the `clscrs_init_crs` API.

The `clscrs_msgf2` callback mechanism has the following signature:

```
typedef  void (*clscrs_msgf)(void *usrp, const oratext *msg, sword msglen);
```

Filters

You can use filters to narrow down Oracle Clusterware entities upon which a CLSCRS API operates. Simple filters are attribute-value pairs with an operator. Operators must be surrounded by spaces, as shown in the examples. You can combine simple filters into expressions called expression filters using Boolean operators.

Supported filter operators are:

`=`
`>`
`<`
`!=`
`co`: Contains
`st`: Starts with

en: Ends with

Supported Boolean operators are AND and OR.

Examples of filters are:

- TYPE = type1
- ((TYPE = type1) AND (CHECK_INTERVAL > 50))
- (TYPE = type1) AND ((CHECK_INTERVAL > 30) OR (AUTO_START co never))
- NAME en network.res
- TYPE st ora.db

> **See Also:** Use the clscrs_comparator enum and the clscrs_operator enum located in the $ORA_CRS_HOME/crs/demo/clscrsx.h file to get the correct type for the above comparators and operators, respectively, in the API calls

There are two types of filters and CLSCRS has a set of APIs to create these filters:

- **Comparison filter**: A simple filter that compares two values. For example:

  ```
  TYPE = ora.db.type
  ```

  Use the clscrs_compfilter_create API to create a comparison filter. For example, to create the (TYPE = ora.db.type) comparison filter:

  ```
  clscrs_compfilter_create(ctx, clscrs_TYPE,
                    clscrs_comparator_eq, (const oratext *)"ora.db.type",
                    &myCompFilter);
  ```

- **Expression filter**: A filter that is created from either a set of comparison filters or expression filters, or both. For example:

  ```
  ((TYPE = ora.db.type) AND (CHECK_INTERVAL > 50))
  ```

  Use the clscrs_expfilter_create API to create a comparison filter. For example, to create an expression filter:

  ```
  clscrs_exprfilter_create(myCompFilter1, clscrs_operator_or,
                           myCompFilter2, &myExprFilter);
  ```

> **See Also:** The $ORA_CRS_HOME/crs/demo/clscrsx.h file for usage information for the clscrs_compfilter_create and clscrs_expfilter_create APIs

---

> **Note:** Both the clscrs_compfilter_create and clscrs_expfilter_create APIs allocate memory that must be freed by calling clscrs_filter_destroy().

You can use filters in the following interactive CLSCRS APIs in place of an entity list:

```
clscrs_start_resource2
clscrs_stat2
clscrs_stop_resource2
clscrs_check_resource2
```

`clscrs_relocate_resource2`

Example F–3 describes using filters in an interactive CLSCRS API.

Example F–3 Filters In an Interactive CLSCRS API

```
clscrs_start_resource2(myCompFilter, NULL,
                       env, msgf2, NULL,
                       0, pOpStatus);
```

Script Agent Usage

When you use CLSCRS APIs inside script agent entry points, keep the following in mind:

1. Some actions, such as start, stop, and clean, are executed under a lock on the resource instance. Thus, issuing a request to the server to act on the resource directly or by extension of a relation results in a dead-lock.
2. Issuing read-only (`clscrs_stat2`) is generally safe unless it is an initial check, where the script agent must not call back on the server, because that results in a dead-lock, as well. Use the `clsagfw` APIs to query the check entry point.

See Also: Appendix B, "Oracle Clusterware Resource Reference" for examples of script agents

Help Interface

You can find the entire list of CLSCRS APIs, including usage information for each, in the `$ORA_CRS_HOME/crs/demo/clscrsx.h` file, along with a demo called `crsapp.c`.

Deprecated CLSCRS APIs

Table F–1 lists the deprecated CLSCRS APIs and the corresponding new APIs for Oracle Clusterware 11*g* release 2 (11.2).

Table F–1 Deprecated CLSCRS APIs

Deprecated Command	Replacement
`clscrs_register_resource`	`clscrs_register_resource2`
`clscrs_start_resource`	`clscrs_start_resource2`
`clscrs_stat`	`clscrs_stat2`
`clscrs_stop_resource`	`clscrs_stop_resource2`
`clscrs_check_resource`	`clscrs_check_resource2`
`clscrs_relocate_resource`	`clscrs_relocate_resource2`
`clscrs_unregister_resource`	`clscrs_unregister_resource2`
`clscrs_msgf`	`clscrs_msgf2`
`clscrs_fail_resource`	No replacement.

Interactive CLSCRS APIs

The APIs listed in Table F–2 make calls to the Cluster Ready Services daemon (`crsd`) to run commands. The `crsd` must be up and running for these APIs to function.

Table F–2 Summary of Interactive CLSCRS APIs for Oracle Clusterware

C API	Description
`clscrs_register_type`	Registers the resource types in the input resource list.
`clscrs_register_serverpool`	Registers a server pool for the input list of servers.
`clscrs_register_resource2`	Registers the resources in the input resource list.
`clscrs_start_resource2`	Notifies Oracle Clusterware to start a named set of resources.
`clscrs_stat2`	Obtains information about the entities identified in rqlist.
`clscrs_stop_resource2`	Notifies Oracle Clusterware to stop a named set of resources.
`clscrs_check_resource2`	Notifies Oracle Clusterware to run the check entry points for the identified resources.
`clscrs_relocate_resource2`	Relocates the list of resource identifiers.
`clscrs_unregister_resource2`	Unregisters the resources in the input list of resource names.
`clscrs_unregister_type`	Unregisters the resource types in the input list.
`clscrs_unregister_serverpool`	Unregisters the given server pool.
`clscrs_relocate_server`	Relocates a list of servers.

Non-Interactive CLSCRS APIs

You can use non-interactive CLSCRS APIs for functions such as context initialization, preparing request payloads for interactive APIs, and post-processing output of the interactive APIs. The non-interactive CLSCRS APIs do not call `crsd`.

A callback error reporting mechanism is not available for the non-interactive CLSCRS APIs. All interactive CLSCRS APIs, except, `clscrs_stat2`, use this callback mechanism. Clients of these APIs also use the callback mechanism to receive error, warning, and progress messages from the `crsd`.

You can also use filters to reduce the list of CRS entities. You can also use filters in the interactive APIs to reduce the list of CRS entities.

> **See Also:** "Error Handling and Tracing" on page F-4, "Callback Mechanism" on page F-4, and "Filters" on page F-5 for more information

Table F–3 describes the non-interactive CLSCRS APIs.

Table F–3 Non-Interactive CLSCRS APIs

C API	Description
`clscrs_entity_id_destroy`	Frees the memory associated with an entity identifier created from `clscrs_entity_id_create()`.
`clscrs_exprfilter_create`	Constructs an expression filter from comparison and/or expression filters.
`clscrs_filter_destroy`	Frees the memory for a filter.
`clscrs_get_entity_type`	Obtains the entity type corresponding to the entity identifier provided.
`clscrs_get_fixed_attrlist`	Obtains the list of attributes that correspond to an attribute group identifier.
`clscrs_get_resource_instance_details`	Obtains the resource instance details, such as resource name, cardinality, and degree, from the resource instance identifier that is used.
`clscrs_getnodename`	Obtains the node name.
`clscrs_init_crs`	Initializes a context for communications with Oracle Clusterware.
`clscrs_is_crs_admin`	Checks whether the user is an Oracle Clusterware administrator.
`clscrs_res_attr_count`	Obtains the number of attributes for a resource.
`clscrs_res_create`	Creates a new resource.
`clscrs_res_destroy`	Frees the memory for a resource.
`clscrs_res_get_attr`	Obtains a resource attribute for a resource.
`clscrs_res_get_attr_list`	Obtains the attribute list for a resource.
`clscrs_res_get_name`	Obtains the name of a resource.
`clscrs_res_get_op_status`	Obtains the status of an operation for an entity.
`clscrs_res_get_registered`	Obtains the registration status of a resource.

Table F–3 (Cont.) Non-Interactive CLSCRS APIs

C API	Description
clscrs_res_get_reslist	Obtains the resource list for a resource.
clscrs_res_set_attr_list	Sets the attribute list for a resource.
clscrs_res_set_reslist	Sets the resource list for a resource.
clscrs_reslist_append	Adds a resource to a resource list.
clscrs_reslist_count	Counts the number of resources in a resource list.
clscrs_reslist_create	Creates a new resource list.
clscrs_reslist_delete_res	Deletes a resource from a resource list.
clscrs_reslist_destroy	Frees the memory for a resource list.
clscrs_reslist_find	Finds a resource in a resource list.
clscrs_reslist_first	Obtains the first resource on a resource list.
clscrs_reslist_next	Obtains the current next resource from the resource list.
clscrs_sp_get	Obtains the name and value components of a stringpair.
clscrs_sp_set	Changes the value part of a stringpair.
clscrs_splist_append	Adds a new stringpair (sp) to a stringpair list (splist).
clscrs_splist_create	Creates a new stringpair list.
clscrs_splist_delete_sp	Deletes a stringpair (sp) from a stringpair list (splist).
clscrs_splist_first	Obtains the first stringpair (sp) from a stringpair list (splist).
clscrs_splist_replace	Replaces the value for a stringpair (sp) in a stringpair list (splist).
clscrs_term_crs	Releases a context for communications with CRS.
clscrs_type_create	Creates a new resource type.
clscrs_type_get_attr	Obtains the value/properties of a resource type attribute.
clscrs_type_set_attr	Adds an attribute to a resource type.
clscrs_compfilter_create	Constructs a simple filter that compares two values.
clscrs_entity_id_create	Creates an entity identifier that identifies a CRS entity such as a resource, resource type, server group, and so on.
clscrs_register_serverpool	Registers a server pool for the input list of servers.
clscrs_register_type	Registers the resource types in the input resource list.
clscrs_relocate_server	Relocates a list of servers.
clscrs_res_get_node_list	Obtains the nodelist currently hosting the resource.
clscrs_res_set_attr	Sets a resource attribute for a resource.

Table F–3 (Cont.) Non-Interactive CLSCRS APIs

C API	Description
`clscrs_sp_get_value`	Obtains the value component of a stringpair.
`clscrs_splist_count`	Counts the number of stringpairs (sp) in a stringpair list (splist).
`clscrs_splist_create_and_set`	Creates a new stringpair list (splist) and set the name and value for the first stringpair in the list.
`clscrs_splist_destroy`	Frees the memory for a stringpair list (splist).
`clscrs_splist_find`	Finds the value for a stringpair (sp) in a stringpair list (splist).
`clscrs_splist_next`	Obtains the current next stringpair (sp) from a stringpair list (splist). Current next SP is effectively the next SP in the SPLIST. The list iterator is stored within the API and is not exposed.
`clscrs_stat2`	Obtains information about the entities identified in rqlist.

G

Managing the Oracle Cluster Registry

This appendix describes the syntax of the Oracle Cluster Registry (OCR) configuration utility, OCRCONFIG. It also explains how to troubleshoot OCR using the OCRDUMP and OCRCHECK utilities. You can also use these utilities on Oracle Local Registry (OLR).

This appendix contains the following topics:

About OCRCONFIG

This section contains topics which relate to using the OCRCONFIG utility.

Overview

Use the `ocrconfig` command to manage OCR. Using this utility you can import, export, add, delete, restore, overwrite, backup, repair, replace, move, upgrade, or downgrade OCR.

Operational Notes

Usage Information

- The OCRCONFIG executable is located in the `Grid_home/bin` directory
- The `ocrconfig` command syntax is as follows:

```
ocrconfig -option
```

Using Utility Help

To display the help output for the OCRCONFIG utility:

```
ocrconfig -help
```

Privileges and Security

To use the OCRCONFIG utility you must be logged into the operating system as a user with administrative privileges.

Log Files

When you use the OCRCONFIG utility, a log file called `ocrconfig_pid.log` is created in the `$ORACLE_HOME/log/host_name/client` directory. Ensure that you have write privileges in this directory before running the OCRCONFIG utility.

OCRCONFIG Command Reference

This section lists the following OCRCONFIG commands:

- `ocrconfig -add`
- `ocrconfig -backuploc`
- `ocrconfig -delete`
- `ocrconfig -downgrade`
- `ocrconfig -export`
- `ocrconfig -import`
- `ocrconfig -manualbackup`
- `ocrconfig -overwrite`
- `ocrconfig -repair`
- `ocrconfig -replace`
- `ocrconfig -restore`
- `ocrconfig -showbackup`
- `ocrconfig -upgrade`

ocrconfig -add

Use the `ocrconfig -add` command to add an OCR location to a storage device or Oracle Automatic Storage Management (Oracle ASM) disk group. OCR locations that you add must exist, have sufficient permissions, and, in the case of Oracle ASM disk groups, must be mounted before you can add them.

Syntax

```
ocrconfig -add location_name
```

Usage Notes

- You must run this command as `root`.
- The *`location_name`* variable can be a device name, a file name, or the name of an Oracle ASM disk group. For example:
  - `/dev/raw/raw1`: Ensure that the device exists
  - `/oradbocfs/crs/data.ocr`: You must create an empty (0 byte) OCR location
  - `d:\oracle\mirror.ocr`: You must create an empty (0 byte) OCR location
  - `+newdg`: Ensure that the disk group exists and is mounted

    If you specify an Oracle ASM disk group, the name of the disk group must be preceded by a plus sign (+).

See Also:

- *Oracle Grid Infrastructure Installation Guide* for information about creating OCR locations and setting correct permissions
- *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management

Example

To add an OCR location to the default location in Oracle ASM, `data`:

```
# ocrconfig -add +data
```

ocrconfig -backuploc

Use the `ocrconfig -backuploc` command to specify an OCR backup directory location.

Syntax

```
ocrconfig [-local] -backuploc file_name
```

Usage Notes

- You must run this command as `root`.
- Use the `-local` option to back up OLR.
- The *`file_name`* variable can be a full directory path name that is accessible by all nodes. For example:
  - *`Grid_home`*`/cdata/cluster3/`
  - `d:\cdata\cluster3`
- The default location for generating OCR backups on Linux or UNIX systems is *`Grid_home`*`/cdata/`*`cluster_name`*, where *`cluster_name`* is the name of your cluster. The Windows default location for generating OCR backups uses the same path structure.
- The default location for generating OLR backups on Linux or UNIX systems is *`Grid_home`*`/cdata/`*`host_name`*, where *`host_name`* is the name of the node on which the OLR resides that you want to back up. The Windows default location for generating OLR backups uses the same path structure.

Example

To specify an OCR backup location in a directory:

```
# ocrconfig -backuploc $Grid_home/cdata/cluster3
```

ocrconfig -delete

Use the `ocrconfig -delete` command to remove an OCR device or file.

Syntax

```
ocrconfig -delete file_name
```

Usage Notes

- You must run this command as `root`.
- The *`file_name`* variable can be a device name, a file name, or the name of an Oracle ASM disk group. For example:

  - /dev/raw/raw1
  - /oradbocfs/crs/data.ocr
  - d:\oracle\mirror.ocr
  - +olddg

  If you specify an Oracle ASM disk group, the name of the disk group must be preceded by a plus sign (+).

Example

To remove an OCR location:

```
# ocrconfig -delete +olddg
```

ocrconfig -downgrade

Use the `ocrconfig -downgrade` command to downgrade OCR to an earlier specified version.

Syntax

```
ocrconfig -downgrade [-version version_string]
```

Usage Notes

- You must run this command as `root`.

Example

To downgrade OCR to an earlier version:

```
# ocrconfig -downgrade -version
```

ocrconfig -export

Use the `ocrconfig -export` command to export the contents of OCR to a target file.

Syntax

```
ocrconfig [-local] -export file_name
```

Usage Notes

- You must run this command as `root`.
- Use the `-local` option to export the contents of OLR.
- The *`file_name`* variable can be a full path name or the name of an Oracle ASM disk group that is accessible by all nodes. For example:
  - /oradbocfs/crs/data.ocr
  - d:\oracle\

Example

To export the contents of OCR to a file:

```
# ocrconfig -export d:\tmp\a
```

ocrconfig -import

Use the `ocrconfig -import` command to import the contents of a target file into which you exported the contents of OCR back into OCR.

Syntax

```
ocrconfig [-local] -import file_name
```

Usage Notes

- You must run this command as `root`.
- Use the `-local` option to import the contents of OLR from a file.
- The *`file_name`* variable must be a full path name that is accessible by all nodes. For example:
  - `/oradbocfs/crs/data.ocr`
  - `d:\oracle\`
- You must shut down Oracle Clusterware before running this command.

Example

To import the contents a file back into OCR:

```
# ocrconfig -import d:\tmp\a
```

ocrconfig -manualbackup

Use the `ocrconfig -manualbackup` command to back up OCR on demand in the location you specify with the `-backuploc` option.

Syntax

```
ocrconfig [-local] -manualbackup
```

Usage Notes

- You must run this command as `root`.
- Use the `-local` option to perform a manual backup of OLR.

Example

To back up OCR:

```
# ocrconfig -manualbackup
```

ocrconfig -overwrite

Use the `ocrconfig -overwrite` command to overwrite an OCR configuration in the OCR metadata with the current OCR configuration information that is found on the node from which you run this command.

Syntax

```
ocrconfig -overwrite
```

Usage Notes

- You must run this command as `root`.

Example

To overwrite an OCR configuration:

```
# ocrconfig -overwrite
```

ocrconfig -repair

Use the `ocrconfig -repair` command to repair an OCR configuration on the node from which you run this command. Use this command to add, delete, or replace an OCR location on a node that may have been stopped while you made changes to the OCR configuration in the cluster. OCR locations that you add must exist, have sufficient permissions, and, in the case of Oracle ASM disk groups, must be mounted before you can add them.

Syntax

```
ocrconfig -repair -add file_name | -delete file_name | -replace
current_file_name -replacement new_file_name
```

Usage Notes

- You must run this command as `root`.
- Oracle High Availability Services must be started to successfully complete the repair.
- The Cluster Ready Services daemon must be stopped before running `ocrconfig -repair`.
- The *`file_name`* variable can be a valid OCR and either a device name, an absolute path name of an existing file, or the name of an Oracle ASM disk group. For example:
  - `/dev/raw/raw1`
  - `/oradbocfs/crs/data.ocr`
  - `d:\oracle\mirror.ocr`
  - `+newdg`

    If you specify an Oracle ASM disk group, the name of the disk group must be preceded by a plus sign (+).

    See Also:

    - *Oracle Grid Infrastructure Installation Guide* for information about creating OCRs and setting correct permissions
    - *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management
- You can only use one option with `ocrconfig -repair` at a time.
- Running this command only modifies the local configuration and it and only affects the current node.

Example

To repair an OCR configuration:

```
# ocrconfig -repair -delete +olddg
```

ocrconfig -replace

Use the `ocrconfig -replace` command to replace an OCR device or file on the node from which you run this command. OCR locations that you add must exist, have sufficient permissions, and, in the case of Oracle ASM disk groups, must be mounted before you can add them.

Syntax

```
ocrconfig -replace current_location_name -replacement new_location_name
```

Usage Notes

- You must run this command as `root`.
- The *new_location_name* variable can be a device name, a file name, or the name of an Oracle ASM disk group. For example:
  - `/dev/raw/raw1`: Ensure that the device exists
  - `/oradbocfs/crs/data.ocr`: You must create an empty (0 byte) OCR location
  - `d:\oracle\mirror.ocr`: You must create an empty (0 byte) OCR location
  - `+newdg`: Ensure that the disk group exists and is mounted

    If you specify an Oracle ASM disk group, the name of the disk group must be preceded by a plus sign (+).

    See Also:

    - *Oracle Grid Infrastructure Installation Guide* for information about creating OCRs and setting correct permissions
    - *Oracle Database Storage Administrator's Guide* for more information about Oracle ASM disk group management
- You must have at least two OCR devices to use this command. If you do not have at least two OCR devices, then you must run the `ocrconfig -add` command to add a new OCR device followed by the `ocrconfig -delete` command to delete the OCR device you want to replace.

Example

To replace an OCR device or file:

```
# ocrconfig -replace /dev/raw/raw1 -replacement +newdg
```

ocrconfig -restore

Use the `ocrconfig -restore` command to restore OCR from an automatically created OCR backup file.

Syntax

```
ocrconfig [-local] -restore file_name
```

Usage Notes

- You must run this command as `root`.
- Before running this command, ensure that the original OCR or OLR files exist. If the original file does not exist, then you must create an empty file.
- Use the `-local` option to restore a backup of OLR.
- Example file names are:
  - `/oradbocfs/crs/BACKUP00.ocr`
  - `d:\oracle\BACKUP01.ocr`

- Ensure that the storage devices that you specify exist and that those devices are valid.
- If OCR is located on an Oracle ASM disk group, then ensure that the disk group exists and is mounted.

Example

To restore OCR from a file on Oracle ASM:

```
# ocrconfig -restore +backupdg:BACKUP02
```

ocrconfig -showbackup

Use the `ocrconfig -showbackup` command to display the backup location, timestamp, and the originating node name of the backup files. By default, this command displays information for both automatic and manual backups unless you specify `auto` or `manual`.

Syntax

```
ocrconfig [-local] -showbackup [auto | manual]
```

Usage Notes

- Use the `-local` option to show manual OLR backup information. The `-local` flag functions only with the `manual` option.
- You can optionally specify `auto` or `manual` to display information about only automatic backups or only manual backups, respectively:
  - `auto`: Displays information about automatic backups that Oracle Clusterware created in the past 4 hours, 8 hours, 12 hours, and in the last day and week.
  - `manual`: Displays information about manual backups that you invoke using the `ocrconfig -manualbackup` command.

Example

To display manual backup information for OLR:

```
$ ocrconfig -local -showbackup manual
```

ocrconfig -upgrade

Use the `ocrconfig -upgrade` command to upgrade OCR from a previous version.

Syntax

```
ocrconfig [-local] -upgrade [user [group]]
```

Usage Notes

- You must run this command as `root`.
- Use the `-local` option to upgrade OLR.

Example

To display manual backup information for OLR:

```
# ocrconfig -local -showbackup manual
```

Troubleshooting and Diagnostic Output

This section describes various methods for troubleshooting problems with OCR, and obtaining diagnostic information from the utilities used to manage the OCR.

This section contains the following topics:

Oracle Cluster Registry Troubleshooting

Table G–1 describes common OCR problems with corresponding resolution suggestions.

Table G–1 Common Oracle Cluster Registry Problems and Solutions

Problem	Solution
Not currently using OCR mirroring and would like to enable it.	Run the `ocrconfig` command with the `-replace` option.
OCR failed and you must replace it. Error messages in Oracle Enterprise Manager or OCR log file.	Run the `ocrconfig` command with the `-replace` option.
OCR has a misconfiguration.	Run the `ocrconfig` command with the `-repair` option as described.
You are experiencing a severe performance effect from OCR processing or you want to remove OCR for other reasons.	Run the `ocrconfig` command with the `-replace` option as described.
OCR has failed and before you can fix it, the node must be rebooted with only one OCR.	Run the `ocrconfig` with the `-repair` option to remove the bad OCR location. Oracle Clusterware cannot start if it cannot find all OCRs defined.

Using the OCRCHECK Utility

The OCRCHECK utility displays the version of the OCR's block format, total space available and used space, OCRID, and the OCR locations that you have configured. OCRCHECK performs a block-by-block `checksum` operation for all of the blocks in all of the OCRs that you have configured. It also returns an individual status for each file and a result for the overall OCR integrity check.

You can run the `ocrcheck -help` command to display usage information about this utility.

The following example shows a sample of the OCRCHECK utility output:

```
# ocrcheck

Status of Oracle Cluster Registry is as follows :
        Version                  :          3
        Total space (kbytes)     :     262120
        Used space (kbytes)      :        752
        Available space (kbytes) :     261368
        ID                       : 2098980155
        Device/File Name         : +dg1
                                   Device/File integrity check succeeded
        Device/File Name         : +dg2
                                   Device/File integrity check succeeded
                                   Device/File not configured
                                   Device/File not configured
                                   Device/File not configured
        Cluster registry integrity check succeeded
        Logical corruption check succeeded
```

Note: The logical corruption check is only performed if you run the `ocrcheck` command as `root`.

To display only configured OCRs:

```
$ ocrcheck -config

Oracle Cluster Registry configuration is :
        Device/File Name         : Grid_home/oracle/has_work/data.ocr
        Device/File Name         : Grid_home/oracle/has_work/mirror.ocr
```

Run the `ocrcheck -local -config` command to obtain OLR information.

```
$ ocrcheck -local -config

Oracle Local Registry configuration is :
        Device/File Name         : Grid_home/oracle/has_work/data.olr.stact23
```

OCRCHECK creates a log file in the *Grid_home*`/log/`*host_name*`/client` directory. To change the log level, edit the *Grid_home*`/srvm/admin/ocrlog.ini` file.

Using the OCRDUMP Utility to View Oracle Cluster Registry Content

This section explains how to use the OCRDUMP utility to view OCR and Oracle Local Registry (OLR) content for troubleshooting. The OCRDUMP utility enables you to view the OCR and OLR contents by writing the content to a file or `stdout` in a readable format.

You can use several options for OCRDUMP. For example, you can limit the output to a key and its descendents. You can also write the contents to an XML file that you can view using a browser. OCRDUMP writes the OCR keys as ASCII strings and values in a data type format. OCRDUMP retrieves header information based on a best effort basis.

OCRDUMP also creates a log file in *`Grid_home`*`/log/`*`host_name`*`/client`. To change the log level, edit the *`Grid_home`*`/srvm/admin/ocrlog.ini` file.

To change the logging component, edit the entry containing the `comploglvl=` entry. For example, to change the log level of the `OCRAPI` component to 3 and to change the log level of the `OCRRAW` component to 5, make the following entry in the `ocrlog.ini` file:

```
comploglvl="OCRAPI:3;OCRRAW:5"
```

> **Note:** Make sure that you have file creation privileges in the *`Grid_home`* directory before using the OCRDUMP utility.

This section includes the following topics:

- OCRDUMP Utility Syntax and Options
- OCRDUMP Utility Examples
- Sample OCRDUMP Utility Output

OCRDUMP Utility Syntax and Options

This section describes the OCRDUMP utility command syntax and usage. Run the `ocrdump` command with the following syntax where *`file_name`* is the name of a target file to which you want Oracle Database to write the Oracle Cluster Registry output and where *`key_name`* is the name of a key from which you want Oracle Database to write Oracle Cluster Registry subtree content:

```
$ ocrdump [file_name | -stdout] [-local] [-backupfile backup_file_name
[-keyname key_name] [-xml] [-noheader]
]
```

Table G–2 describes the OCRDUMP utility options and option descriptions.

Table G–2 OCRDUMP Options and Option Descriptions

Options	Description
`file_name`	The name of a file to which you want OCRDUMP to write output. By default, OCRDUMP writes output to a predefined output file named `OCRDUMPFILE`. The *`file_name`* option redirects OCRDUMP output to a file that you specify.
`-stdout`	Use this option to redirect the OCRDUMP output to the text terminal that initiated the program. If you do not redirect the output, OCRDUMP writes output to a predefined output file named `OCRDUMPFILE`.

Table G–2 (Cont.) OCRDUMP Options and Option Descriptions

Options	Description
`-local`	Use this option to dump the contents of OLR.
`-backupfile`	Use this option to view the contents of an OCR backup file. Use the `-local` option with this option to view the contents of an OLR backup file.
`backup_file_name`	The name of the backup file with the content you want to view. You can query the backups using the `ocrconfig -showbackup` command.
`-keyname` *`key_name`*	The name of an Oracle Cluster Registry key whose subtree is to be dumped.
`-xml`	Use this option to write the output in XML format.
`-noheader`	Does not print the time at which you ran the command and when the Oracle Cluster Registry configuration occurred.

OCRDUMP Utility Examples

The following `ocrdump` utility examples extract various types of OCR information and write it to various targets:

```
ocrdump
```

Writes the OCR content to a file called `OCRDUMPFILE` in the current directory.

```
ocrdump MYFILE
```

Writes the OCR content to a file called `MYFILE` in the current directory.

```
ocrdump -stdout -keyname SYSTEM
```

Displays the OCR content from the subtree of the key `SYSTEM` in the terminal window.

```
ocrdump -stdout -xml
```

Displays the OCR content in the terminal window in XML format.

```
ocrdump -stdout -backupfile $ORA_CRS_HOME/cdata/cluster_name/file_name
```

Writes the entire OCR and OLR content to a backup file located in the `$ORA_CRS_HOME/cdata/`*`cluster_name`* directory. You must run this command as `root` to be able to view all of the keys. Be sure to name the file appropriately so that it can be recognized by anyone as an OCR backup file, such as `BACKUPOO.ocr`.

Sample OCRDUMP Utility Output

The following OCRDUMP examples show the `KEYNAME`, `VALUE TYPE`, `VALUE`, permission set (`user`, `group`, `world`) and access rights for two sample runs of the `ocrdump` command. The following shows the output for the `SYSTEM.language` key that has a text value of `AMERICAN_AMERICA.WE8ASCII37`.

```
[SYSTEM.language]
ORATEXT : AMERICAN_AMERICA.WE8ASCII37
SECURITY : {USER_PERMISSION : PROCR_ALL_ACCESS, GROUP_PERMISSION : PROCR_READ,
OTHER_PERMISSION : PROCR_READ, USER_NAME : user, GROUP_NAME : group}
```

The following shows the output for the `SYSTEM.version` key that has integer value of `3`:

```
[SYSTEM.version]
UB4 (10) : 3
```

```
SECURITY : {USER_PERMISSION : PROCR_ALL_ACCESS, GROUP_PERMISSION : PROCR_READ,
OTHER_PERMISSION : PROCR_READ, USER_NAME : user, GROUP_NAME : group}
```

Diagnostic Output for OCRCONFIG

The OCRCONFIG utility creates a log file in *Grid_home*/log/*host_name*/client.

To change the amount of logging, edit the path in the *Grid_home*/srvm/admin/ocrlog.ini file.

H

Troubleshooting Oracle Clusterware

This appendix introduces monitoring the Oracle Clusterware environment and explains how you can enable dynamic debugging to troubleshoot Oracle Clusterware processing, and enable debugging and tracing for specific components and specific Oracle Clusterware resources to focus your troubleshooting efforts.

This appendix contains the following topics:

Monitoring Oracle Clusterware

You can use Oracle Enterprise Manager to monitor the Oracle Clusterware environment. When you log in to Oracle Enterprise Manager using a client browser, the Cluster Database Home page appears where you can monitor the status of both Oracle Clusterware environments. Monitoring can include such things as:

- Notification if there are any VIP relocations
- Status of the Oracle Clusterware on each node of the cluster using information obtained through the Cluster Verification Utility (`cluvfy`)
- Notification if node applications (nodeapps) start or stop
- Notification of issues in the Oracle Clusterware alert log for the Oracle Cluster Registry, voting disk issues (if any), and node evictions

The Cluster Database Home page is similar to a single-instance Database Home page. However, on the Cluster Database Home page, Oracle Enterprise Manager displays the system state and availability. This includes a summary about alert messages and job activity, and links to all the database and Automatic Storage Management (Oracle ASM) instances. For example, you can track problems with services on the cluster including when a service is not running on all of the preferred instances or when a service response time threshold is not being met.

You can use the Oracle Enterprise Manager Interconnects page to monitor the Oracle Clusterware environment. The Interconnects page shows the public and private interfaces on the cluster, the overall throughput on the private interconnect, individual throughput on each of the network interfaces, error rates (if any) and the load contributed by database instances on the interconnect, including:

- Overall throughput across the private interconnect

- Notification if a database instance is using public interface due to misconfiguration
- Throughput and errors (if any) on the interconnect
- Throughput contributed by individual instances on the interconnect

All of this information also is available as collections that have a historic view. This is useful with cluster cache coherency, such as when diagnosing problems related to cluster wait events. You can access the Interconnects page by clicking the Interconnect tab on the Cluster Database home page.

Also, the Oracle Enterprise Manager Cluster Database Performance page provides a quick glimpse of the performance statistics for a database. Statistics are rolled up across all the instances in the cluster database in charts. Using the links next to the charts, you can get more specific information and perform any of the following tasks:

- Identify the causes of performance issues.
- Decide whether resources must be added or redistributed.
- Tune your SQL plan and schema for better optimization.
- Resolve performance issues

The charts on the Cluster Database Performance page include the following:

- **Chart for Cluster Host Load Average**: The Cluster Host Load Average chart in the Cluster Database Performance page shows potential problems that are outside the database. The chart shows maximum, average, and minimum load values for available nodes in the cluster for the previous hour.
- **Chart for Global Cache Block Access Latency**: Each cluster database instance has its own buffer cache in its System Global Area (SGA). Using Cache Fusion, Oracle RAC environments logically combine each instance's buffer cache to enable the database instances to process data as if the data resided on a logically combined, single cache.
- **Chart for Average Active Sessions**: The Average Active Sessions chart in the Cluster Database Performance page shows potential problems inside the database. Categories, called wait classes, show how much of the database is using a resource, such as CPU or disk I/O. Comparing CPU time to wait time helps to determine how much of the response time is consumed with useful work rather than waiting for resources that are potentially held by other processes.
- **Chart for Database Throughput**: The Database Throughput charts summarize any resource contention that appears in the Average Active Sessions chart, and also show how much work the database is performing on behalf of the users or applications. The Per Second view shows the number of transactions compared to the number of logons, and the amount of physical reads compared to the redo size for each second. The Per Transaction view shows the amount of physical reads compared to the redo size for each transaction. Logons is the number of users that are logged on to the database.

In addition, the Top Activity drilldown menu on the Cluster Database Performance page enables you to see the activity by wait events, services, and instances. Plus, you can see the details about SQL/sessions by going to a prior point in time by moving the slider on the chart.

See Also: *Oracle Database 2 Day + Real Application Clusters Guide*

Clusterware Log Files and the Unified Log Directory Structure

Oracle Database uses a unified log directory structure to consolidate the Oracle Clusterware component log files. This consolidated structure simplifies diagnostic information collection and assists during data retrieval and problem analysis.

Alert files are stored in the directory structures shown in Table H–1.

Table H–1 Locations of Oracle Clusterware Component Log Files

Component	Log File Location[1]
Cluster Ready Services Daemon (CRSD) Log Files	*Grid_home*/log/*host_name*/crsd
Cluster Synchronization Services (CSS)	*Grid_home*/log/*host_name*/cssd
Cluster Time Synchronization Service (CTSS)	*Grid_home*/log/*host_name*/ctssd
Grid Plug and Play	*Grid_home*/log/*host_name*/gpnpd
Multicast Domain Name Service Daemon (MDNSD)	*Grid_home*/log/*host_name*/mdnsd
Oracle Cluster Registry records	For the Oracle Cluster Registry tools (OCRDUMP, OCRCHECK, OCRCONFIG) record log information in the following location:[2] *Grid_home*/log/*host_name*/client The Oracle Cluster Registry server records log information in the following location: *Grid_home*/log/*host_name*/crsd
Oracle Grid Naming Service (GNS)	*Grid_home*/log/*host_name*/gnsd
Oracle High Availability Services Daemon (OHASD)	*Grid_home*/log/*host_name*/ohasd
Event Manager (EVM) information generated by evmd	*Grid_home*/log/*host_name*/evmd
Oracle RAC RACG	The Oracle RAC high availability trace files are located in the following two locations: *Grid_home*/log/*host_name*/racg $ORACLE_HOME/log/*host_name*/racg Core files are in subdirectories of the log directory. Each RACG executable has a subdirectory assigned exclusively for that executable. The name of the RACG executable subdirectory is the same as the name of the executable. Additionally, you can find logging information for the VIP and database in these two locations, eruptively.
Server Manager (SRVM)	*Grid_home*/log/*host_name*/srvm
Disk Monitor Daemon (diskmon)	*Grid_home*/log/*host_name*/diskmon
Grid Interprocess Communication Daemon (GIPCD)	*Grid_home*/log/*host_name*/gipcd

[1] The directory structure is the same for Linux, UNIX, and Windows systems.

[2] To change the amount of logging, edit the path in the *Grid_home*/srvm/admin/ocrlog.ini file.

Diagnostics Collection Script

Every time an Oracle Clusterware error occurs, you should use run the `diagcollection.pl` script to collect diagnostic information from Oracle Clusterware in trace files. The diagnostics provide additional information so Oracle Support can resolve problems. Run this script from the following location:

Grid_home/bin/diagcollection.pl

Note: You must run this script as the `root` user.

Oracle Clusterware Alerts

Oracle Clusterware posts alert messages when important events occur. The following is an example of an alert from the CRSD process:

```
2009-07-16 00:27:22.074
[ctssd(12817)]CRS-2403:The Cluster Time Synchronization Service on host stnsp014
is in observer mode.
2009-07-16 00:27:22.146
[ctssd(12817)]CRS-2407:The new Cluster Time Synchronization Service reference node
is host stnsp013.
2009-07-16 00:27:22.753
[ctssd(12817)]CRS-2401:The Cluster Time Synchronization Service started on host
stnsp014.
2009-07-16 00:27:43.754
[crsd(12975)]CRS-1012:The OCR service started on node stnsp014.
2009-07-16 00:27:46.339
[crsd(12975)]CRS-1201:CRSD started on node stnsp014.
```

The location of this alert log on Linux, UNIX, and Windows systems is in the following directory path, where *Grid_home* is the name of the location where the Oracle grid infrastructure is installed: *Grid_home*/log/*host_name*.

The following example shows the start of the Oracle Cluster Time Synchronization Service (OCTSS) after a cluster reconfiguration:

```
[ctssd(12813)]CRS-2403:The Cluster Time Synchronization Service on host stnsp014
is in observer mode.
2009-07-15 23:51:18.292
[ctssd(12813)]CRS-2407:The new Cluster Time Synchronization Service reference node
is host stnsp013.
2009-07-15 23:51:18.961
[ctssd(12813)]CRS-2401:The Cluster Time Synchronization Service started on host
stnsp014.
```

Alert Messages Using Diagnostic Record Unique IDs

Beginning with Oracle Database 11*g* release 2 (11.2), certain Oracle Clusterware messages contain a text identifier surrounded by "`(:`" and "`:)`". Usually, the identifier is part of the message text that begins with "`Details in...`" and includes an Oracle Clusterware diagnostic log file path and name similar to the following example. The identifier is called a DRUID, or Diagnostic Record Unique ID:

```
2009-07-16 00:18:44.472
[/scratch/11.2/grid/bin/orarootagent.bin(13098)]CRS-5822:Agent
'/scratch/11.2/grid/bin/orarootagent_root' disconnected from server. Details at
(:CRSAGF00117:) in /scratch/11.2/grid/log/stnsp014/agent/crsd/orarootagent_
```

```
root/orarootagent_root.log.
```

DRUIDs are used to relate external product messages to entries in a diagnostic log file and to internal Oracle Clusterware program code locations. They are not directly meaningful to customers and are used primarily by Oracle Support when diagnosing problems.

Note: Oracle Clusterware uses a file rotation approach for log files. If you cannot find the reference given in the file specified in the "`Details in`" section of an alert file message, then this file might have been rolled over to a rollover version, typically ending in `*.l`*`number`* where *`number`* is a number that starts at `01` and increments to however many logs are being kept, the total for which can be different for different logs. While there is usually no need to follow the reference unless you are asked to do so by Oracle Support, you can check the path given for roll over versions of the file. The log retention policy, however, foresees that older logs are be purged as required by the amount of logs generated.

Glossary

action script

A script that defines the start, stop and check actions for a resource. The start action is invoked while starting the resource, the stop action for stopping the resource, and the check action while checking the running status of a resource.

administrator managed

Database administrators define on which servers a database resource should run, and place resources manually as needed. This is the management strategy used in previous releases.

availability directive

Instructions to Oracle Clusterware to reconfigure the system when a server leaves or joins a cluster.

cluster

Multiple interconnected computers or servers that appear as if they are one server to end users and applications.

cluster-aware

Any application designed to be deployed using clusterware.

cluster administrator

An administrator who can manage a certain part of a cluster based on set policies and privileges.

cluster resource

A resource that is aware of the cluster environment and subject to cross-node switchover and failover.

Cluster Time Synchronization Service

A time synchronization mechanism that ensures that all internal clocks of all nodes in a cluster are synchronized.

Cluster Verification Utility (CVU)

A tool that verifies a wide range of Oracle RAC components such as shared storage devices, networking configurations, system requirements, Oracle Clusterware, groups, and users.

dependency

The relationship between two or more resources. and the interaction expressed between them.

disk group

An Oracle ASM disk group is a collection of disks that Oracle ASM manages as a unit. Within a disk group, Oracle ASM exposes a file system interface for Oracle Database files. The content of files that is stored in a disk group is evenly distributed, or striped, to eliminate hot spots and to provide uniform performance across the disks. Oracle ASM files may also be optionally mirrored within a disk group. The performance of disks in a disk group is comparable to the performance of raw devices.

grid infrastructure

The software that provides the infrastructure for an enterprise grid architecture. In a cluster this software includes Oracle Clusterware and Oracle ASM. For a standalone server, this software includes Oracle Restart and Oracle ASM. Oracle Database 11*g* release 2 (11.2) combines these infrastructure products into one software installation called the *grid infrastructure home* (`Grid_home`).

fixup script

Oracle Universal Installer detects when minimum requirements for installation are not completed, and creates shell script programs, called fixup scripts, to resolve many incomplete system configuration requirements. If Oracle Universal Installer detects an incomplete task, it prompts you to create a fixup script and then to run the fixup script in a separate terminal session. You can also generate fixup scripts with certain CVU commands by using the `-fixup` flag.

local resource

A resource that runs on the nodes of a cluster but is unaware of anything outside of the scope of the node.

Oracle Automatic Storage Management (Oracle ASM)

Oracle ASM manages the storage disks used by Oracle Clusterware and Oracle RAC in disk groups. By default, Oracle Clusterware uses Oracle ASM to store OCR and voting disks.

Oracle Cluster Registry (OCR)

The Oracle RAC configuration information repository that manages information about the cluster node list and instance-to-node mapping information. The OCR also manages information about Oracle Clusterware resource profiles for customized applications.

Oracle Clusterware

Software that allows groups (clusters) of connected servers to operate or be controlled as a unit.

Oracle Clusterware stack

The Oracle Clusterware stack includes Oracle Clusterware, Event Manager, Cluster Synchronization Services, and Oracle ASM (if used).

policy managed

Database administrators specify the server pool (excluding generic or free) in which the database resource runs. Oracle Clusterware places the database resource on a server.

resource

A database, application, or process managed by Oracle Clusterware.

resource state

The state of a particular resource at any given time that determines its availability to the cluster.

resource type

Defines whether a resource is either a **cluster resource** or a **local resource**.

server pool

A logical division of servers in a cluster into a group that hosts applications, databases, or both.

Single Client Access Name (SCAN)

A single name that resolves to three IP addresses in the public network.

start effort evaluation

The process that Oracle Clusterware goes through when it starts a resource. During this process, Oracle Clusterware considers resource dependencies contained in the profile of the resource.

state

A set of values that describes what the condition of a particular resource.

Index

Symbols

A

B

C

D

E

F

G

H

I

L

M

N

O

P

R

S

T

U

V

W