



Integration Guide  
for  
Oracle Real Application  
Clusters 10g  
on  
Red Hat  
Enterprise Linux 3  
(Itanium)

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## Introduction

This guide explains how to integrate Oracle Real Application Clusters 10g (RAC) on 64-bit Itanium servers running Red Hat Enterprise Linux 3 with a Pillar Axiom system. The Pillar Axiom system is a complete and integrated storage system for network attached storage (NAS) and storage area networks (SAN).

This document discusses installing Oracle RAC 10g on a Pillar Axiom system that is configured for NAS only.

Oracle RAC 10g, combined with the Pillar Axiom system, gives you a powerful tool to maintain storage data integrity and security. The advantages of Oracle RAC 10g and the Pillar Axiom system's fault-tolerant features ensure high availability.

This document covers the following topics:

- [Installation Examples](#)
- [System Requirements](#)
- [Oracle RAC 10g Preinstallation Tasks](#)
- [Pillar Axiom System Preinstallation Tasks](#)
- [NFS Mount Options](#)
- [Introduction to Oracle RAC 10g](#)
- [Install Oracle RAC 10g on Local Disks](#)
- [Install the Oracle Database 10g Software\(10.1.0.3\)](#)
- [Configure Failover and Load Balancing](#)

For more information on Oracle RAC 10g, visit the Oracle Web site:

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

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## Audience

This document is for administrators of Oracle environments, including Database Administrators, System Administrators, and Storage Administrators who are familiar with:

- Pillar Axiom system architecture and usage
- Basic Oracle RAC 10g architecture
- Red Hat Enterprise Linux 3
- Network File System (NFS) configuration

## Contact Information

Table 1 Contacts at Pillar Data Systems

For help with...	Contact...
<ul style="list-style-type: none"><li>• Error messages</li><li>• Usage questions</li></ul>	Context-sensitive help that is available in the graphical user interface (GUI). <a href="mailto:support@pillardata.com">support@pillardata.com</a> . USA: 1.877.4PILLAR (1.877.474.5527)—request Technical Support at the prompt. International: +1.408.518.4400. Web: <a href="http://support.pillardata.com/">http://support.pillardata.com/</a> . Have your system serial number ready.
<ul style="list-style-type: none"><li>• Implementation assistance</li><li>• System information</li><li>• Enhancement requests</li></ul>	<a href="mailto:sales@pillardata.com">sales@pillardata.com</a> . USA: 1.877.4PILLAR (1.877.474.5527)—request Sales at the prompt. International: +1.408.503.4200.
Documentation improvements and resources	<a href="mailto:docs@pillardata.com">docs@pillardata.com</a> . <a href="http://www.pillardata.com/techdocs/">http://www.pillardata.com/techdocs/</a> —log in with your username and password.

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## Installation Examples

The examples in this document assume the following information:

- The Pillar Axiom system's shared mount point is `/RACoradata`. It is mounted on each RAC node with the same mount parameters. This mount point will contain the data files, control file, redo logs, and undo tablespaces.
- The Oracle database is installed and set up as `oracle` user of group `dba`.
- Each node in the Oracle RAC 10g cluster has its own Oracle Home located on `/rac/oracle/product/10.1`. You can locate this mount point on the Pillar Axiom File Server or the local disk drive of the RAC nodes. For ease of patch maintenance and upgrades, Pillar Data Systems recommends you place the Oracle Home on the Pillar Axiom File Server. For RAC, mount each Oracle Home on the same mount point as the other node.
- The database name of the RAC cluster is `orcl`, with instances named `orcl1` and `orcl2`.

**Important!** In order for the examples in this document to work on your system, you must change the above information to be consistent with your system setup.

## System Requirements

The following is required to install Oracle as described in this document:

- Oracle RAC 10g (10.1.0.3)
- Red Hat Enterprise Linux 3
- A Linux user account for Oracle Home owner where the Oracle processes will run. Normally, this user account is called `oracle`. Add this account to each RAC node and the Pillar Axiom system.
- Super user privilege to start the cluster manager as super user (`root`) on each RAC node.
- Two networks set up as follows:
  - A private Ethernet network that provides intercluster communication between the Linux servers.

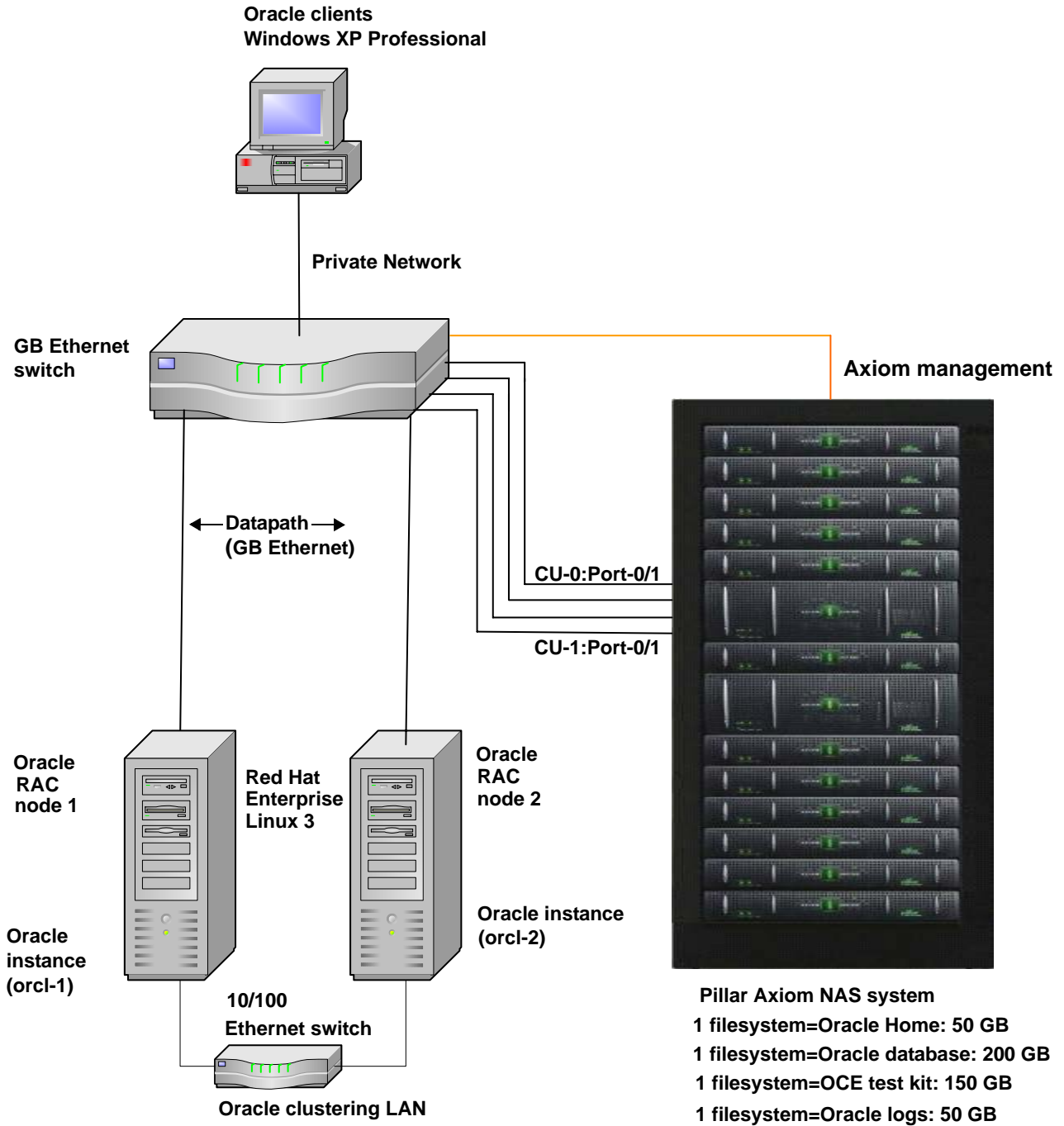
- 
- A network for datapath from the Linux cluster to communicate with the Pillar Axiom system so the Linux cluster can communicate to the public IP network.

Note: The private network names used in the document are ca-iopL03-priv and ca-iopL04-priv.

- RAC Nodes–The number of systems required in the RAC cluster depend on the throughput. A two-node configuration is described in this document.

[Figure 1](#) is an example of a RAC cluster with two nodes (ca-iopL03 and ca-iopL04) and two Oracle instances. It illustrates the configuration used by Pillar Data Systems for testing purposes.

Figure 1 Oracle RAC 10g on a Pillar NAS Configuration



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## Oracle RAC 10g Preinstallation Tasks

Before you perform the Oracle RAC 10g software installation, you must do the following tasks:

- [Check for Required Linux Packages](#)
- [Verify the hangcheck-timer Module](#)
- [Set Up IP Addresses](#)
- [Configure Secure Shell on All Cluster Nodes](#)
- [Configure Kernel Parameters on Linux](#)

This section describes each task.

For more detailed installation instructions, see the appropriate Oracle RAC 10g documentation on the Oracle Web site:

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

### Check for Required Linux Packages

Use the command `# rpm -q package_name` or a similar command to verify the required packages listed below are installed on your system. Versions may be the same or later than those listed below:

- make-3.79.1-17
- gcc-3.2.3-34
- gcc-c++-3.2.3-34
- compat-db-4.0.14-5
- compat-gcc-7.3-2.96.128
- compat-gcc-c++-7.3-2.96.128
- compat-libstdc++-7.3-2.96.128
- compat-libstdc++-devel-7.3-2.96.128
- openmotif-2.2.2-16
- openmotif21-2.1.30-8

- 
- XFree86-libs-4.3.0-62.EL
  - setarch-1.3-1
  - openmotif21-2.1.30-9.RHEL3.6

## Verify the hangcheck-timer Module

The hangcheck-timer module must be running on each node. Do the following to verify the module is running, or start it on your system:

- 1 Use the following command to verify the module is installed and running on each server in the cluster (This module is included on Linux kernel 2.4.9-e.12 Enterprise or higher):

```
# /sbin/lsmmod
```

- 2 If the module is not listed, use the following command to start the module on that node (as user root):

```
# /sbin/insmod hangcheck-timercheck hangcheck_tick=30  
hangcheck_margin=180
```

- 3 On each node, add the following `insmod` command to `etc/modules.conf` to load the hangcheck-timer during reboot:

```
options hangcheck-timer hangcheck_tick=30 hangcheck_margin=180
```

If you are running a different Linux kernel version of 2.4.9-e.3, e.8, e.9 or e.10, download and install the hangcheck-timer patch 2594820 from the Oracle Web site:

<http://www.metalink.oracle.com/>

---

## Set Up IP Addresses

The list below outlines IP address requirements.

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

You must also configure cluster node entries on each server:

- 1 Add entries in `Host Files` on each node.
- 2 Edit `/etc/hosts` and `/etc/hosts.equiv` on each node with cluster, public, private, and virtual interconnect addresses as:

```
172.20.186.42 ca-iopL03 #oracle rac 10g node 1 - public network
172.20.186.43 ca-iopL04 #oracle rac 10g node 2 - public network

10.0.0.3 ca-iopL03-priv #oracle rac 10g node 1 - private
interconnect

10.0.0.4 ca-iopL04-priv #oracle rac 10g node 2 - private
interconnect

172.20.186.44 ca-iopL03-v #oracle rac 10g node 1 - virtual
interfaces

172.20.186.45 ca-iopL04-v #oracle rac 10g node 2 - virtual
interfaces
```

---

## Configure Secure Shell on All Cluster Nodes

Before you install the Oracle database software, you must configure secure shell (`ssh`) for the Oracle user on all nodes in the cluster. During installation, the Installer uses the `ssh` and `scp` commands to run remote commands on and copy files to other cluster nodes. You should configure `ssh` so that these commands do not prompt for a password.

- 1 To test the `ssh` configuration, enter the following example commands from one terminal session on each node in the cluster:

```
$ ssh nodename1 date
$ ssh nodename2 date
```

For Example:

```
node-1> ssh ca-iopL04 date
Fri Sep 2 14:49:21 PDT 2005
```

```
node-2> ssh ca-iopL03 date
Fri Sep 2 14:49:21 PDT 2005
```

- 2 To avoid `Xauth` warnings before installing Oracle, create a user-level `ssh` client configuration file for the Oracle software owner user:
  - In any text editor, edit or create the `~oracle/.ssh/config` file.
  - Verify the `ForwardX11` attribute is set to `no`. For example:

```
Host *
ForwardX11 no
```

## Configure Kernel Parameters on Linux

To configure kernel parameters, use any text editor to create or edit the `/etc/sysctl.conf` file. Add or edit lines to reflect the following recommended parameters:

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

---

```
net.core.wmem_default = 262144
net.core.wmem_max = 262144
```

Include lines only for the kernel parameter values that you want to change. For the semaphore parameters (`kernel.sem`), you must specify all four values.

Note: If the current values are larger than the recommended values, specify the larger value.

## Pillar Axiom System Preinstallation Tasks

Complete the following tasks on a Pillar Axiom system before you install Oracle:

- 1 Create and configure a File Server.
- 2 Create filesystems for Oracle binaries, oradata, and archive logs.
- 3 Create an NFS export for the filesystems.
- 4 Mount the NFS export on the client.

For details on how to perform these tasks, see the *Pillar Axiom Administrator's Guide*.

## NFS Mount Options

NFS has mount options you can set to configure how the Oracle RAC 10g server connects to the Pillar Axiom system. [Table 2](#) explains these options. Use the following options to define these NFS mounts in the `/etc/fstab` file:

```
rw,bg,nointr,hard,timeo=600,wsiz=32768,rsiz=32768,\
nfsvers=3,noac,proto=tcp
```

**Table 2 NFS mount options**

Option	Description
hard	This option specifies that the mount point should not time out, and the Oracle RAC 10g server should not run without it. If the mount point times out and the Pillar Axiom system is not responding to NFS, the Oracle RAC 10g server will hang. Similarly, if the Oracle RAC 10g server boots and cannot find the Pillar Axiom system, it will not complete the boot and fail to start. If it is already up and running, all I/O to and from the Pillar Axiom system suspends until the Pillar Axiom system is available again.
nointr	This option prevents signals from interrupting NFS client operations.
bg	This flag causes the mount to return after a timeout, and be retried periodically until it receives a response.
rw	This option mounts a filesystem as read-write (the default).
nfsvers=3	Use NFS protocol version 3 to access database files larger than 2 Gigabytes.
timeo	This parameter varies the Remote Procedure Call (RPC) timeout period. It is indicated in tenths of a second.
rsize, wsize =32768	These options control the maximum transfer size of read (rsize) and write (wsize) operations.
proto=tcp	Use tcp because udp is not reliable.
noac	Disable all forms of attribute caching entirely. This extracts a server performance penalty but it allows two different NFS clients to get results when both clients are actively writing to common filesystems on the server.

---

## Introduction to Oracle RAC 10g

Each instance of an Oracle RAC 10g database consists of an Oracle Home directory and the database files. Oracle Home is a pointer to the directory where the software is installed. The Oracle Database consists of persistent user and system data organized into the following types of files:

- Database
- Control
- Redo log

Oracle Home is identified by the \$ORACLE\_HOME environment variable. Oracle starts the database and provides a consistent and continuous access to it. You can configure Oracle to start a database by using the database parameter file.

A RAC database is made up of two or more Oracle instances running on a separate interconnect. The interconnect is the communication path between each node in the cluster database. Each Oracle instance uses the interconnect for messaging that synchronizes the use of shared resources. The interconnect also transmits data blocks shared by multiple instances. All nodes access data files, which are the primary type of shared resource.

## Install Oracle RAC 10g on Local Disks

Install the Oracle Cluster Ready Services (CRS) software and the Oracle RAC 10g database software on a local disk. Oracle CRS contains the entire cluster and database configuration metadata along with several system management features for RAC. It allows the DBA to register and invite an Oracle instance (or instances) to join the cluster. During normal operation, CRS will send messages through a special ping operation to all nodes configured in the cluster—often called the “heartbeat.” If the heartbeat fails for any of the nodes, it checks with the voting disk (on the shared disk) to distinguish between a real node failure and a network failure.

---

## Install CRS

The procedures below describe how to install CRS.

**Important!** These steps describe the installation procedures for only one primary node in the cluster. The Oracle Universal Installer (OUI) will install the software to all other nodes in the cluster.

- 1 Log on to the system as an Oracle user and set the environment variables on both nodes.
- 2 Execute the `runInstaller` command from the top level directory of the Oracle CRS.
- 3 On the node you are installing on, open a new console window as the `root` user account.
- 4 Navigate to the `oraInventory` directory and run `oraInstRoot.sh`.
- 5 On the File Locations screen, verify the destination listed for your `$ORA_CRS_HOME` directory. Enter a name to identify this `ORA_CRS_HOME`.
- 6 On the Cluster Configuration screen, enter information for the public and private nodes:
  - For public node, enter the public alias specified in `/etc/hosts` (For example, `ca-iopL03`).
  - For private node, enter the private alias specified in `/etc/hosts` (For example, `ca-iopL03-priv`).
- 7 On the Private Interconnect Enforcement screen, select the interface types accordingly.
- 8 When prompted for Oracle Cluster Registry (OCR) and Voting Disk, provide the location on the Pillar Axiom system (For example, `/RAC10g/oracle/ocr` and `/RAC10g/oracle/quorum`).
- 9 On the Summary screen, choose Install to complete the installation.
- 10 After the installation completes, run the `root.sh` script.
- 11 Open a new console window on each node in the RAC cluster and enter the following command as the `root` user account:

```
> cd /rac/crs/product/10.1
> ./root.sh
```

---

The output should be similar to the following:

```
CSS is active on these nodes.  
ca-iop103  
ca-iop104  
CSS is active on all nodes.  
Oracle CRS stack installed and running under init (1M)
```

12 Run `olsnodes` from the `$ORA_CRS_HOME/bin` directory. For example:

```
> cd /rac/crs/product/10.1/bin  
> ./olsnodes -n  
ca-iop103 1  
ca-iop104 2
```

## CRS Background Processes

After you install the CRS software, the following processes must be running:

- `evmd`—The event manager daemon that starts the `racgevt` process to manage callouts.
- `ocssd`—Manages cluster node membership and runs as oracle user. If this process fails, the cluster will restart.
- `crsd`—Performs high availability recovery and management operations such as maintaining the OCR. Manages application resources, runs as root user, and restarts automatically if it fails.

---

To verify the processes are running:

- 1 Use the `[oracle]/home/oracle> ps -ef | grep d.bin` command to verify the processes are running. Output should be similar to the following:

```
[oracle]/home/oracle> ps -ef | grep d.bin
root      1444   1      0Sep06 ?        00:01:05  /rac/crs/product/10.1/
bin/crsd.bin
oracle    1559 1535   0Sep06 ?        00:00:27  /rac/crs/product/10.1/
bin/ocssd.bin
root      1568 1444   0Sep06 ?        00:00:00  [crsd.bin <defunct>]
oracle    1572 1427   0Sep06 ?        00:00:16  /rac/crs/product/10.1/
bin/evmd.bin
oracle    6575 29055  022:31 pts/6   00:00:00  grep d.bin
```

- 2 It is very important that the resource information for the VIP (managed by CRS) is visible on your system. To see it, go to your `CRS_HOME/bin` directory and run the `crs_stat` command on each node.

Output should be similar to the following:

```
NAME=ora.ca-iopl03.vip
TYPE=application
TARGET=ONLINE
STATE=ONLINE on ca-iopl03

NAME=ora.ca-iopl04.vip
TYPE=application
TARGET=ONLINE
STATE=ONLINE on ca-iopl04
```

This example shows that both of the VIPs are online and are assigned to their respective nodes. In case of failover, one or more VIPs may be moved to another node. This is automatically managed by CRS.

---

## Install the Oracle Database 10g Software(10.1.0.3)

The following steps describe how to install the database software.

**Important!** Perform the following installation procedures on only one node in the cluster. The Oracle Universal Installer will install the software to all other nodes in the cluster.

- 1 Log on to the system as an Oracle user and set the environment variables on both nodes.
- 2 Execute the `runInstaller` command from the top level directory of Oracle CRS.
- 3 On the File Locations Screen, verify the destination listed for your `$ORACLE_HOME` directory. Enter a name to identify this `ORACLE_HOME`.
- 4 On the Specify Hardware Cluster Installation Mode screen, select Cluster Installation and select other nodes in the cluster.

**Important!** If the Specify Hardware Cluster Installation Mode screen does not display, `$ORACLE_HOME` is not set, or CRS is not running. Do not continue the installation. Refer to the Oracle installation guide for problem resolution.

- 5 The Specify Hardware Cluster Installation Mode screen shows all your public aliases. Select All. The local node is selected by default.
- 6 Choose the installation type and select Do Not Create a Starter Database under the Database Configuration screen.
- 7 On the Specify Database File Storage Option screen, provide the location on the Pillar Axiom system (For example, `/RACoradata/ORCL/orcl`).
- 8 The Summary screen should include Real Application Clusters; choose Install to complete the installation.
- 9 After the installation completes, run the `root.sh` script as prompted.
- 10 Open a new console window on each node in the RAC cluster as the `root` user account. You must run the `root.sh` script on all nodes in the RAC cluster one at a time, beginning with the node you are running the database installation from. As the script completes, it displays the Virtual Internet Protocol Configuration Assistant (VIPCA) on the first node you ran `root.sh` on.
- 11 Continue to run the `root.sh` script on all nodes in the cluster one at a time.

- 
- 12 Select the interface for the public network only (For example, eth0). The interface must be identical on all hosts in the cluster. (If it is eth0 on the installation host, it must be eth0 on all other hosts in the cluster.)
  - 13 VIPs for cluster nodes - Enter the VIP alias (host name; for example ca-iopL03-v and ca-iopL04-v) and VIP address for each host that was configured in your DNS.
  - 14 Click Finish. VIPCA creates and starts VIP, Global Storage Daemon (GSD), and Oracle Notification Service (ONS) application resources.

## Create a RAC Database on the Pillar Axiom System

You can create clustered databases by using the Database Creation Assistant (DBCA). Follow these steps to create a RAC database that uses datafiles from a Pillar Axiom filesystem:

- 1 Start the DBCA on one of the nodes:  

```
dbca &
```
- 2 In the Welcome screen, select Oracle Real Application Clusters Database. The Operations page displays.
- 3 Select Create a Database and click Next.
- 4 On the Node Selection screen, click on Select All (ca-iopL03 and ca-iopL04).  
**Important!** If nodes are missing from the Node Selection screen, then perform clusterware diagnostics.
- 5 On the Node Selection screen, the local node is selected by default. If the global storage daemon (GSD) is not running on any of the nodes, a dialog displays explaining how to start the daemon with the `gsdctl start` command. Use this command to start the daemon.

---

## Select Database Templates

The Database Template screen asks you to select a template from which to create your cluster database. To create a preconfigured database, select a template that includes datafiles. The templates on this page include the Transaction Processing, General Purpose, and Data Warehouse preconfigured templates. These templates include datafiles and specially configured options for each environment. However, the New Database template does not include datafiles or the specially configured options.

- 1 In the Database Identification page, enter the global database name and the Oracle system identifier (`sid`) prefix for your cluster database and click Next.
- 2 Select the database features to configure in your cluster database and click Next. If you selected the New Database template, then the DBCA displays the Database Connection Options page.
- 3 Select the connection mode for your cluster database and click Next.

## Choose Parameter and Table Space Options

You must choose parameter and tablespace options to finish the RAC installation.

- 1 In the Initialization Parameters page, select the File Locations tab. If you select Create Server Parameter file (`spfile`), modify the location for the server parameter file to point it to the Pillar Axiom filesystem.
- 2 Select the Archive tab on the Initialization Parameters page to see the archive log destination settings.
- 3 Click All Initialization Parameters to display the All Initialization Parameters dialog. Complete your entries in the dialog and click Close.
- 4 Verify your entries for the File Locations tab and the other tabs are correct.
- 5 On the Database Storage page, enter file names for each tablespace such as SYSTEM, USERS, TEMP, DRSYS, TOOLS, INDX. The Storage page displays these file names in the Datafiles folder.
- 6 To enter file names for these objects on the Database Storage page, click the Tablespaces icon to expand the object tree. Click the tablespace objects under the tree and replace the default file names with the files located on the Pillar Axiom File Server if needed.
- 7 Click Next.

---

## Set Database Options

After completing your entries on the Database Storage page, DBCA displays Creation options.

- 1 Select the database options you want to use:
  - Create Database—creates the database.
  - Save as a Database Template—creates a template that records the structure of the database, such as user-supplied inputs and initialization parameters which you can later use to create a database.
  - Generate Database Creation Scripts—generates database creation scripts.

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

- 2 Review the Summary dialog information and click OK. To stop the database creation process, click Cancel.
- 3 After you click OK, the DBCA displays a password page. Use the password page to override the default password settings for the SYS and SYSTEM user accounts.

Note: You should change the default passwords for the user accounts SYS and SYSTEM by entering and confirming new passwords for these accounts and clicking OK. If you click OK, the DBCA validates the passwords, saves the new passwords, and exits.

## Configure Failover and Load Balancing

You can configure Oracle RAC for server-side load balancing/failover and client-side load balancing/failover. For server-side load balancing, configure the listener and dynamic service registration. For client-side load balancing, configure `tnsnames.ora`.

---

## Dynamic Service Registration

Configure each instance in the cluster to register itself with every listener in the cluster. To do this, set the `LOCAL_LISTENER` and the `REMOTE_LISTENER` parameter in `init.ora`. The `LOCAL_LISTENER` parameter must point to listener running on the same host. The `REMOTE_LISTENER` parameter should point to all other listeners in the cluster.

## OCI Client

The OCI client connects to the database using `tnsnames.ora`. This file contains the following database connection aliases:

### Load Balancing And Failover aliases

```
ORCL =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP) (HOST = ca-iopL03-v) (PORT = 1521))
    (ADDRESS = (PROTOCOL = TCP) (HOST = ca-iopL04-v) (PORT = 1521))
    (LOAD_BALANCE = yes)
    (FAILOVER = on)
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = orcl)
```

### Instance Aliases Bypassing Load Balancing

```
ORCL1 =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP) (HOST = ca-iopL03-v) (PORT = 1521))
    (LOAD_BALANCE = yes)
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = orcl)
      (INSTANCE_NAME = orcl1)
```

---

## Transparent Application Failover Aliases

```
ORCLTEST =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP) (HOST = ca-iopL03-v) (PORT = 1521))
    (ADDRESS = (PROTOCOL = TCP) (HOST = ca-iopL04-v) (PORT = 1521))
    (LOAD_BALANCE = yes)
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = orcltest)
    (FAILOVER_MODE =
      (TYPE = SELECT)
      (METHOD = BASIC)
      (RETRIES = 180)
      (DELAY = 5)
```