



Implementation of Oracle Real Application Cluster

Hayat Z.^{1*}, Soomro T.R.²

^{*1} Ankabut IT, Khalifa University of Science & Technology, UAE
² Department of Computer Science, SZABIST Dubai Campus, UAE

Email: Zulqarnain.hayat@kustar.ac.ae

ABSTRACT

Oracle Real Application Cluster (RAC) is Oracle technology component that can be active on multiple servers to serve as Oracle database server unique. Each server has separate own database instance and these all act as instance of single database for the external network access on the unique virtual IP address. The architecture of the RAC is provides fault tolerance and a great power of treatment. Oracle RAC provides several features in any database operation of the enterprise level for example the scalability, availability, load balancing and failover. The purpose of this study is to serve as a quick reference guide to the installation of management and operation of the Oracle Cluster-ware Real Application Cluster (RAC) database. This feature is initially targeted for the technical staff mainly for DBA Admins of the system.

Keywords: RAC, Shared Storage, SAN, Cluster-ware, Oracle ASM, Oracle Kernel.

1. INTRODUCTION

Cluster database instances are common challenging for each vendor application is presenting its own architecture design. Customers have the option to choose the product for mission-critical application. There are two leading management relational database products are available in the market. Both are data management platforms that provide different features that have demonstrated their ability to manage large-scale, mission-critical applications. However, both companies are offering different visions of how large-scale, mission-critical applications of the future will be developed, designed and implemented. Oracle is unique application vendor offering Real Application Clusters (RAC) which increased in technology scale-out as the silver bullet for all types of applications, databases, essentially canceling the approximation traditional scale. Oracle claims that RAC offers unique scalability and availability at a low cost because of its ability to use inexpensive hardware. Oracle RAC and related technologies are the maximum availability of Oracle architecture, which improves disaster protection database and provide load balancing application. All previous architectures have existed in earlier versions of Microsoft SQL Server. Consequently, only improvements can be found in most of the features of SQL Server 2008 [1].

1.1 What is Oracle?

Oracle Corporation is an American global computer technology, headquartered in Redwood City, California. The company mainly specializes in the development and marketing of database software and technology, engineering

systems in the cloud and enterprise software products. Oracle is the world's leading supplier of software for information management, but is best known for its refined products for relational databases. An Oracle database is a collection of data treated as a unit. The purpose of a database is to store and retrieve related information any. A database server is the key to solving the problems of information management [2].

1.2 Why using Oracle Real Application?

Oracle Real Application Clusters is Oracle technology component that can be allows multiple servers to serve as a database server Oracle alone. Each server has its own database instance and this act as a single instance database instance for access to the external network in the single virtual IP address. Architecture is the RAC provides fault tolerance and high processing capacity. Oracle RAC is providing multiple functions in any database operation at company level, for example, scalability, availability, load balancing and failover. The purpose of this study is to serve as a quick reference guide for installation management and operation of the database Oracle Real Application Cluster (RAC). This study is initially intended for technical staff, mainly system administrators DBAs [3].

1.3 Comparison of Oracle RAC with other database management system

A failover cluster solution in general cannot be associated with Oracle Real Application Clusters. With Oracle RAC same database instance is running on all RAC nodes enabling all nodes to actively share workload in the cluster. This

means, Oracle Real Application Clusters can make use of any new node in the cluster, scaling out the workload immediately across all nodes. Using Oracle's Automatic Storage Management (ASM), mirroring data either within a storage subsystem or between more than one storage systems is totally transparent to the RAC database. ASM provides normal redundancy to maintain a single mirror (either on another disk or other storage systems) and high redundancy to maintain 2 data copies in different locations. ASM stripes the data across all disks, ensuring an optimized IO utilization. In addition, all ASM disk groups, the logical unit in which ASM organizes the disk available to ASM, are open and accessible on every node of the cluster at any point in time. In case of a node failure, no data needs to be made visible to another node, since all the data is already accessible to any node. In case of a storage failure, the RAC database remains fully operational without any service interruption. Microsoft introduced new feature SQL database mirroring like Oracle Data Guard. It was provided in an early version as part of the initial SQL Server 2005 release. Microsoft changed the status as part of the SP1 upgrade. With SQL Server 2008, the Mirror Database feature has undertaken some further enhancements. For example, only in the 2008 version of SQL Server, a manual failover can be performed without restarting the database. In addition, the mirroring protection is comprehensive to pages of data in a way that once a page is found to be corrupt on either the principal server or mirror server, the corresponding page is retrieved from its partner server and the database operation can continue seamlessly. Using a newly available compression technology, Microsoft furthermore allows compressing the data flow between the primary server and the mirror server to reduce network traffic. While the classic Mirror Database approach could only have 1 mirror server, Microsoft SQL Server 2008 introduces a variant allowing periodical Log Shipping between more than 1 warm standby sites. Log shipping occurs on a schedule and therefore, there is a time delay between the data changes on the master server and these changes transferred to the secondary server [1] [4].

RAC provide all system types, from read-only data warehouse systems to update-intensive online transaction processing (OLTP) systems. This study focuses on installation and configuration of two node Oracle real time application cluster and can be helpful to learn about two node cluster database and conversion standby oracle database to oracle RAC instance [3]. This study can help to know about Oracle RAC architecture deep knowledge about oracle RAC and also compare between Oracle RAC and Microsoft SQL Server [5].

2. MATERIAL AND METHODS

This study is based on experimental approach this section provided all pre-installation and post installation methods, which includes Virtual Lab software requirements followed by Hardware requirement and software requirements in general for Oracle RAC for cluster environment installation and configuration. Before launching installation methods, we need to consider few as follows:

Virtual Lab Requirements are as follows:

- (1) VMware Workstation 9.0.0 build-812388
- (2) Open filer SAN 2.99 64bit

- (3) Install VMware client tool
- (4) Number of Virtual Machines = 2

Hardware requirements are as follows:

- (1) Physical memory (at least 1.5 gigabyte(GB) of RAM
grep MemTotal /proc/meminfo
- (2) swap space (Virtual Memory) An amount of swap equal the amount of RAM
#grep SwapTotal /proc/meminfo
- (3) Temporary space (at least 1GB) available in /tmp#
df -k /tmp
- (4) A processor type (CPU) that is certified with Version of Oracle Software being installed.
- (5) At minimum of 1024 x 786 display resolution, so that Oracle Universal Installer (OUI) displays correctly.
- (6) All servers should be used in the cluster should have the same chip Architecture, for example, all Linux processors or all x86 64-bitprocessors
uname -m
x86_64
- (7) Disk space for software installation locations
GRID_HOME = 10GB
ORACLE_HOME = 10GB
Allocated Space = 80GB for both homes
Mounting point = /u01 on both nodes

Software Requirements are as follows:

- (1) Oracle database 11.2.0.1 or higher
- (2) Oracle Cluster Ready Services 11.2.0.1 or H

Shared Storage requirement is as follows:

- Oracle ASM been used for Shared Storage for Oracle Database files, Oracle Cluster files and Fast Recovery area
- (1) Total No of DG = 3 (CRS,DATA,FRA)
 - (2) CRS = 10G
 - (3) DATA = 300G
 - (4) FRA = 200G

Network Hardware requirements are as follows:

- (1) Public Interface Name = eth0,eth1
- (2) Bonding Name = bond0
- (3) Public host config(IPs and hostnames)
Racnode1.localdomain : 192.168.1.30
Racnode2.localdomain : 192.168.1.31
- (4) Private Interfaces Name : eth2,eth3
- (5) Bonding Name = bond1
- (6) Private host config
racnode1-priv.localdomain : 192.168.2.32
racnode2-priv.localdomain : 192.168.2.33

The Network Adapter for the public interface must support TCP/IP. The network adapter for the private interface must support the user datagram protocol (UDP) using high-speed network adapters and a network switch that supports TCP/IP (Gigabit Ethernet or better). For the private network, the end points of all designated interconnect interfaces must be completely reachable on the network. Every node in the cluster should be able to connect to every private network interface in the cluster. The Hostname of each node must conform to the RFC 952 standard, which permits alphanumeric characters. Host names using underscores (_) are not allowed.

IP Address Requirements are shown in Table 1, Table 2 and Table 3 as follows:

Table 1. A public IP address for each node

Public Hostname	Public IP Address	Name
racnode1.localdomain	192.168.1.30	racnode1
racnode2.localdomain	192.168.1.31	racnode2

Table 2. A Private IP address for each Node

Private Hostname	Private IP Address	Name
Racnode1-priv.localdomain	192.168.2.32	Racnode1-priv
Racnode2-priv.localdomain	192.168.2.33	Racnode2-priv

Table 3. A virtual IP address for each node

Virtual Hostname	Virtual IP Address	Name
Racnode1-vip.localdomain	192.168.1.34	Racnode1-vip
Racnode2-vip.localdomain	192.168.1.35	Racnode2-vip

Define the SCAN (Single Client Access Name) in your corporate DNS (Domain Name Service) you must ask your network administrator to create a single name, which resolves to 3 IP addresses using a round robin algorithm. The IP addresses must be on the same subnet as your public network in the cluster. Nslookup for all IPs in the Nodes as shown in Figure 1 below:

```

# Public
192.168.1.30      racnode1.localdomain      racnode1
192.168.1.31      racnode2.localdomain      racnode2
# Private
192.168.2.32      racnode1-priv.localdomain  racnode1-priv
192.168.2.33      racnode2-priv.localdomain  racnode2-priv
# Virtual
192.168.1.34      racnode1-vip.localdomain   racnode1-vip
192.168.1.35      racnode2-vip.localdomain   racnode2-vip
# SCAN
192.168.1.41      rac-scantest.localdomain   rac-scantest
192.168.1.42      rac-scantest.localdomain   rac-scantest
192.168.1.43      rac-scantest.localdomain   rac-scantest
[oracle@racnode1 bin]$ nslookup rac-scantest.localdomain
Server:          192.168.1.30
Address:         192.168.1.30#53

Name:   rac-scantest.localdomain
Address: 192.168.1.43
Name:   rac-scantest.localdomain
Address: 192.168.1.41
Name:   rac-scantest.localdomain
Address: 192.168.1.42

[oracle@racnode1 bin]$ f_

```

Figure 1. Nslookup output

After all above pre-requisites meets, then we can start our installation process in steps from step-1 to step 13.

Step-1 On racnode1 we run following command to validate all required operating packages and Update operating System
`#yum install oracle-validated`
`# yum update`

Step-2 repeat step-1 on racnode2

Step-3 Network Time Protocol Setting

To deactivate the NTP service, we must stop the existing ntpd service disable it from the initialization sequences and

remove the ntp.conf file. Oracle cluster will uses Cluster Time Synchronization Service (CTSS).

```

# /sbin/service ntpd stop
# chkconfig ntpd off
# rm /etc/ntp.conf

```

Step-4 User Accounts

(1) Create OS groups using the command below Enter commands as the root user.

```

# /usr/sbin/groupadd -g 501 dba
# /usr/sbin/groupadd -g 531 oinstall
# /usr/sbin/groupadd -g 532 asmadmin
# /usr/sbin/groupadd -g 533 asmdba
# /usr/sbin/groupadd -g 534 asmoper
# /usr/sbin/groupadd -g 535 oper

```

(2) Create the users that will own the Oracle software using the commands.

```

# /usr/sbin/useradd -g oinstall -G asmadmin, asmdba, asmoper, dba -m grid
# /usr/sbin/useradd -g oinstall -G dba, asmdba, asmadmin, oper -m oracle

```

(3) Set the password for the oracle account using the following command. Replace password with your own password.

```

# passwd oracle
Changing password for user devdb.
New UNIX password: *****
retype new UNIX password: *****
passwd: all authentication tokens updated successfully.
# passwd grid

```

(4) Repeat Step 1 through Step 3 on each node in your cluster

Step-5 SSH Configuration

OUI (Oracle User Interface) can setup password less SSH for you, if you want to configure this yourself, refer to Note. 300548.1.

Step- 6 Configuring Kernel Parameters

Set the following kernel parameters to values greater than or equal to the recommended values shown below. Location of the file /etc/sysctl.conf

```

kernel.shmmax = 68719476736
kernel.shmall = 4294967296
kernel.shmmni = 4096
kernel.sem = 250 32000 100 128
fs.file-max = 6815744
net.ipv4.ip_local_port_range = 9000 65500
net.core.rmem_default = 262144
net.core.wmem_default = 262144
net.core.rmem_max = 4194304
net.core.wmem_max = 1048576
fs.aio-max-nr = 1048576

```

We may skip to change the parameter if the default setting in our system is higher than Oracle requirement.

```

# vi /etc/security/limits.conf
* hard nfile 65536
* soft nfile 4096
* hard nproc 16384
* soft nproc 2047
* soft stack 10240

```

`# init 6 - Restart the nodes`

OUI checks the current settings for various kernel parameters to ensure they meet the minimum requirements for deploying Oracle RAC.

Step – 7 Create the Oracle Inventory Directory

To create the Oracle Inventory directory enter the following commands as the root user:

```
# cd /u01
# mkdir -p /oracle/oraInventory
# chown -R grid:oinstall /oracle/oraInventory
# chmod -R 775 /oracle/oraInventory
```

Step –8 Creating the Oracle Grid Infrastructure Home Directory.

To create the Grid Infrastructure home directory, enter the following commands as the root user.

```
# mkdir -p /u01/grid/app/oracle/product/11.2.0
# chown -R grid: oinstall /u01/grid/app/oracle/product/11.2.0
# chmod -R 775 /u01/grid/app/oracle/product/11.2.0
```

Step -9 Creating the Oracle Grid Home Base Directory

To create the Oracle Base directory, enter the following commands as the root user.

```
# mkdir -p /u01/grid/oracle
# chown -R grid:oinstall /u01/grid/oracle
# chmod -R 775 /u01/app/oracle
```

Step -10 Creating the Oracle RDBMS Home Directory

To create the Oracle RDBMS Home directory, enter the following commands as the root user.

```
# mkdir -p /u01/app/oracle/product/11.2.0/db
# chown -R devdb: oinstall /u01/app/oracle/product/11.2.0/db
# chmod -R 775 /u01/app/oracle/product/11.2.0/db
```

Step -11 Stage the Oracle Software

It is recommended that we stage the required software onto a local drive on Node 1 of our cluster. Important, Ensure that we use the correct version either LINUX or x86-64. For the RDBMS software download from OTN:

Open file SAN
 Oracle Database 11g Release 2 (11.2.0.3) for Linux
 For the Grid Infrastructure (clusterware and ASM) software download:
 Oracle Database 11g Release 2 Grid Infrastructure (11.2.0.3) for Linux

Step -12 Prepare the shared storage for Oracle RAC

All of the devices in an Automatic Storage Management Disk Group should be the Same Size and have same Performance Characteristics. A Disk Group should not contain more than one partition on a Single Physical Disk Device. The User Account with which you perform the installation (oracle) must have write permissions to create the files in the path that you specify. Enter commands similar to the following on every node to change the Owner, Group, and Permissions on the character raw device file for each disk slice that you want to add to a disk group, where grid is the grid infrastructure installation Owner, and asmadmin is the OSASM group

Here open file UDEV configuration for Multipath for ASM disk spaces.

Device which are configured for ASM Disks

Step -13 Perform Prerequisite Checks

```
/dev/mapper/Disk1
/dev/mapper/Disk2
/dev/mapper/Disk3
# chown -R grid: asmadmin /dev/mapper/Disk1p1
# chown -R grid: asmadmin /dev/mapper/Disk2p1
# chown -R grid: asmadmin /dev/mapper/Disk3p2
# chmod -R 660 /dev/mapper/Disk1p1
# chmod -R 660 /dev/mapper/Disk2p1
# chmod -R 660 /dev/mapper/Disk3p2
```

Step – 13 Oracle Grid Infrastructure Software Installations On racnode1 host

Login grid user

```
# xhost +
# su – grid
#cd /Stage
#./runinstaller
```

We will explain each screen in following steps.

- Step-1 Oracle Grid Infrastructure setting up Grid infrastructure Step 1-10 (Download software updates)
- Step -2 Select the installation option
- Step -3 Select the Product language
- Step -4 Select the installation type
- Step- 5 Grid plug and play information
- Step-6 Cluster node information windows as shown in Figure 2 below.

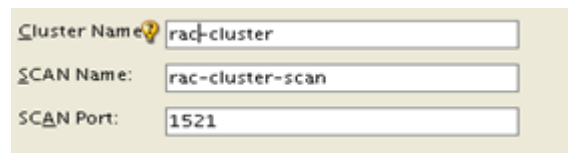


Figure 2.

- Step -7 Specify network interface usage
- Step-8 Storage option information as shown in Figure 3.

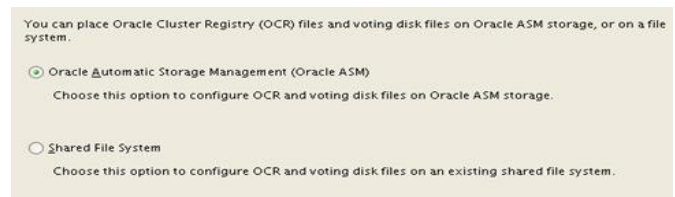


Figure 3.

- Step - 9 creating ASM disk group
- Step -10 Specify ASM password
- Step -11 Privileged operating system groups
- Step -12 Specify the installation Location, as shown in Figure 4 below.

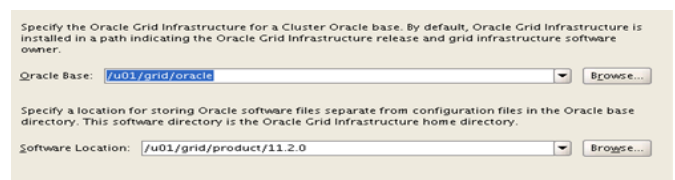


Figure 4.

Step -14 Finish installations.

Standard Sequence of Stopping and Starting Oracle RAC.

Startup Procedure steps are as follows:

- (1) Start nodeapps (Listener, VIP, GSD, ONS) on each node
- (2) Start RAC Database instance on each node

Shutdown Procedure steps are as follows:

- (1) Stop RAC Database instance on each node
- (2) Stop nodeapps (Listener, VIP, GSD, ONS) on each node

In RAC shutting down one instance does not interfere with the operation of other running instances. To shut down a RAC database completely, shut down every instance that has the database open or mounted. All Cluster-ware commands should be executed from \$CRS_HOME/bin. Monitoring Real Application Clusters Setup, following are the commands:

Checking database status

```
#!/srvctl status database -d ORCL
```

Checking database configuration

```
#!/srvctl config database -d ORCL will show database configuration for each node
```

Checking Node Applications services status

```
#!/srvctl status nodeapps -n nod1| nod2
```

Checking all cluster services status

```
#!/crs_stat -t Provides status information for resources on the cluster nodes,below is a sample output
```

Checking Voting Disk status

```
#!/crsctl query css votedisk
```

3. RESULT AND FINDING

After an in-depth analysis of Oracle RAC and SQL Server it concludes that; Oracle RAC is an interesting technology with great potential. However its high-cost and Excessive administrative complexity offsets any potential hardware cost savings obtained by using commodity hardware. SQL Server on SMP servers with Database Mirroring for high availability is a more cost effective and easier to manage solution than Oracle RAC. SQL Server can meet the scalability requirements of 99% of customers' real-world applications, while providing the desired levels of availability. For situations where scale-out architectures are the only choice, both Oracle RAC and SQL Server should be considered as equally.

4. DISCUSSION

Oracle Real Application Cluster is projected for High Availability and scalability [9]. RAC provide protection level hardware and software. Oracle Real Application Cluster database delivers High Availability to ensure constant data access even some cluster nodes are down due to any failure of hardware and software. It can be scaled up or down because the business scale grows. Oracle Application Cluster is unique in the market offering its capabilities. RAC is being used by millions customers worldwide in all industries who having mission critical application environments.

REFERENCES

- [1] Oracle, Oracle Grid Infrastructure, Oracle Documentation, from http://docs.oracle.com/cd/E18248_01/doc/install.112/e16763/oraclerestart.htm#CHDFDAIG.
- [2] Oracle, What is Oracle, from <https://www.oracle.com/corporate/index.html#info>.
- [3] D. O. O. Source, why RAC, from https://docs.oracle.com/cd/B28359_01/rac.111/b28254/admcon.htm.
- [4] Oracle, Oracle® Database Installation Guide 11g Release 2 (11.2) for Linux, from http://docs.oracle.com/cd/E11882_01/install.112/e24321/oraclerestart.htm.
- [5] Oracle, Oracle white paper, from www.oracle.com/technetwork/.../twp-racsqlserver-2008-130739.pdf, accessed on May 2008.
- [6] Oracle, Oracle® Real Application Clusters Installation Guide 11g Release 2 (11.2) for Linux, from http://docs.oracle.com/cd/E11882_01/install.112/e24660/chklist.htm.
- [7] Oracle, Oracle® Grid Infrastructure Installation Guide 11g Release 2 (11.2) for Linux, from http://docs.oracle.com/cd/E11882_01/install.112/e22489/prelinux.htm.
- [8] Oracle, TECH: Unix Semaphores and Shared Memory Explained [ID 15566.1], from http://docs.oracle.com/cd/E11882_01/install.112/e24321/pre_install.htm.
- [9] Nawaz R., Soomro T.R., Role of oracle active data guard in hight availability database operations, *International Journal of Applied Information Systems*, Vol. 5, No. 5, from <http://research.ijais.org/volume5/number5/ijais13-450914.pdf>, accessed on Apr. 2013.