Rolling Upgrade from Oracle® 10g Release 2 on Red Hat Enterprise Linux 4.5 to Oracle® 11g Release 1 on Red Hat Enterprise Linux 4.6

A Dell Technical White Paper

Databases & High Availability Clustering Solutions

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About this White Paper

This paper focuses on a rolling upgrade of an Oracle® Real Application cluster running Oracle 10g R2 (10.2.0.3) on Red Hat® Enterprise Linux® AS 4 Update 5 x86_64 to Oracle 11g R1 (11.1.0.6) on Red Hat Enterprise Linux AS 4 Update 6 x86_64.

Customers can use the following three approaches to upgrade Oracle 10g RAC to Oracle 11g RAC:

- Using the Oracle Database Upgrade Assistant (DBUA) utility
- Upgrading their systems manually
- Exporting the Oracle 10g database and importing into Oracle 11g database

The recommended approach is to use DBUA to upgrade your database and Automatic Storage Management (ASM). DBUA automates many of the manual tasks, which significantly simplifies the upgrade process. This white paper describes the following areas:

- Rolling upgrade of operating system and Oracle Clusterware for reduced downtime
- Database upgrade using DBUA

Assumptions

This whitepaper makes the following assumptions:

- All the nodes in the Oracle RAC cluster are running 64-bit Red Hat Enterprise Linux 4 U5 and Oracle 10g (10.2.0.3) with ASM or OCFS as the cluster file system.

- The voting disk, OCR and SP files, are on the shared storage.

- The nodes in the cluster are implemented with the software and hardware configuration as per the Solution Deliverable List (SDL) of Dell|Oracle Tested and Validated configuration. This SDL document is in the following location:
  www.dell.com/content/topics/global.aspx/alliances/en/oracle_10g_r2_ee_x86_64?c=us&cs=555&l=en&s=biz
Pre-upgrade Readiness – Backing Up the Database

Before starting the upgrade, you should have a backup copy of the database. If something goes wrong during an upgrade process, you can recover the database using the database backup.

Based on your backup recovery strategy, you can use either hot backup or cold backup for backing up the whole database. It is always recommended to use RMAN (Recovery Manager) for all kinds of backup and recovery activities.

Requirements

The following software will be required during the Migration/Upgrade:

- Red Hat Enterprise Linux - AS 4 Update 6 with Red Hat kernel 2.6.9-67.0.12 CDs
- Naviagent - Naviagentcli-6.26.2.0.2-1.noarch.rpm (or above releases )
- EMC® PowerPath® for Linux - EMCpower.LINUX-5.1.0-194.rhel.x86_64.rpm
- Oracle ASM - Oracleasm-2.6.9-67.ELlargesmp-2.0.3-1.x86_64.rpm
- OCFS - Ocfs2-2.6.9-67.ELlargesmp-2.0.3-1.x86_64.rpm
- Oracle - Oracle 11g R1 (11.1.0.6) Clusterware and Database Software Binaries

Make sure that software binaries installed on the cluster nodes match the Dell|Oracle Tested and Validated SDL found in the preceding link. In case of mismatches, apply the patches or upgrade the software components to be compliant with the SDL list. This step is necessary for Migration/Upgrade readiness.

Upgrade/Migration Path

To upgrade of Oracle RAC clusters, users must upgrade the following components.

- OS upgrade
- Oracle Clusterware upgrade
- Oracle Database upgrade

The following components can be upgraded in a rolling fashion.

- OS (Red Hat Enterprise Linux)
- Oracle Clusterware

Please note that the database cannot be upgraded in a rolling fashion and that it requires downtime.

The steps for upgrade/migration for the Oracle RAC cluster are shown in the following block diagram.
Operating System Rolling Upgrade

The operating system upgrade uses the following procedure:

1. **Step 1: Upgrade kernel-utils**
2. **Step 2: Upgrade the Red Hat Linux from Update 5 to Update 6**
3. **Step 3: Upgrade Multipathing**
4. **Step 4: Upgrade ASM / OCFS**

**NOTE:** Follow these steps if you are using a PowerPath® release lower than 5.0.0.

- Run the `powermt save` command to ensure you have saved the latest PowerPath configuration information. Back up the `/etc/powermt.custom` and `/etc/emcp` registration files.

- Unmount any file systems mounted on PowerPath devices and deactivate any volume groups using these file systems. Stop `powermt display` if it is running. Refer to the *PowerPath Product Guide* for information about `powermt display`.

- If the default major and minor numbers associated with a native device (for example, `/dev/sda`) have been changed, upgrading to PowerPath fails to preserve pseudo-to-native device mappings and device policy/priority settings.

  Follow these steps to avoid this problem:
  1. With the existing version of PowerPath installed, run the `powermt display dev=all` command and redirect the output to a file.
  2. Run the `/etc/init.d/PowerPath stop` command.
  3. Delete all the native devices listed in the `powermt log` file created in Step 1.
  4. Use the `mknod` command to re-create the native devices with the default major/minor numbers.
  5. Run the `/etc/init.d/PowerPath start` command

**NOTE:**

- The rolling upgrade for OS is achieved with the OS upgrade of one node at a time. Perform the steps in the following procedure only on first node in the cluster.

- Make sure the second node is up and running and all the services are online with respect to OS and Oracle. This ensures that the database is up and running while upgrading the OS on the first node.
Upgrade kernel-utils

To upgrade the kernel-utils, execute the following steps on the first node in the cluster.
- Mount the second RHEL 4 Update 6 x86_64 CD
- Locate kernel-utils-2.4-13.1.105 RPM
- Type the following command to upgrade the kernel:
  
  # rpm -Uvh kernel-utils-2.4-13.1.105.x86_64.rpm

Upgrading the Red Hat Enterprise Linux 4 Update 5 x86_64 to Update 6 x86_64

Execute the following steps on the first node to upgrade OS from RHEL 4 Update 5 to Update 6.

- Shut down the Database, ASM, CRS, Nodeapps, Naviagent and PowerPath on the node, unplug the FC cables, and set these services to stop/off on startup.
- Execute the following commands before rebooting the node for upgrade:
  - `srvctl stop instance -d <db_name> -i <instance_name>`
  - `srvctl stop nodeapps -n <node_name>`
  - `crsctl stop crs`
  - `/etc/init.d/init.crs disable`
  - `service naviagent stop`
  - `chkconfig naviagent off`
  - `service PowerPath stop`

- For OCFS cluster file system follow these steps:
  - `chkconfig o2cb off`
  - `chkconfig ocfs2 off`

- For ASM or raw devices follow these steps:
  - `srvctl stop asm -i <asm_instance> -n <node_name>`
  - `service rawdevices stop`
  - `chkconfig rawdevices off`
  - `service oracleasm stop` (does not apply if ASMLib rpms are not installed)
  - `chkconfig oracleasm off` (does not apply if ASMLib rpms are not installed)

For OS Rolling Upgrade, start the upgrade process on the first node as mentioned in the following steps:
- Boot through the first RHEL 4 Update 6 CD.
- Once you boot through the CD, select the following option:
  Upgrade an existing installation
- Once you select the Upgrade an existing installation option, installer will check for the existing RPMs installed on the node and will upgrade all the necessary RPMs for RHEL 4 Update 6 from all operating system CDs.
- After the upgrade is complete, it will reboot with the new kernel.
Upgrading Multipathing

Upgrading EMC PowerPath Software

To upgrade the EMC PowerPath software in rolling fashion, perform the following steps only on the first node after the kernel upgrade.

- Download the following PowerPath software from Powerlink website (http://Powerlink.EMC.com).
  - EMCpower.LINUX-5.1.0-194.rhel.x86_64.rpm

- Execute the following command to remove the previous version of the PowerPath software installed on the system.
  - rpm –e EMCpower.LINUX-5.0.0-157.rhel.x86_64.rpm

- Execute the following command to install the new PowerPath release
  - rpm –ivh EMCpower.LINUX-5.1.0-194.rhel.x86_64.rpm

- Start the following PowerPath service
  - service PowerPath start

NOTE: If the PowerPath application fails to preserve pseudo-to-native device mappings and device priorities, use the mknod command to re-create the native devices as per the default major and minor numbers captured before kernel upgrade.

Upgrading MPP Driver

For this white paper, MPP driver version and storage management software version are the same for the MD3000 SAS storage.

After kernel upgrade, make sure that you can see all the LUNS from SAS storage. If partitions are not visible, stop the MPP agent and reboot the nodes.

Upgrading ASM / OCFS

After upgrading Multipathing software, upgrade the software for the cluster file system (for example, either ASM or OCFS).

Upgrading ASM

Execute the following steps on the first node for upgrading ASM

- Download all the ASM lib, tools and driver RPMs for Red Hat kernel version kernel-2.6.9-67.EL.x86_64.rpm from the following link:
    - oracleasm-2.6.9-67.ELlargesmp-2.0.3-1.x86_64.rpm
    - oracleasm-support-2.0.3-1.x86_64.rpm
    - oracleasmlib-2.0.2-1.x86_64.rpm

- Execute the following command to uninstall the old ASM RPM.
  - rpm –e oracleasm

- Execute the following command to install the RPMs downloaded in the preceding step.
  - rpm –ivh oracleasm
• Execute the following command to configure oracleasm service.
  - service oracleasm configure

• Execute the following command to start the asm service.
  - service oracleasm start

• Execute the following command to verify that all the ASM disks are listed after the upgrade.
  - service oracleasm listdisks

Upgrading OCFS

  - ocfs2-2.6.9-67.0.1.ELlargesmp-1.2.8-2.el4.x86_64.rpm
  - ocfs2-2.6.9-67.0.1.EL-debuginfo-1.2.8-2.el4.x86_64.rpm

• Execute the following command to upgrade OCFS RPMs downloaded in the preceding step.
  - rpm -Uvh ocfs2*

• Execute the following commands to add the OCFS services for startup on boot after the upgrade.
  - chkconfig --add o2cb
  - chkconfig --add ocfs2
  - chkconfig o2cb on
  - chkconfig ocfs2 on

• Execute the following commands to start all the OCFS services relating to OCFS services.
  - service o2cb start
  - service ocfs2 start

• Execute the following command to check that all the mount points on the node are properly mounted.
  - # df -k

• If mount points are not visible, execute the following command to mount the OCFS partitions.
  - # mount -a -t ocfs2

Reboot the Node

After rebooting the first node, perform the following steps.
- crsctl start crs
- crsctl enable crs
- crs_stat -t

Make sure all the cluster resources are up and running on the node.

OS Rolling Upgrade on the Second Node in the Cluster

Once you successfully upgrade the OS on the first node, start the database on the first node. Make sure that applications can connect to the upgraded node.

Follow the steps to upgrade the OS on second node. During the OS upgrade on the second node, the application connects the database to the database instance on the first node.
The next section provides the steps for a rolling upgrade of Oracle Clusterware.

**Clusterware Rolling Upgrade**

**NOTE:**
- The rolling upgrade for Oracle Clusterware is achieved with the clusterware upgrade of one node at a time. Follow the next steps only on the first node in the cluster.
- Make sure the second node is up and running and all the services are online with respect to the operating system and Oracle Clusterware. This ensures that the database is up and running while upgrading the clusterware on the first node.

**Rolling Upgrade of Clusterware to 11g on the First Node**

- For rolling upgrade of Oracle Clusterware to release 11g R1, the current Oracle Clusterware must be running at version 10.2.0.3 or 10.2.0.2 with CRS Bundle Patch #2 (reference Bug 5256865).
- The 10.2.0.3 patchset (5337014) can be downloaded from Oracle Metalink and Refer to Oracle Metalink Note 419058.1 for information on Oracle 10.2.0.3 patch set for Linux x86.

**NOTE:** In this white paper, Oracle Clusterware home is /crs/oracle/product/10.2.0/crs_1 and Oracle database home is /opt/oracle/product/10.2.0/db_1.

**Oracle Clusterware Pre-installation Checks**

- Cluster Verification Utility (CVU) reduces the complexity and time it takes to install RAC. The tool scans all the required components in the cluster environment to ensure all criteria are met for a successful installation.
- Download and uncompress the Oracle Clusterware 11.1.0.6 software from OTN to a temporary directory and execute runcluvfy.sh (with the following command) as an Oracle user:

  ```bash
  /stage/clusterware/runcluvfy.sh stage -pre crsinst -n all -verbose > /tmp/prechecks.log
  ```

  Verify all prerequisites are met. You can ignore the "Package existence checked failed" for openmotif-2.2.3-3.RHEL3.

**Stop All Database Resources on the First Node**

Execute the following commands to stop the database resources on the first node.

- `srvctl stop instance -d <db_name> -i <instance_name>`
- `srvctl stop asm -n <Node_name>`
- `srvctl stop nodeapps -n <Node_name>`
- `crs_stat -t`

Make sure all the cluster resources are offline from the first node.

**Prepare the Oracle Clusterware Home Environment for Upgrade**

Execute the `preupdate.sh` script on the first node to prepare the clusterware home environment for upgrade. This script stops the Oracle Clusterware stack and changes the permissions of files in the Oracle Clusterware Home directory.

On the first node, execute the following steps as the root user.
• cd /stage/clusterware/upgrade
• ./preupdate.sh -crshome /crs/oracle/product/10.2.0/crs_1 -crsuser oracle

Shutting down Oracle Cluster Ready Services (CRS):
Stopping resources. This could take several minutes.
Successfully stopped CRS resources.
Stopping CSSD.
Shutting down CSS daemon.
Shutdown request successfully issued.
Shutdown has begun. The daemons should exit soon.
Checking to see if Oracle CRS stack is down...
Oracle CRS stack is down now.

Upgrade the Oracle Clusterware

NOTE: Run the Oracle Universal Installer (OUI) on one node. The OUI will perform the remote install on all
the nodes in the cluster.

1. Log in as root
2. Start the X Window System by typing
   Startx
3. Open a terminal window and type:
   xhost +
4. Mount the Oracle Clusterware CD.
5. Start the OUI as "oracle user"
   /stage/clusterware/runInstaller
6. Welcome: Click Next. Specify Home Details: Verify the correct CRS_Home directory is displayed.
7. Specify Hardware Cluster Installation Mode: Verify Single node is selected (the node that you are
   upgrading).
8. Product-Specific Prerequisite Checks: Verify overall result is successful.
9. Summary: Click Install.
10. Execute Configuration scripts: Execute the following scripts as the root user.

Execute: /crs/oracle/product/10.2.0/crs_1/install/rootupgrade.sh on the first node

NOTE:
• While executing the rootupgrade script on the first node, the second node will be active with all the
  resources up and running with the old version of Oracle Clusterware.
• While performing the preceding steps, the database will be available from alternate nodes in the
  cluster.
Rolling Upgrade of Clusterware to 11g on Second Node

At this stage, the first node will be upgraded to Oracle Clusterware 11g R1. All the clusterware resources are up and running on the first node, but the active version of the clusterware will still be version 10.2.0.3. This is because until all nodes in the cluster are upgraded to Oracle Clusterware 11g R1, the resources will be running in the older version. Once the upgrade is complete on all other nodes in the cluster, the active version will become 11g R1.

Perform the steps in the following sections to upgrade the Oracle Clusterware on the second node.

Post Clusterware Upgrade Checks

Perform the following steps to check the successful upgrade of Oracle Clusterware.

- `ORA_CRS_HOME/bin/crsctl check crs`
  - Cluster Synchronization Services appears healthy
  - Cluster Ready Services appears healthy
  - Event Manager appears healthy
- `ORA_CRS_HOME/bin/crsctl query crs softwareversion`
  - Oracle Clusterware version on node [<Node_name>] is [11.1.0.6.0]
- `ORA_CRS_HOME/bin/crsctl query crs activeversion`
  - Oracle Clusterware active version on the cluster is [11.1.0.6.0]
- `ORA_CRS_HOME/bin/crs_stat -t`
  - Make sure all the cluster resources on both the nodes are online.

The next section provides the steps for upgrading the Oracle database.

Database Upgrade

Note that a database cannot be upgraded in a rolling fashion and it requires downtime.

Execute the following commands as “oracle user” on the first node to bring down the database and all resources on all nodes on the cluster.

- `srvctl stop instance -d <db_name> -i <instance_name1>`
- `srvctl stop instance -d <db_name> -i <instance_name2>`
- `srvctl stop instance -d <instance_name>`
- `srvctl stop asm -n <First_node>`
- `srvctl stop asm -n <Second_node>`
- `srvctl stop nodeapps -n <First_node>`
- `srvctl stop nodeapps -n <Second_node>`
- `crs_stat -t` (make sure all the cluster resources are offline from the first and second node)

Execute the following commands as “root user” on all nodes in the cluster.

- `crsctl stop crs`
- `crsctl stop crs`

Upgrading Oracle Software Binaries to 11g

As the oracle user, create the new Oracle home environment on both nodes.

```
mkdir -p /opt/oracle/product/11.1.0/db_1
```

Install the Oracle Database software. (Download the Oracle Database software from OTN.)
1. Log in as root
2. Start the X Window System:
   
   Startx

3. Open a terminal window and type:
   
   xhost +

4. Mount the Oracle Clusterware CD.

5. Start the OUI as "oracle user":" 
   
   /stage/clusterware/runInstaller

6. Welcome: Click on Next.

7. Select Installation Type: Select Custom.

8. Specify Home Details:
   - Oracle Base: /opt/oracle.
   - Name: OraDb11g_home1
   - Path: /opt/oracle/product/11.1.0/db_1

9. Specify Hardware Cluster Installation Mode:
   - Select Cluster Installation
   - Click on Select All.

10. Product-Specific Prerequisite Checks: Verify overall result is successful.

11. Available Product Components: Select all the required components.

12. Privileged Operating System Groups:
   - Database Administrator (OSDBA) Group: dba.
   - Database Operator (OSOPER) Group: oinstall.
   - ASM administrator (OSASM) Group: dba.

13. Create Database:
   - Select Install database Software only.

14. Summary: Click on Install.

15. Execute Configuration scripts: Execute the scripts below as the root user.
   
   Execute /opt/oracle/product/11.1.0/db_1/root.sh on all nodes (one node at a time).

16. Return to the Execute Configuration scripts screen and click OK.

17. 18. End of Installation: Click on Exit.

**Database Upgrade with DBUA**

**Pre-database Upgrade Checks**

Execute the following steps as root user on both the nodes

- `crsctl start crs`
- `crsctl start crs`
- `crs_stat -t` (Make sure all the cluster resources are online from the first and second node.)
Prior to running the Database Upgrade Assistant (DBUA), execute the pre-database upgrade checks, utlu111i.sql to verify that all pre-requisites are met. As part of the upgrade process, the DBUA changes the cluster_database parameter automatically from true to false. Re-execute the pre-database upgrade script after making the necessary modifications.

Connect to the database as the sys user on any one node and run the script utlu111i.sql:

- SQL> spool /tmp/utlu111i.log
- SQL> @/opt/oracle/product/11.1.0/db_1/rdbms/admin/utlu111i.sql

Make sure all the following parameters are met to make the database ready for upgrade

- Tablespace: [make adjustments in the current environment]
- Update Parameters: [Update Oracle Database 11.1 init.ora or spfile]
- Renamed Parameters: [Update Oracle Database 11.1 init.ora or spfile]
- Obsolete/Deprecated Parameters: [Update Oracle Database 11.1 init.ora or spfile]
- Components: [The following database components will be upgraded or installed]

Miscellaneous Warnings

If the time zone file version used by the Oracle Database 11g Release 1 (11.1) server does not match the time zone file version that was used with the existing database being upgraded, the upgrade script will terminate without upgrading the database. The TIMESTAMP WITH TIME ZONE data stored in the database can be corrupted during the upgrade if there is a time zone file version mismatch.

Execute the following command to find the version of existing timezone files:

```
SQL> select * from v$timezone_file;
FILENAME          VERSION
----------------- ----------
timezlrg.dat        4
```

Refer Metalink Note 396906.1: If there is mismatch with the timezone file in the database, patch the database with the OPatch utility for 10.2.0.3 home, and then rerun the utlu111i.sql command to make sure the patch application is a match.

Modify the Oracle User Environment File

Modify the ORACLE_HOME to reflect the new Oracle Database 11g directory on both nodes. Following is the sample from first node and this has to be changed in the second node also.

Log in as oracle and follow these steps:

- export EDITOR=vi
- export ORACLE_SID=<db_name>
- export ORACLE_BASE=/opt/oracle
- export ORACLE_HOME=$ORACLE_BASE/product/11.1.0/db_1
- export ORA_CRS_BASE=/crs/oracle/product/10.2.0/crs
- export LD_LIBRARY_PATH=$ORACLE_HOME/lib

Upgrade the Database

As the Oracle user, execute the following commands on the first node to upgrade the database with dbua.
1. Log in as root
   - Start the X Window System by typing: `Startx`

2. Open a terminal window and type: `xhost +`, and then perform the following steps in the terminal:
   - `./.profile`
   - `which dbua`
   - `/opt/oracle/product/11.1.0/db_1/bin/dbua`
   - `dbua`

3. Welcome: Click **Next**.
4. Upgrade Operations: Select **Upgrade a Database**.
5. Databases: Select **devdb**.
6. Database Upgrade Assistant: Click **Yes** to migrate the existing listener.
7. Database Upgrade Assistant: Click on **Yes** to upgrade ASM.
8. Diagnostic Destination:
9. Oracle Base: `/opt/oracle`
10. Diagnostic Destination: `/opt/oracle`
11. Recovery Configuration:
12. Select **Specify Flash Recovery Area**.
14. Flash Recovery Area Size: 2048 MB.
15. Recompile Invalid Objects: Select **Recompile invalid objects at the end of upgrade**.
16. Summary: Click **Finish**.
17. Progress: Click **OK** to see the results of the upgrade.

18. Upgrade Results: Click **Close** and with the below command check all the components have upgraded.
   - SQL> `select comp_name, version, status from dba_registry;`
     - Make sure all the selected components are upgraded to Oracle 11g.
   - `srvctl config database -d <db_name>`
   - `$ORA_CRS_HOME/bin/crs_stat -t`
     - Make sure all the cluster resources are online on all the nodes.