

Upgrade of SAP NetWeaver Installation to
Oracle Grid Infrastructure 12.1.0.2 with
Oracle Real Application Clusters 12c Release 1
Upgrade of existing installations with Oracle RAC

ORACLE WHITE PAPER | MARCH 2015





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Preface

This document explains all the necessary steps to upgrade an SAP system for use of Oracle 12c Release 1 Real Application Clusters. The purpose of this paper is to give a detailed overview of all the steps necessary to upgrade an already existing Oracle RAC 10.2 or Oracle RAC 11.2 system. It is intended to act as a template for use in your specific system environment. It will give you information on configuring your SAP R/3 system accordingly.

This documentation is only for upgrading Oracle systems running on **UNIX and Linux** operating systems. The Windows operating system is covered in a separate document.

This white paper assumes that there is no change in the specific setup of the cluster hardware, the operating system and the storage subsystem used in your cluster solution for the upgrade process. All pre-installation steps necessary for setting up the underlying cluster hardware are considered minimum requirements. Please refer to the documentation of the respective platform and operating system vendor for details on how to configure or patch the cluster hardware of choice to meet all requirements for running Oracle 12c Clusterware and Oracle 12c Real Applications Clusters database software. Additional and up-to-date information on supported configurations are documented in SAP Support Note [527843](#). It is strongly recommended that you check the latest updates for your operating system, storage solution, etc. This paper does however cover those aspects that are necessary for using Oracle Grid infrastructure; the Oracle Clusterware that ships with Oracle 12.1.0.2 RAC and that is used in conjunction with Oracle database software. This paper describes the supported RAC configurations for an SAP installation that have been successfully tested.

Important note: This guide helps you to upgrade a RAC-enabled SAP system. It describes all required changes to the Oracle database, Oracle network configuration, Oracle database parameters etc. But it is not complete: You must follow all additional steps addressed in SAP Installation and Upgrade Guides for Oracle Database 12c Release 1 as well (Reference SAP Note: 1914631). Please also refer to all RAC-related SAP notes. Start checking for Oracle RAC related information from SAP OSS note 527843.



Basic Setup: Prepare the SAP System

It is only supported to upgrade to Oracle 12.1.0.2 RAC with the following configuration:

- Upgrade to 12.1.0.2 RAC from Oracle RAC 11.2.0.4 or later

If your SAP system is not yet running with Oracle RAC 11.2.0.4, you cannot upgrade directly to Oracle RAC 12c. Starting with Oracle RAC 11.2 there was major change in the OS users and groups for Oracle software installations used for SAP systems. Because of this change a direct upgrade of releases before Oracle RAC 11.2 is not possible.

Installing the Oracle database software in a shared file system is classified as an installation with a "Shared Oracle Home".

Note: SAP installations with RAC require a Shared Oracle Home. Oracle Grid software is installed in a local location on every node in the cluster.

It is assumed that there is no change in the location of voting disks and OCR repository files with the upgrade to Oracle RAC 12.1.0.2. Intended changes to these locations should be accomplished before or after the upgrade.

Note to SAPCTL users: You must install a new version of SAPCTL designed for Oracle 12.1.0.2 clusterware. The SAPCTL version you run with Oracle 11.2 CRS is not compatible with the Oracle 12.1.0.2 cluster framework.

Upgrade Oracle Grid installation

Software Owner

The new Oracle Clusterware software should be installed using the default Oracle user account 'oracle'. This user account is the owner of the Oracle Grid infrastructure software. Since Oracle RAC 11.2g, we recommend using the username oracle for this user. This is the default owner for all Oracle software in Oracle best practice recommendations. Assumption in this whitepaper is that all Oracle software is installed by OS user account "oracle".

To upgrade the existing Oracle Grid Infrastructure installation to Oracle Grid Infrastructure 12c Release 1 (12.1) you must first verify if you need to apply any mandatory patches for upgrade to succeed. Oracle CVU tool can be used to check readiness.

Rolling Upgrade

The upgrade of the Oracle Grid Infrastructure supports a rolling upgrade avoiding complete cluster outage. Oracle recommends that you leave Oracle RAC database instances running when upgrading Oracle Clusterware. When you start the **rootupgrade.sh** script on each node, the database instances on that node are shut down and then the **rootupgrade.sh** script starts the instances again.

Root Automation

You can use **root** user automation to automate running the **rootupgrade.sh** script during the upgrade. When you use **root** automation, you can divide the nodes into groups, or batches, and start upgrades of these batches. Between batches, you can move services from nodes running the previous release to the upgraded nodes, so that services are not affected by the upgrade. Nevertheless, to avoid transaction rollback within the SAP application servers, the SAP application server connected to a dedicated database service must be stopped before the database service is relocated to another database instance and after that the SAP application server can be started again. **This can be accomplished** before you start the root scripts manually.

Therefore, we recommend that you run the the **rootupgrade.sh** script manually for the upgrade of an SAP system.

Checks to complete before upgrading Oracle Clusterware

Cluster Verification Utility 'cluvfy'

Oracle provides a tool for verifying that the conditions for a successful installation have been met. This tool is called cluvfy and is shipped with the Oracle software.

Note: Use the tool cluvfy to verify that all minimum requirements are met.

Before starting the upgrade, complete the following tasks:

On each node, run the Cluster Verification Utility (CVU) to ensure that the cluster is ready for the upgrade. CVU can generate scripts to fix up potential problems on the servers. Execute the runcluvfy.sh script as the software owner of the Oracle clusterware, which is user oracle in SAP configurations. Unset any environment variable which is related to Oracle software, and remove all \$ORACLE_HOME/bin settings in the PATH environment.

```
#su - oracle
$unset $ORA_CRS_HOME;
$unset $ORACLE_HOME;
$unset $ORACLE_BASE;
$unset $ORA_NLS10;
$unset $TNS_ADMIN;
```

Navigate to the staging area for the upgrade, where the runcluvfy.sh script is located.

```
./runcluvfy.sh stage -pre crsinst -upgrade -rolling -src_crshome <GRID_HOME_11.2> -dest_crshome <GRID_HOME_12.1> -dest_version 12.1.0.1 -fixup -verbose
```

Check the output of the script. If there are errors or major warnings reported, fix these critical issues first before starting the actual upgrade of the cluster.

Collect the following information which is required during the upgrade installation interview:

- » The Oracle base location for Oracle Clusterware.
- » An Oracle Grid Infrastructure home location that is different from your existing Oracle Clusterware location.
- » SCAN name and addresses, and other network addresses.
- » Privileged user operating system groups.
- » **root** user access, to run scripts as **root** during installation.

For the upgrade to Oracle Clusterware release 12.1.0.2, use existing users and groups. Do not change privileged user operating groups used in the existing Oracle Clusterware 11.2 installation. If the existing installation is using OS group separation for permission segregation by OS group authentication, software installation user oracle should be member in groups asmadmin, asmdba and asmoper. If the existing installation does not use OS group authentication for job roles, software installation user oracle should be member of group dba.

Software Owner, OS Groups and Administrator Accounts

The user oracle has primary group oinstall and is the software owner of all Oracle software starting with Oracle Release 11.2.0.1 RAC databases. User oracle also belongs to group dba by default for a SAP database configuration. If you want to manage the ASM instances and the ASM storage by user oracle as some sort of super administrator, you can assign the groups asmdba, asmoper and asmadmin to user oracle. If your security constraints require separate users for storage administration tasks you must create additional users and assign them to the appropriate groups asmdba, asmoper and asmadmin.

GROUP ASSIGNMENT FOR SOFTWARE OWNER 'ORACLE' DEPENDING ON JOB ROLE SEPARATION

User	Job Role Separation	No Job Role Separation
oracle	oinstall (primary group) asmadmin asmoper asmdba dba oper	oinstall (primary group) dba oper

Check the Oracle documentation for all other minimum requirements before starting the installation.

Upgrade Oracle Grid Infrastructure Software on your Cluster

This task must be completed before the Oracle RAC database software upgrades to Oracle RAC 12.1.0.2. Oracle Grid infrastructure software is the combination of Oracle Clusterware (CRS) and Oracle Storage Management software (ASM). As both components must be installed into the same ORACLE_HOME directory Oracle home, we will refer to this directory as the Grid installation directory GRID_HOME throughout this paper.

Log on as user oracle (Oracle software owner) and start the installation with the Oracle Universal Installer

Installation Option	Upgrade Oracle Grid Infrastructure or Oracle Automatic Storage management
Product Language	English
Node Selection	All nodes. Do not select checkbox "Skip upgrade on unreachable nodes"
Management Options	You may want to register with Enterprise Manager (EM) Cloud Control. If so, specify host, port EM Admin User Name and Password.
Operating System Groups	Role separated: OSASM asmadmin OSDBA for ASM asmdba OSOPER for ASM asmoper Not Role separated: OSASM dba OSDBA for ASM dba OSOPER for ASM dba You must use the same configuration as in the existing installation. Otherwise you will receive a warning message from OUI
Installation Location	Oracle Base: Not on Oracle Engineered System /oracle/BASE Oracle Engineered System /u01/app/oracle Software Location: Not on Oracle Engineered System /oracle/GRID/12102 Oracle Engineered System /u01/app/12.1.0.2/grid
Root script execution	Do not check automated root script execution. Run root script manually on each node when prompted.



Check the summary screen. You do not have to specify any network interface for the cluster. Also, you can't change the option to use GNS during the upgrade. This information is all taken from the existing cluster configuration. In addition, you can't change the location of OCR and voting files during the upgrade. If you plan to change any configuration in the cluster, e.g. placing OCR and voting files to ASM, you should accomplish these task separated either before or after the upgrade.

When prompted to run the **rootupgrade.sh** script you must stop and relocate any running SAP application server which are connected to the database instance running on the node where the script is supposed to run next. Use the tool `srvctl` from the RDBMS Home to move the associated database service to another database instance in the cluster. After successful relocation of the database service, you can startup the SAP application server again.

When you start script **rootupgrade.sh**, all running database instances on the stopped. The Oracle clusterware on this node is stopped for the upgrade. At the end of the upgrade procedure on that node, Oracle clusterware and all database instances which have been running before the upgrade are started automatically.

Leveraging the rolling upgrade feature you can avoid complete outage of your SAP system. You can control a partial outage of the SAP application servers when you move the database services around. Nevertheless, rolling upgrade is only possible for the upgrade of the Oracle clusterware. For the upgrade of the Oracle database a complete shutdown of the SAP system is required.

Oracle CRS Parameter Adjustments for SAP Installations

Adjustment of CRS parameters is only required if the database files reside on a 3rd party cluster file system, or the Oracle RDBMS software is installed on a 3rd party cluster file system. If the database files are on Oracle ASM storage and the Oracle RDBMS software is either on a local disk or a shared ORACLE ACFS file system, no changes to CRS default parameter settings are required in general.

In some cases the default values of several timing related parameters for error detection and health check are too aggressive for a complex SAP environment, especially if the service times of components like network or disk I/O is not deterministic in a sense that there is a high deviation from the mean or average values.

Important timing parameters for the Oracle clusterware are **misscount**, **disktimeout**, **reboottime** and **diagwait**.

The parameter **disktimeout** specifies the maximum I/O completion time for read/write access to the OCR repository and the voting disks. Timing values are given in seconds. A node must be able to access at least one of the OCR repository files and at least one of the voting disks; otherwise the node will leave the cluster by issuing a reboot.

The parameter **misscount** gives the maximum time in seconds for outstanding communication probes via the network connections among the nodes. It checks network healthiness. If a node can't reach any of the other nodes within **misscount** seconds timeframe, it will start split-brain resolution and probably evict itself from the cluster by doing a reboot.

Parameter **reboottime** holds the estimated time for a reboot. Default value is 3 seconds. It is the time assumed to bring down a node completely.

The parameter **diagwait** is the amount of time to wait in seconds after a node is considered dead and reconfiguration can safely start. This parameter is important in conjunction with the `oproc` timing values. A dead or blocked node must already be fenced out by `oproc` (via a fast reboot) before the remaining nodes can safely start reconfiguration. If reconfiguration starts too early, data integrity may be compromised.

You can query the values by the `crsctl` command. Switch to user `root`, then issue the command to query the current value of the parameter.

```
# $GRID_HOME/bin/crsctl get css disktimeout
```

Set the parameter by using command (e.g.)

```
# $GRID_HOME/bin/crsctl set css disktimeout 200
```



You must restart CRS on all nodes to have the parameters take effect. Easiest way is to reboot all nodes.

```
# reboot
```

In rare cases, the default timing constraints for the Oracle health monitoring processes can't be met due to long or poor scheduling times in the operating system, which may cause false node evictions (Oracle clusterware will reboot the node).

The Oracle Clusterware stack must be down on all nodes, modification to diagwait should be made using the crsctl command and the Clusterware should be re-started. Always make sure that the Clusterware 'misscount' is greater than diagwait.

Install Oracle Database Software Release 12.1.0.2 on a Cluster

Once the Oracle Grid infrastructure software has been successfully upgraded and started on all nodes, the next step in the upgrade process is to install the database software.

A major change compared to earlier releases (9.2, 10.2) of Oracle database software in an SAP environment is that the installation of Oracle 11.2.0.4 RAC is now performed by user oracle. This is the same user and owner of the software as used for the GRID software installation.

Note: You must install the database software into a separate ORACLE_HOME location. Do not choose the same location as the Oracle Clusterware.

Prepare the storage location for storing the ORACLE_HOME directory. The Oracle RDBMS software must be installed into an empty directory. If the ORACLE_HOME directory is shared among the nodes, it must be accessible from all nodes in the cluster. We assume that the name for this directory is /oracle/<SID>/12102. This directory naming scheme follows the SAP defaults for single instance database installations (see SAP Note 1521371).

Prepare a directory for ORACLE_BASE of the RDBMS installation. This directory will be used for holding diagnostic data and can be shared among all cluster nodes for SAP installations.

Note: The ORACLE_BASE for Oracle database software and Oracle Grid infrastructure software are different directories. Do not use the same for both installation types with SAP (see SAP Note 1521371).

We recommend that you use directory /oracle/<DBSID> as the location for ORACLE_BASE on a shared filesystem.

Log on as user oracle and start the installation with the Oracle Universal Installer. Select "Install database software only" in the step Installation Option.

Grid Installation Options	Install database software only
Install Type	Oracle Real Application Clusters database installation
Nodes Selection	Select all nodes
Product Languages	English
Database Edition	Enterprise Edition
Installation Location	Oracle Base /oracle/<SID> Software Location /oracle/<SID>/12102
Operating System Groups	Database Administrator (OSDBA) group dba Database Operator (OSOPER) group oper Database Backup and Recovery (OSBACKUPDBA) group oper Data Guard administrative (OSDGDBA) group dba Encryption Key Management administrative (OSKMDBA) group dba

We recommend to use a separate Oracle Base location with every Oracle database software installation. For use with SAP, the Oracle Base directory should reside on a shared file system if possible.

Use exactly the suggested groups. Remember that the Oracle software owner is user oracle with primary group oinstall. By choosing dba as the OSDBA and oper as OSOPER group, any user belonging to these groups can perform administrative tasks like starting or stopping the database (connect / as SYSDBA, connect / as SYSOPER).

SAP user ora<dbsid> belongs to group dba and is allowed to perform all administrative tasks. **Note:** All software maintenance tasks like installing new patchsets or applying patches are configuration tasks for which you must use OS user oracle.

Check the summary screen. If all information is correct, press Install to start the installation process.

The Oracle installer checks that all minimum requirements have been met. If this check is not passed, do not continue with the installation! Once the software has been installed, you must run the **root.sh** scripts on all nodes as user root.

The last screen shows the result of the installation. Do not continue with configuration changes if there are any warning messages.

Apply all required patches for SAP to the freshly installed database software

Once the OUI has installed the software, you must apply all patches required for running an SAP system. You must download all recommended and certified patches (SAP Bundle Patches, SBPs) from the SAP marketplace. Always use the latest most up-to-date SAP Bundle Patch and apply the patch using **MOPatch** as described in detail in the SBP README instructions from the patch bundle. In addition, we recommend the usage of the **SAP-Specific Database Upgrade Scripts for 12.1.0.2**. These upgrade scripts help you to automate pre-upgrade and post-upgrade tasks. By providing this functionality, it simplifies the database upgrade process of your SAP RAC database to release 12.1.0.2. After the upgrade the scripts also configure all database parameters according to the SAP/Oracle recommendations. Check SAP note **1915315** for further information regarding usage of these script.

```
# su - oracle
$ export ORACLE_HOME=/oracle/<SID>/12102
$ cd <patch location>
$ $ORACLE_HOME/MOPatch/mopatch.sh -v-s p9584028_121020_Generic.zip
```

We recommend that you use **MOPatch** to apply all required patches.

Upgrade the Oracle Database using SAP-Specific Database Upgrade Scripts

We recommend that you use the SAP-Specific Database Upgrade Script instead of running DBUA for the upgrade of your existing 11.2 RAC database. The script acts as a wrapper around DBUA and simplifies the upgrade process.

Log on to the system as user oracle. Start the upgrade assistant. DBUA through **dbua.sap.sh**. Follow instructions from SAP note 1915315 and perform the pre-upgrade steps. This pre-upgrade steps assure that your SAP database is correctly configured and ready for the upgrade. Optionally you can create a restore point.

Set environment variables DISPLAY, DB_SID, ORACLE_HOME_SRC and ORACLE_HOME_TGT. For details see SAP note 1915315.

Select Operation	Upgrade Oracle Database
Available Databases	<SID>
Prerequisite Checks	Correct any warnings and errors
Upgrade Options	Recompile Invalid Objects Parallelism >= 3 Upgrade Timezone Data Custom SQL Scripts After Upgrade <new ORACLE_HOME>/sap/ora_upgrade/post_upgrade/sapupprof_profile.sql
Management Options	No registration required
Recovery Options	No RMAN Backup, Choose I have my own backup and restore strategy

Select the recompilation option in the upgrade options screen. Backup of your existing database is a prerequisite which you must have completed before any upgrade step was performed.



Once DBUA is finished, you can start and stop the database with tool `srvctl`.

Manual Upgrade of the database

We do not recommend manual upgrade of the database. If you decide to perform a manual upgrade using SQL*Plus, see MOS note 1503653.1, “Complete Checklist for Manual Upgrades to Oracle Database 12c Release 1 (12.1)”.

If you are still using a text parameter file `pfile init<SID>.ora` for instance startup, edit this file with a text editor and make sure the parameter `cluster_database` is set to `false`.

In the case of a single server parameter file `spfile.ora` which is needed by SAP for RAC, change the setting of the parameter using `sqlplus`:

```
$ sqlplus / as sysdba

SQL> startup nomount
SQL> alter database set parameter cluster_database='false' scope=spfile;
SQL> shutdown immediate;
```

SAP User Environment

In the SAP scripts `.dbenv*` for user `<sid>adm` and `ora<dbsid>` you the value for variable `ORACLE_HOME` must be updated after the database upgrade to Oracle release 12c.

Replace all occurrence of variable `ORACLE_HOME` in all `.dbenv*` scripts to reflect the new value of the release version, e.g. replace `'112_64'` by `'121'`.

Do not set variable `ORACLE_HOME` permanently in any login script for OS user `oracle`. Appropriate settings can be established by execution of tool `oraenv`.

SAP Instance and START Profile

There is no change or correction required. All settings remain the same.

SAP BR*Tools

The SAP BR*Tools for Oracle database administration support a RAC configuration. Always download the latest version of the BR*Tools from the SAP service marketplace when using RAC. All required configuration changes for an SAP system with RAC are documented in chapter 6 of the SAP manual "SAP Database Guide: Oracle".

Beside the automatic registration of the Oracle instances to the listener processes, there is still a `SID_LIST` for every listener to maintain. The `SID_LIST` entries in the file `listener.ora` inform the local node listener about the existence of the instance, even if the instance is not running. This is important for the BR*Tools from SAP, to differentiate between a stopped and a non-existing instance.

After the upgrade to Oracle clusterware release 12.1.0.2, check the entries for known SAP databases in the configuration file for the listeners. Check for corrected location for entry `ORACLE_HOME` in the `SID_LIST_LISTENER` section in file `$GRID_HOME/network/admin/listener.ora`. The entry `ORACLE_HOME` should contain the new RDBMS Home location after database upgrade to Oracle release 12.1.0.2.

Log on to the system as user `oracle`. Add the `SID_LIST` entry at the end of the file `listener.ora` in the `/oracle/GRID/12102/network/admin` directory.



```
SID_LIST_LISTENER =  
(SID_LIST=(SID_DESC=(SID_NAME=<SID>001)(ORACLE_HOME=/oracle/<SID>/12102)))
```

Remember that you must do this on every node in the cluster as the Grid installation is local on every node. Put everything in one line, do not use CR/LF or whitespaces.

Implementation and Configuration of SAP Enqueue Replication

All setup and configuration steps defined in this document are in line with the implementation of the Oracle Clusterware Agent SAPCTL for SAP Enqueue Replication.

For details on how to configure SAP Enqueue Replication with Oracle Clusterware please consult the Oracle white paper

"Providing High Availability for SAP Resources"

You can obtain a copy of the white paper either from the SAP service marketplace

<http://service.sap.com/dbaora> -> Oracle Database Administration -> Media Library -> Oracle RAC

or from the Oracle website

<http://www.oracle.com/sap> -> ORACLE RAC FOR SAP -> Best Practices

References

SAP Notes

- 1521371 – Setting of ORACLE_BASE in SAP environments
- 1915315 – Oracle 12c Database Upgrade Scripts
- 527843 – Oracle RAC support in the SAP environment
- 1888485 – Oracle 12c: Database Parameter 12.1.0
- 1914631 – Oracle 12C: Central Technical Note for Oracle 12c

MOS NOTES

- 1503653.1 - Complete Checklist for Manual Upgrades to Oracle Database 12c Release 1 (12.1)
- 250.2 - Oracle Support Lifecycle Advisors

SAP/Oracle Community: <http://scn.sap.com/community/oracle>

www.oracle.com/sap



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Hardware and Software, Engineered to Work Together

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