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# Upgrade Methods for Upgrading to Oracle Database 11g Release 2

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## Introduction

The recommended method to upgrade an Oracle database to Oracle Database 11g Release 2 is by using the Database Upgrade Assistant. However, there are circumstances when using the DBUA is not possible and it is more appropriate to use another method.

This white paper looks at the various upgrade methods that can be used. Choosing a particular method is dependent on several factors. Some of the factors that help determine which upgrade method to use include:

- Version from which you are upgrading
- Amount of downtime that is acceptable
- Preference for GUI versus SQL scripts
- Complexity and amount of manual intervention required
- Additional disk space or hardware resources required
- Different operating system architecture or migration to a new hardware platform

This paper discusses these upgrade methods and guidelines for their use. It does not discuss the pre upgrade, upgrade, or post upgrade steps that a user should follow to ensure a successful upgrade. For information on all these steps, see the following:

- Oracle Database Upgrade Guide 11g Release 2 (Part Number E10819-02)
- Oracle Database Upgrade Companion 11g Release 2 (My Oracle Support Note 785351.1)
- Oracle Database 11g Upgrade page on OTN

## Database Upgrade Methods

Depending on the environment, there are several alternatives available when upgrading a database. This section discusses why a particular method would be chosen, lists considerations when using each method, and gives pointers to additional useful information.

### Database Upgrade Assistant (DBUA)

The DBUA provides a graphical user interface (GUI) that guides a user through the in-place upgrade of a database. It is the recommended method for performing either a major release upgrade or patch release upgrade.

The DBUA automates the upgrade process by performing all of the tasks that would otherwise need to be performed manually. It can be launched during installation of Oracle Database 11g Release 2 with the Oracle Universal Installer or it can be launched as a standalone tool at any time after installation is complete.

The DBUA is a very useful tool, because it evaluates the current database and makes appropriate recommendations for configuration options such as tablespace sizes, cluster checks, initialization parameters, and Automatic Storage Management upgrades.

#### **DBUA is a good choice if the upgrade environment has the following characteristics:**

- Operating system remains the same (including upgrades in the same OS family, such as Windows XP to Windows Vista or Solaris 2.8 to Solaris 2.10)
- Graphical user interface is preferred over manual interface
- Real Application Clusters or Automatic Storage Management is installed
- Much easier and less error prone than manual method – HIGHLY recommended!
- Existing database is at least 9.2.0.4 for Oracle Database 11g Release 1 and 9.2.0.8 for Oracle Database 11g Release 2



#### Considerations for using DBUA:

- Databases must be on the same system (in-place upgrade where the new version of Oracle is installed on the same server as the existing version). The DBUA cannot upgrade a database remotely.

#### For more information:

- Oracle Database Upgrade Guide 11g Release 2
- Oracle Database Upgrade Companion 11g Release 2
- Oracle Database 11g Upgrade page on OTN
- Complete Checklist to Upgrade to 11g Release 2 using DBUA (My Oracle Support Note 870814.1))

#### Manual Upgrade

A manual upgrade consists of running SQL scripts and utilities from a command line to do an in-place upgrade of a database to the new Oracle Database 11g release. Although a manual upgrade gives finer control over the upgrade process, it is more susceptible to error if any of the upgrade steps are not followed or are performed out of order.

Unlike the DBUA, the Pre-Upgrade information Tool (utlu111i.sql) that is shipped with the Oracle Database 11 software must be run manually to see what changes must be made to the

target database. It performs checks on configuration options such as components, init parameters, and tablespace sizes.

**Manual upgrade is a good choice if the upgrade environment has the following characteristics:**

- Manual interface is preferred over graphical user interface
- Existing database is at least 9.2.0.4 for Oracle Database 11g Release 1 and 9.2.0.8 for Oracle Database 11g Release 2 (1 step upgrade). Manual upgrades can be done for databases before 9.2.0.x, but 2 steps are required versus 1. For example, if upgrading from 8.1.7.4, it is necessary to first upgrade to 10.2.0.x and then to 11.1 or 11.2.

**Considerations for manual upgrade:**

- Cannot change operating system architecture

**For more information:**

- Oracle Database Upgrade Guide 11g Release 2
- Oracle Database Upgrade Companion 11g Release 2
- Oracle Database 11g Upgrade page on OTN
- Complete Checklist for Manual Upgrades to 11g Release 2 (My Oracle Support Note 837570.1))

## Oracle Data Pump Export and Import / Original Export and Import

In this method, the Export and Import utilities physically copy data from the current database to a new database. When upgrading from Oracle Database 10g or higher, Data Pump Export and Import are strongly recommended for improved performance and better manageability.

Oracle Data Pump Export/Import and original Export/Import perform a full or partial export from the current database, followed by a full or partial import into a new Oracle Database 11g.

In order to have two physical copies of the database, along with the dump file set, a significant amount of disk space may be required. However, the user has the flexibility (especially with Data Pump) to choose subsets of the database to export such as tablespaces, schemas, tables, and rows, leaving the original database unchanged. In addition, Data Pump Export/Import has two features that can help with this issue. First, Data Pump Import can be used in Network Mode, which allows the new Oracle database to be directly loaded across the network from the old database being upgraded. Thus, no intervening dump files are required. Second, when using Data Pump Export and Import in Oracle Database 11g, the imported data can be compressed with the Oracle Advanced Compression Option to improve performance (only when going from 11g Release 1 to Release 2 or for patch set upgrades from Oracle Database 11g onward).

Data Pump Export/Import and original Export/Import do not change the existing database, which enables the database to remain available throughout the upgrade process. Data Pump Export and Import use Flashback technology to get a consistent view of the data. However, neither Data Pump Export/Import nor original Export/Import provide consistent snapshots by default.

Because the current database can remain available, the existing production database can be kept available for read-only transactions while the new Oracle Database 11g database is being built at the same time by Data Pump Export/Import or original Export/Import. The current database can then be deleted once the upgraded system is determined to be fully functional.

Note that Data Pump Export/Import is supported starting in Oracle Database 10g. When upgrading an Oracle database that is older than 10g, original Export and Import must be used.

**Data Pump Export/Import or Export/Import is a good choice if the upgrade environment has the following characteristics:**

- Migration to different operating system architecture or hardware platform
- Source database is running on a version such as 8.0.3 or 8.1.6 that is not directly upgradable to the target version
- Side-by-side testing of the old and new versions of Oracle Database is needed (because an entirely new database is created)
- New database will be restructured (i.e. new tablespaces will be created and populated by imported data, or a new partitioning scheme will be implemented)

**Considerations for using Data Pump Export/Import or Export/Import:**

- Downtime will be much longer than other methods, depending on size of the database (i.e. 10+ hours for large databases). This can be tested by running a test export into the file system and then doubling or tripling the amount of time that would be required for the subsequent import.
- Additional disk space will be necessary to store both the export dump files and the new copy of the database

**For more information:**

- Oracle Database Upgrade Guide 11g Release 2
- Oracle Database Utilities 11g Release 2 (Part Number E10701-02)
- Oracle Database Upgrade Companion 11g Release 2
- Oracle Database 11g Upgrade web page on OTN
- Oracle Database Utilities web page on OTN

## Oracle Transportable Tablespaces

Oracle Transportable Tablespaces (TTS) is an option for performing database upgrades in less than one hour for databases that have simple schemas and where the data files do not need to be transferred as part of the transport process (such as when the data files will be used in place, or when shared storage is available in a system migration).

With this method, an empty 11g Release 2 database is created and data is moved from the existing database to the 11g Release 2 database. Metadata for tables and indices and the objects needed to support the tables and indices in the tablespaces is exported from the existing database and then imported into the new database using Data Pump Export/Import or original Export/Import. The majority of time taken for the upgrade is for the metadata export and import, and this is where there may be less than optimal performance.

Transportable Tablespaces has been used effectively to reduce database upgrade time. However, because it was not originally designed as a database upgrade solution, it does not have the same level of automation as the DBUA. Consider whether the added testing time and complexity of using a TTS upgrade are worth the potential to reduce downtime during the upgrade.

Starting with Oracle Database 10g, tablespaces can be moved across platforms. Many, but not all platforms are supported for cross platform tablespace transport. A cross-endian move involves an RMAN convert, but is a simple operation across platforms within the same endian group. Note that the time needed for the RMAN convert is essentially equivalent to the time needed for an RMAN backup of the database.

### **Transportable Tablespaces is a good choice if the upgrade environment has the following characteristics:**

- Downtime must be less than one hour
- Data files do not need to be transferred as part of the transport process
- Existing database's object structure is not complex

### **Considerations when using Transportable Tablespaces:**

- Metadata gets transported from the existing database to the new database and may increase upgrade time. If desired, a time estimate can be obtained by performing a metadata-only export on the source database.
- Higher level of skill is required for the database administrator

### **For more information:**

- Oracle Database Administrator's Guide 11g Release 2 (Part Number E10595-04)
- Database Upgrade Using Transportable Tablespaces: Oracle Database 11g Release 1 white paper

- Platform Migration Using Transportable Tablespaces: Oracle Database 11g Release 1 white paper
- Platform Migration Using Transportable Database: Oracle Database 11g and 10g Release 2 white paper

### Oracle Data Guard SQL Apply (Logical Standby)

Starting with Oracle Database 10 (10.1.0.3), Data Guard SQL Apply (logical standby) can be used to perform a database rolling upgrade with minimal downtime. The upgrade can be to a higher Oracle Database release or a later patch set. The overall downtime can be as little as the time it takes to perform a switchover.

Oracle Data Guard provides the management, monitoring, and automation software infrastructure to create and maintain one or more standby databases to protect Oracle data from failures, disasters, errors, and data corruptions. There are two types of standby databases. A physical standby uses Redo Apply to maintain a block for block, exact replica of the primary database. A logical standby uses SQL Apply and contains the same logical information as the primary database, although the physical organization and structure of the data can be different. SQL Apply also enables rolling upgrades by allowing the synchronization of a standby database with a primary database that is using an earlier release of the Oracle Database.

A database rolling upgrade entails first upgrading a logical standby database to a later Oracle release or patch set, and then allowing SQL Apply to re-synchronize the primary and standby databases. When the administrator is satisfied that the upgrade has been successful, the process is completed by using a Data Guard switchover operation to transition the standby to the primary role. The only downtime experienced by applications is the time needed to complete the switchover process and reconnect clients to the new primary database. The actual database upgrade is performed while applications continue to access the original production database.

Beginning with Oracle Database 11g, Data Guard physical standby users can also benefit from rolling database upgrades by temporarily converting a physical standby to a transient logical standby database, enabling SQL Apply to synchronize the primary and standby databases while they operate at different Oracle releases or patch sets. The transient logical process is attractive because it can use existing physical standby databases and it only requires a single catalog upgrade to migrate both primary and standby databases to the new Oracle release. When the upgrade process is complete, the configuration reverts to its original state of having a primary with a physical standby database.

**Oracle Data Guard SQL Apply is a good choice if the upgrade environment has the following characteristics:**

- Oracle Data Guard SQL Apply is installed
- Minimal downtime is a requirement
- Current database is at least 10.1.0.3

**Considerations when using Oracle Data Guard SQL Apply:**

- Operating systems must be the same
- Higher level of skill is required for the database administrator

**For more information:**

- Oracle Database Administrator's Guide 11g Release 2
- Oracle Maximum Availability Architecture Best Practices web page on OTN
- Database Rolling Upgrade Using Data Guard SQL Apply – Oracle Database 11g and 10g R2 white paper
- Database Rolling Upgrade Using Physical Standby Databases and the Transient Logical Rolling Upgrade Process

## Online Database Upgrade with Oracle GoldenGate

Oracle GoldenGate is a real-time change data capture application that provides guaranteed data capture, routing, transformation, and delivery across heterogeneous business systems. The application uses a low-overhead architecture to capture transactions nonintrusively from a source database by reading online transaction logs, transforming the data when needed, and applying those transactions with guaranteed integrity to a target database in real time.

Oracle GoldenGate can be used to achieve little or no database downtime during database or patchset upgrades. A database can be migrated from one platform, for example IBM AIX to Oracle Linux. A copy of the current database is upgraded using Oracle GoldenGate. The upgraded database is synchronized with the production database to keep changes synchronized during the upgrade process. The only downtime that occurs is during the switch from the current database to the new database.

**Oracle GoldenGate is a good choice if the upgrade environment has the following characteristics:**

- Operating systems are different
- Little or no downtime is a requirement
- Current database is at least 8.1

**Considerations when using Oracle GoldenGate:**

- Requires GoldenGate license

**For more information:**

- Oracle Database Administrator's Guide 11g Release 2
- Oracle GoldenGate Online Documentation Library 11g Release 1 (Part Number E18101-01)

**Online Database Upgrade with Oracle Streams**

Oracle Streams, a built-in feature of the Oracle database, is a data replication and integration feature. Oracle Streams enables the propagation of data, transactions and events in a data stream either within a database, or from one database to another.

Oracle Streams can be used to achieve little or no database downtime during database or patchset upgrades. A database can be migrated to different platform, for example Intel Solaris to Oracle Linux, or to a different character set. A copy of the current database is upgraded using Oracle Streams to keep changes synchronized during the upgrade process. The only downtime that occurs is during the switch from the current database to the new database.

**Oracle Streams is a good choice if the upgrade environment has the following characteristics:**

- Operating systems are different
- Little or no downtime is a requirement
- Current database is at least 9.2

**Considerations when using Oracle Streams:**

- Performance restrictions may occur in an OLTP environment if the copy of the database does not keep up with existing database
- Significant amount of expertise is required by the database administrator

**For more information:**

- Oracle Database Administrator's Guide 11g Release 2
- Oracle Streams Concepts and Administration 11g Release 2, Appendix D (Part Number E10704-02)

## Conclusion

Database Upgrade Assistant is the preferred method for upgrading a database to Oracle Database 11g Release 2. However, it is not always possible to use the DBUA, and in such situations there are other options available.

Choosing the appropriate upgrade method depends on the environment, amount of downtime that is acceptable, and tolerance for complexity of the database administrator doing the upgrade. It is important for the database administrator to understand the various upgrade methods and choose the one that best suits business requirements.

## References

1. Oracle Database Upgrade Guide 11g Release 2 (Part Number E10819-02)
2. Oracle Database Upgrade Companion 11g Release 2 (My Oracle Support Note 785351.1)
3. Oracle Database 11g Upgrade page on OTN
4. Complete Checklist to Upgrade to 11g Release 2 using DBUA (My Oracle Support Note 870814.1.1)
5. Complete Checklist for Manual Upgrades to 11g Release 2 (My Oracle Support Note 837570.1)
6. Oracle Database Utilities 11g Release 2 (Part Number E10701-02)
7. Oracle Database Utilities web page on OTN
8. Oracle Database Administrator's Guide 11g Release 2 (Part Number E10595-04)
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14. Database Rolling Upgrade Using Physical Standby Databases and the Transient Logical Rolling Upgrade Process
15. Oracle GoldenGate Online Documentation Library 11g Release 1 (Part Number E18101-01)
16. Oracle Streams Concepts and Administration 11g Release 2 (Part Number E10704-02)



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