Oracle Database Appliance: Migration Strategies
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Executive Overview

The Oracle Database Appliance is an engineered system offering that saves time and money by simplifying the deployment, maintenance, and support of a high availability database solution - all supported by a single vendor – Oracle. It is a fully integrated system with software, servers, storage and networking in a single box capable of supporting a wide range of home grown, packaged OLTP and Data Warehousing applications.

The Oracle Database Appliance offers customers a unique pay-as-you-grow software licensing capability allowing seamless scalability from 4 to 24 processor cores without any hardware upgrades. It comes as a rack unit (RU) server appliance that consists of two server nodes and 12 TB raw storage capacity running Oracle Database 11g Release 2 (11.2) on Oracle Linux 5. It offers an ideal solution for customers who value simplicity and who seek to reduce the required skills, complexity, costs and risks in deploying a highly available database solution.

Oracle Database Appliance software includes preconfigured database templates that are optimized for different classes of databases, each with different workload profiles and performance requirements. The templates incorporate Oracle best practices. Before you migrate your data from the current host, Oracle Database Appliance creates a database this is optimized for your application and business whether it is a small, medium or large sized database. This paper discusses how to move your data from the current database to the Oracle Database Appliance’s pre-created optimized database.

Introduction

After the Oracle Database Appliance is installed and configured, the next step to using your database with your application is loading existing data from the current database into the Oracle Database Appliance database. There are flexible data migration options based on your Oracle skill level, the complexity of the option, and the time it takes to move the application data to the Oracle Database Appliance.

Some common factors that will help decide which option is best to migrate the database includes the processing power and resources available on the source system, the available network bandwidth between the source and target, and the volume and complexity of the data and data structures. This white paper describes the data migration options that are available
to you and how we can expediently and efficiently advise you how to start using the Oracle Database Appliance while reducing application outage and risk.

This paper presents strategies for migrating to the current version of the Oracle Database Appliance:

- Oracle Database version 11.2.x
- Oracle Grid Infrastructure version 11.2.x
- Oracle Linux
- Maximum configurable local disk space of 4TB with optional expandable storage using NFS

Network connectivity between the source system and the Oracle Database Appliance must be available. The Oracle Database Appliance offers both GbE and 10GbE connections. While this paper is written specifically for the Oracle Database Appliance, these data migration options may be familiar to you as these are best practices tested by Oracle to migrate data from one Oracle database to another.

Migration Approach

Migrating to the Oracle Database Appliance is not particularly different than migrating to any other Oracle database server. The most common migration strategies follow these steps:

1. Evaluate migration requirements
2. Plan and test the migration strategy
3. Migrate your data to the Oracle Database Appliance
4. Post-migration verifications and updates

Migration strategies typically use a single migration technique, but some systems will require a blend of approaches.

The migration plan, as detailed and thorough as possible, must be tested and evaluated to meet the migration requirements. In addition, an acceptable fallback strategy must be developed, in case
unanticipated problems occur, keeping in mind the outage and availability requirements of the business.

No migration will be complete until operational and management processes and procedures are modified and updated specifically for the Oracle Database Appliance.

In evaluating the options for migrating data to the Oracle Database Appliance, there are a number of key criteria and constraints that will provide guidance. These include the following:

- Data volume (and index volume)
- Acceptable length of system outage
- Network bandwidth (one or two GbE or 10GbE connections, fully dedicated)
- Storage for data staging, as necessary
- Contingency fallback plan in case of migration failure, or post-migration problems
- DBA’s skilled and experienced to sufficient level for migration technique employed
- Source system O/S and version
- Source system database version
- Data type, character sets, and other miscellaneous considerations

Migration Options

While there are a many possible migration techniques, the two most common options are:

- Transportable Tablespaces and
- Data Pump (Export/Import)

These two options provide the simplest, lowest risk, easily-implemented approaches that will be available for Oracle-to-Oracle migrations.

Other notable options, which are not included in this white paper, include Oracle Streams, Insert/Select or Create Table as Select (CTAS) across database links, Oracle Recovery Manager (RMAN) incremental backups, and Custom procedural approaches (PL/SQL, etc.)

The following table lays out the various approaches and their relative merits (relative to alternatives).
Evaluating the relative merits of the migration techniques is often a matter of personal experience, rather than quantifiable. The ratings and indicators used in this table are only meant to provide general guidelines.

- **Complexity (Risk)** – the overall level of complexity inherent in the approach equates to risk, either as the number of steps involved, the skill or experience level required conducting the steps, or the amount of manual involvement required.

- **Skill Level** – the experience and comfort level with the technique. Most DBAs have some experience with one or more of these techniques, especially with export/import. The degree of experience or familiarity with these techniques will reduce levels of risk with the more complex approaches.

- **Outage Window** – the length of outage that would be acceptable to the business, remembering that the data migration is only a part of the overall system migration. The elapsed length of time for the data migration will depend greatly on volume, network connectivity and the migration technique employed.

- **Selectivity** – the degree of selectivity required for the migration, whether all the data from the source database is to be migrated, only specific tables are to be migrated, or specific rows are to be migrated. Not a key factor for many migration projects, but important for some, especially in cases of consolidated source databases, aging data sources, or as part of larger information lifecycle management strategy.

- **Extra Storage** – if additional storage is required for the migration technique, most likely as storage for staging files. Typically, this will mean double the storage required for the datafiles. Best practices, for performance, suggest that this extra storage be located on the Oracle Database Appliance’s /cloudfs directory rather than on an externally available storage system.

- **Prep & Post Work** – the degree of work required preparing for the migration and complete the migration after the data has been transferred. The prep work is usually more extensive for customized approaches, while it is relatively small for Oracle utilities such as Data Pump or
Export/Import. Post migration work would include index builds, enabling constraints, endian conversions, etc. These steps can contribute greatly to the overall elapsed time of the migration approach.

Transportable Tablespaces

Using the Transportable Tablespace approach is a manageable method for transferring entire user tablespaces from a source Oracle database to the target database on the Oracle Database Appliance. The new Cross-Platform Transportable Tablespace (XTTS) feature introduced in the Oracle Database 11g Release 2 database enable this approach even between heterogeneous endian systems.

Conceptually, the use of XTTS is simply a five step method:

1. Prepare for the migration
2. Export the metadata from the source database
3. Copy the datafiles from the source system to the target system using Oracle Recovery Manager or Oracle ASM Configuration Assistant (ASMCA)
4. Import the metadata into the target database
5. Finalize the migration

The advantages that make this approach attractive are:

- Simple, all-encompassing approach – allows a user to migrate all of the data within individual user tablespaces, without having to rebuild indexes or re-validate constraints
- If Linux to Linux, will support migrations from older source databases to the Oracle Database Appliance which will not require endian conversion
- If the source database is at the same level as the target on the Oracle Database Appliance, then XTTS can manage any endian conversion from Oracle Database 11.2 onwards
- If the source database is stored in ASM, then the datafile transport can be done using Oracle ASM Configuration Assistant (ASMCA)
- Faster migration than via Data Pump, though somewhat more complex

In addition, there may be complications due to objects being stored in the SYSTEM tablespace or objects owned by the privileged accounts, SYS and SYSTEM. See the Oracle Database Administrator's Guide Documentation for a full list of XTTS limitations and restrictions. Link to the documentation is located in the References section.

Oracle Data Pump

Oracle Data Pump is the simplest migration approach. While it is fairly foolproof, it is also the slower of the two recommended alternatives.
The variety of features available with Oracle Data Pump enables you to optimize performance and manageability for a number of different scenarios. The data can be staged on the Oracle Database Appliance for faster import, which is recommended but there is also the capability within Oracle Data Pump to directly export/import across the network without staging the data. This is slower, but does not require interim storage. In addition, parallelism is highly manageable, as is post import processing which include index rebuilds, but the data constraints should not need to be revalidated.

For an overview of the features of Oracle Data Pump and how they can be employed for such a migration, refer to the Oracle Database Utilities documentation for the target Oracle Database Appliance database version. You should review the documentation for a list of restrictions, such as no support for LONG and LONG RAW and object datatypes. Plus, further information about supported versions is available in MOS Note 553337.1 - Export/Import DataPump Parameter VERSION - Compatibility of Data Pump Between Different Oracle Versions.

Some of the reasons why users may choose this approach are:

- Simplicity
- Less restrictions between the source operating system and that of the Oracle Database Appliance which uses Oracle Linux Unbreakable Enterprise Kernel (OL UEK)
- Greater flexibility to choose which database objects are migrated
- Benefit of rebuilding the database objects without any legacy storage rules or history

However, inherent within this approach is the fact that it is slower, requiring both the migration of the data and the rebuilding of the indexes in the target system. These rebuilding steps typically consume more time than the actual data migration alone, and require careful management to avoid unacceptable schedule impacts.

Reducing the Outage and Providing Options for Fallback

In some instances, the database migration must be accomplished faster than can be managed directly with the two recommended approaches. In these cases, there needs to be an offline mechanism to instantiate the target database and simultaneously bring it in sync with the source system as transactional activity continues. The outage to occur will be when the primary database is switched from the source legacy system to the target Oracle Database Appliance.

The processing sequence would follow these steps:

- Establish update processing method (from source to target)
- Instantiate the target database (i.e. take an offline copy of the source database and migrate it to the target Oracle Database Appliance, with indexes and constraints in place
- Begin managed update processing against the target Oracle Database Appliance system (i.e. apply changes occurring on the source system to the target system, to bring the target system up to date with the source and keep the two systems in sync)
- When ready, take a brief outage to switch roles between the legacy and Oracle Database Appliance system is now running the primary database.
The actual business outage is limited to switch the roles of the legacy and Oracle Database Appliance system. This same technique would have the additional benefit of providing a fallback in case a fatal problem occurred on the Oracle Database Appliance that would require a switch back to the legacy system.

The recommended techniques for this approach to reducing the outage length include Oracle GoldenGate replication and Oracle Data Guard.

**Oracle GoldenGate**

Oracle GoldenGate provides a well-proven, fully-functioned solution for providing replication processing to and from the Oracle Database Appliance, between heterogeneous systems (including non-Oracle sources) that can be used to reduce a database/application outage and give a simple role reversal as required.

However, this functionality typically requires specialized skills and experience with the Oracle GoldenGate software, and an extended period for configuration. There are also some limitations on the data types that can be replicated using this approach. For further information, please refer to the GoldenGate documentation listed in the Reference section and The Best Practices and Recommendations for using Oracle GoldenGate for Low Downtime Replication to the Oracle Database Appliance (My Oracle Support Note 1391398.1) are available.

**Oracle Data Guard**

Oracle Data Guard is a somewhat simpler alternative to providing much of the replication functionality offered by Oracle GoldenGate. In this case, the Oracle Data Guard standby is instantiated via the normal migration mechanisms, then replication is initiated in order to bring the standby up to date with the source system and to keep it in sync until the database roles are switched.

One advantage of the Data Guard solution over Oracle GoldenGate would be its support for all native Oracle data types. But, Data Guard could not be employed for the replication of non-Oracle data sources.

For more information on Oracle Data Guard and Oracle Database Appliance, please see the best practices white paper on OTN.

**Non-Oracle to Oracle Database Migration**

Oracle offers a wide range of migration services to help you optimize your usage of Oracle technology. Through the use of tools, resources, and proven best practices, Oracle can provide support for migrating from legacy or non-Oracle technologies to Oracle, helping you reduce the effort, cost, and risk - helping you to get your solution to market more quickly and easily. Oracle SQL Developer is an intuitive tool that enables you to migrate a database, including the schema objects, triggers, and stored
procedures, to an Oracle Database using a simple point-and-click process. You can either use the tools available or employ Oracle services to help you complete the migration from a non-Oracle database. For more information, please see the Oracle Database Migration Technology OTN web page.

Summary and Recommendations

The migration of the legacy Oracle database to the Oracle Database Appliance can best be accomplished via Transportable Tablespaces, RMAN incremental backups or Oracle Data Pump. All are proven, simple approaches. However, when used standalone, all of these approaches requires some system outages lasting the length of the migration. If the business can support such an extended outage, then these are the best and simplest ways to complete the migration.

If the business access to the database cannot suffer a long outage, then these techniques may be augmented with the replication functionality provided by Oracle GoldenGate or Oracle Data Guard. Using these tools, the outage can be reduced significantly, but at the cost of greater complexity and the required skill/experience levels.
References

Oracle Database Appliance
- Oracle Database Appliance - 2.1 Supported Versions & Known Issues (My Oracle Support Note 888888.1)
- Information Center: Oracle Database Appliance (My Oracle Support Note 1417713.2)
- Oracle Database Appliance Documentation homepage

Oracle Documentation - Oracle Database 11g Release 2 (11.2) documentation homepage
- Oracle Database Administrator's Guide 11g Release 2 (11.2)
- Oracle Database Utilities 11g Release 2 (11.2)
- Oracle OLAP Reference for Oracle Database
- Oracle OLAP DML Reference for Oracle Database 11g
- Oracle Database Performance Tuning Guide 11g Release 2 (11.2)
- Oracle XML DB Developer's Guide 11g Release 2 (11.2)
- Migrating OLAP From 32 To 64 Bits (My Oracle Support Note 352306.1)
- Enabling a Constraint in Parallel (My Oracle Support Note 124848.1)
- Reduce Transportable Tablespace Downtime using Cross Platform Incremental Backups (My Oracle Support Note 1389592.1)

Data Pump Documentation and References
- Export/Import DataPump Parameter VERSION - Compatibility of Data Pump Between Different Oracle Versions (My Oracle Support Note 553337.1)

Data Guard Documentation and References
- Data Guard 11g Best Practices OTN homepage
- Best Practices for Migrating to Exadata White Paper
- Reduce Transportable Tablespace Downtime using Cross Platform Incremental Backups (My Oracle Support Note 1389592.1)

Golden Gate Documentation and References
- How to set up basic Oracle GoldenGate(OGG) and implement high availability(HA) in Oracle Database Appliance(ODA) environment using Oracle Clusterware
- Oracle GoldenGate Best Practices: Instantiation from an Oracle Source Database (My Oracle Support Note 1276058.1)
- Zero-Downtime Database Upgrades Using Oracle GoldenGate White Paper
- Oracle GoldenGate High Availability using Oracle Clusterware White Paper
- GoldenGate Certification Matrix

Oracle-to-Non-Oracle Migration
- Oracle Database Migration Technologies homepage