

# Migrating an Oracle Database to Dell EMC SC Series Storage

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## Executive summary

There are many reasons why database migration happens. Regardless of the reasons, the new platform should introduce newer and better technologies that would ultimately benefit the organization. Dell EMC SC Series storage includes many of these technologies as core features. This document discusses these features, addresses key considerations of migrating Oracle® databases to the SC Series, and introduces some of the most common migration methods and tools available. This document is not a how-to guide or a comprehensive user manual of the migration process. This type of information can be found in Oracle documentation and at [My Oracle Support](#). See the references at the end of this document for additional information.

# 1 Introduction

Migrating Oracle databases to a new platform can be a complex project, especially when the source and target platforms are dissimilar. Typically, a database migration process involves moving or copying data from one platform to another platform by using applications and OS utilities. The OS and storage platforms might both be changed in the process. In addition, the database itself might also be upgraded as part of the migration process. This paper does not intend to cover all of these scenarios, but primarily focuses on storage platform migration with an Oracle database.

## 1.1 Audience

This document is intended for database administrators, system administrators, storage administrators, and solution architects involved in planning a migration of Oracle database to SC Series storage. The information in this document builds upon the following technologies. It is assumed that the readers have basic knowledge and prior experiences in these areas.

- Dell EMC SC Series
- Oracle RDBMS 11g and 12c architecture
- Oracle Automatic Storage Management (ASM)
- Oracle Real Application Clusters (RAC) or single instance
- General understanding of SAN technologies
- OS platform architecture
- OS administration

## 1.2 Purpose

This document provides a general overview of the migration effort and a list of things to consider before the migration. Several important features in SC Series storage that would benefit the Oracle database are discussed. The document also explores the various methods and software that can assist in a migration process.

## 2 SC Series overview

At the center of SC Series is the Storage Center Operating System (SCOS). SCOS incorporates the best of flash technology, powers the storage virtualization, and delivers greater flexibility and economics for both all-flash and hybrid arrays.

The following list highlights some of the most innovative and core SCOS features. These powerful features are transparent to the OS and applications, such as Linux® and Oracle database, and they can immediately benefit by moving to SC Series storage without much changes.

**Dynamic block architecture** records and tracks metadata for every block of data and provides system intelligence on how those blocks are being used. The metadata enables SC Series storage to take a more sophisticated and intelligent approach to storing, recovering, and managing data.

**Storage virtualization** occurs storage at the disk level, creating a dynamic pool of storage resources shared by all servers. Because read/write operations are spread across all available drives within the same tier, multiple requests are processed in parallel, boosting system performance.

**Dynamic capacity (thin provisioning)** delivers high storage utilization by eliminating allocated but unused capacity. It completely separates storage allocation from utilization, enabling users to create any size of virtual volume upfront, and only consume actual physical capacity when data is written.

**Snapshots** (replays) provide continuous, space-efficient data protection. A snapshot taken of a volume creates a point-in-time copy (PITC) of the volume by making all written pages read-only. Any further changes to the volume get written to new pages (active data). When the volume is read, SC Series storage seamlessly presents the read-only pages from the snapshot and any active data. Consistent snapshots in an Oracle environment can be effective for database backups, recoveries, and cloning. For more information on consistent snapshots, see sections 3.3.2.

**Data Progression (DP)** is a Dell Fluid Data™ storage or automated tiered storage feature that automatically migrates data to the optimal storage tier based on a set of predefined or custom policies called storage profiles. Data Progression eliminates the need to manually classify and migrate data to different storage tiers while reducing the number and cost of drives and reducing the cooling and power costs.

**Fast Track** technology enhances automated tiered storage by dynamically placing the most frequently accessed data on the fastest, or outer, tracks of each hard disk drive. Fast Track does not require any manual configuration and it is licensed separately.

**Deduplication and compression** enable data reduction and work hand-in-hand with Data Progression to reduce the data stored on the array. A Data Progression license includes these data reduction features without extra cost. They are enabled on a per-volume basis. Data is processed for deduplication and compression during the scheduled daily Data Progression cycles or when snapshots are taken which trigger an on-demand Data Progression on the volume. The feature is supported on all SC Series models except the SCv Series. For more information on SC Series data reduction, refer to the [Dell Storage Center OS 7.0 Data Reduction with Deduplication and Compression Solution Guide](#).

**Replication** technology protects a virtual volume by creating a replica on a remote SC Series array using either asynchronous or synchronous mode. After the initial setup, SCOS copies only the data changes made

since the last snapshot. This uses less network bandwidth and less time. In the event of primary array/site failure, the replicas can be activated by the administrator on the remote site.

**Live Volume** is a hyper-volume that stretches across two different SC Series arrays. The feature extends data protection beyond the basic array replication and offers enhanced disaster recovery capability to a remote site. When the primary SC Series array becomes unavailable, Live Volume can seamlessly fail over to the secondary array without causing data access interruption. The feature allows on-demand failover or auto-failover between the two arrays. For more information on Live Volume and how it interacts with Microsoft® and VMware®, refer to [SC Series Technical Documents](#).

**Live Migrate** builds on the same virtualization architecture of Live Volume and allows migrating workloads seamlessly from one array to another. The feature is intended for migrating data between SC Series arrays without causing service interruption. It simplifies the complex manual migration workflow of setting up the Live Volume and replication, mapping the Live Volume to the server, waiting for replication to finish, performing role swap, and removing the Live Volume at the end.

**Dell Storage Manager (DSM)** serves as a centralized administration console for one or multiple SC Series, PS Series, and FluidFS clusters. DSM offers an easy-to-use graphical interface to manage storage volumes, server mappings, storage medium configuration, storage profiles, snapshot profiles, replication, and Live Volumes, and provides performance monitoring of the storage systems with rich charting capabilities. DSM also provides product integration for Microsoft and VMware products. These products include Microsoft System Center Virtual Machine Manager, VMware Site Recovery Manager, and VMware® vSphere® Virtual Volumes™ (vVols). For more information, refer to the DSM *Storage Center Administrator's Guide* and visit [SC Series Technical Documents](#).

**SC Series PowerShell SDK, REST API, and Java-based CompCU** allow administrators to manage the SC Series storage through scripting and automation. They are available to customers free of charge.

**Dell SupportAssist** is built into DSM and every SC Series array. When enabled, DSM sends array configuration, diagnostic, and performance data to Dell technical support for proactive monitoring, performance analysis, and troubleshooting purposes. With SupportAssist, administrators can choose to receive update notification and whether the updates should be pushed directly to DSM automatically. Administrator's approval is always required to apply the updates.

For additional documentation on these features, see the DSM *Storage Center Administrator's Guide*.

## 3 Storage migration planning and considerations

A database migration involves moving a database from one system to a different system. Migration planning is one of the most critical parts of the migration process. In addition to laying out the procedural tasks relating to the migration, this process also needs to thoroughly identify and review the functional and operational differences of the new platform since they have a direct effect on how the database environment is managed and operated. Sufficient end-to-end testing also needs to be performed before the migration. This paper does not discuss the process of the planning and migration, but it discusses certain tasks that administrators should focus on.

### 3.1 Understand the environment

It is important to identify and understand the impact of migration to existing operating procedures. These procedures might require updates because of the operational differences of the SC Series array. Such operating procedures include, but are not limited to:

- Configuring, managing, and mapping volumes: Uses DSM and scripting tools
- Backup/recovery process: Includes snapshot technology
- Disaster recovery procedure: Introduces Live Volume and replication to enhance the disaster recovery capability
- Replication process: Requires understanding the differences in replication modes and how to activate the disaster recovery function in SC Series storage
- Monitoring of storage: Involves training the operation team on DSM
- Database cloning procedure: Uses thin snapshots and scripting tools

### 3.2 Define storage requirements

Both performance and capacity requirements are important criteria when choosing a successful storage platform. It is recommended to start with performance first and then consider capacity, since performance requirements usually require deeper understanding of the applications and the business.

#### 3.2.1 Performance

In the majority of cases, performance statistics of the current environment are either absent or not fully analyzed. This often leads to an unpleasant surprise after the database is migrated. Performance expectations must be defined by quantifiable measurements and clearly communicated to all teams involved, including the Dell EMC team so that they can properly size the SC Series array to meet the objectives. Possible measurements included are covered in the following subsections.

##### 3.2.1.1 IOPS, throughput, and latency

These are the most commonly used metrics when sizing and measuring storage performance. They are application agnostic and focus only on the number and pattern of I/O packets. Some operating systems provide native tools that collect basic IOPS information. For example, on Linux, **sar** and **iostat** come pre-installed on the system. Other free utilities like [atop](#) and [collectl](#) are similar to sar but have additional features. On Microsoft Windows®, **Performance Monitor** is readily available. Dell EMC also offers a free tool, the **Dell Performance Analysis Collection Kit (DPACK)**, to assist in collecting and analyzing system and I/O performance data. For information on DPACK, check out the [DPACK FAQ](#) or contact the Dell EMC team.

### 3.2.1.2 Transactions

These are measurements in terms of database transactions and latency. In most cases, the application vendors would have some built-in facilities that allow capturing such information. For an Oracle database, the mostly used utilities are **statspack** and **AWR**. AWR is preferred to the older statspack but either one can provide abundant performance statistics of a database.

## 3.2.2 Capacity

The advanced features of SC Series such as thin provisioning, auto-tiering, multi-RAID levels, data reduction features, and snapshot capability make the best and most efficient use of storage space possible. To figure out the capacity needed to support the applications and databases being migrated to the SC Series, consider the following factors that have direct effects on the storage consumption. Also, storage capacity can be dynamically added or removed from the SC Series without affecting the applications. Thus, customers only invest in what they need and still maintain the flexibility to meet any future growth.

- All flash, all HDDs, or a hybrid system
- RAID types
- Snapshot frequency and retention policy
- Use of deduplication and compression
- Number of database environments (full size plus thin clone)
- Data growth rate
- Data change rate
- Oracle ASM redundancy level
- Amount of archive logs to keep

Oracle Automatic Workload Repository (AWR) can be used to help estimate how much storage is required for snapshots. It provides detailed usage information on redo logs, archived logs, temporary space, and data files. DBAs should be able to deduce the data-change rate from the AWR reports. Reports should be generated from different time periods to coincide with the time the snapshots are intended to be taken, and the information used as the basis of the calculation.

Dell EMC is well equipped to help customers analyze both storage and performance requirements based on many of these inputs.

## 3.3 Configure SC Series volumes for the database

This section shows some of the features unique to the SC Series that might influence how the database storage layer is configured. A detailed discussion of configuring Oracle RDBMS on an SC Series array can be found in the document, [Dell EMC SC Series Arrays and Oracle](#). Many of the features can be enabled through setting the various volume attributes at any time during or after the initial creation.

### 3.3.1 Database volumes attributes

The following SC Series volume attributes can be defined and modified in DSM:

**Number of volumes:** To take advantage of both controllers in an SC Series array, it is recommended to have at least two volumes configured for a database. Keep the total number of volumes within the limit of a

consistency group. SCOS 7.2 has lifted the maximum number of volumes in a single consistency group from 40 to 100. Section 3.3.2 describes the use of a consistency group with taking database snapshots.

**Volume size:** In general, there are no noticeable performance differences in volume sizes. Consider using fewer larger-sized volumes to reduce administration overhead. In Oracle 11gR2, ASM supports volume sizes up to 2 TB. In Oracle 12c, it is drastically increased to 32 PB. SCOS supports up to 500 TB for a single volume.

**Storage profile:** Data Progression moves data between RAID levels and storage tiers based on the storage profile assigned to each volume. This includes both active data blocks and frozen snapshots so performance and capacity are balanced and optimized automatically. See section 3.3.3 for more information.

**Snapshot profile:** It is recommended to create one consistent profile for each database and assign it to volumes belonging to the same database. See section 3.3.2 for more information.

**Data reduction feature:** Depending on the type of data the database holds, deduplication and compression or just compression might provide additional storage savings. Since the features can be enabled at any time, they can be enabled after the migration. Monitor the space savings in DSM after the Data Progression cycle is run. For OLTP-type environments, data reduction should be tested to gauge the user acceptance of performance.

The disk space savings information can be found in **DSM > Storage Tab > Volumes > Statistics**.

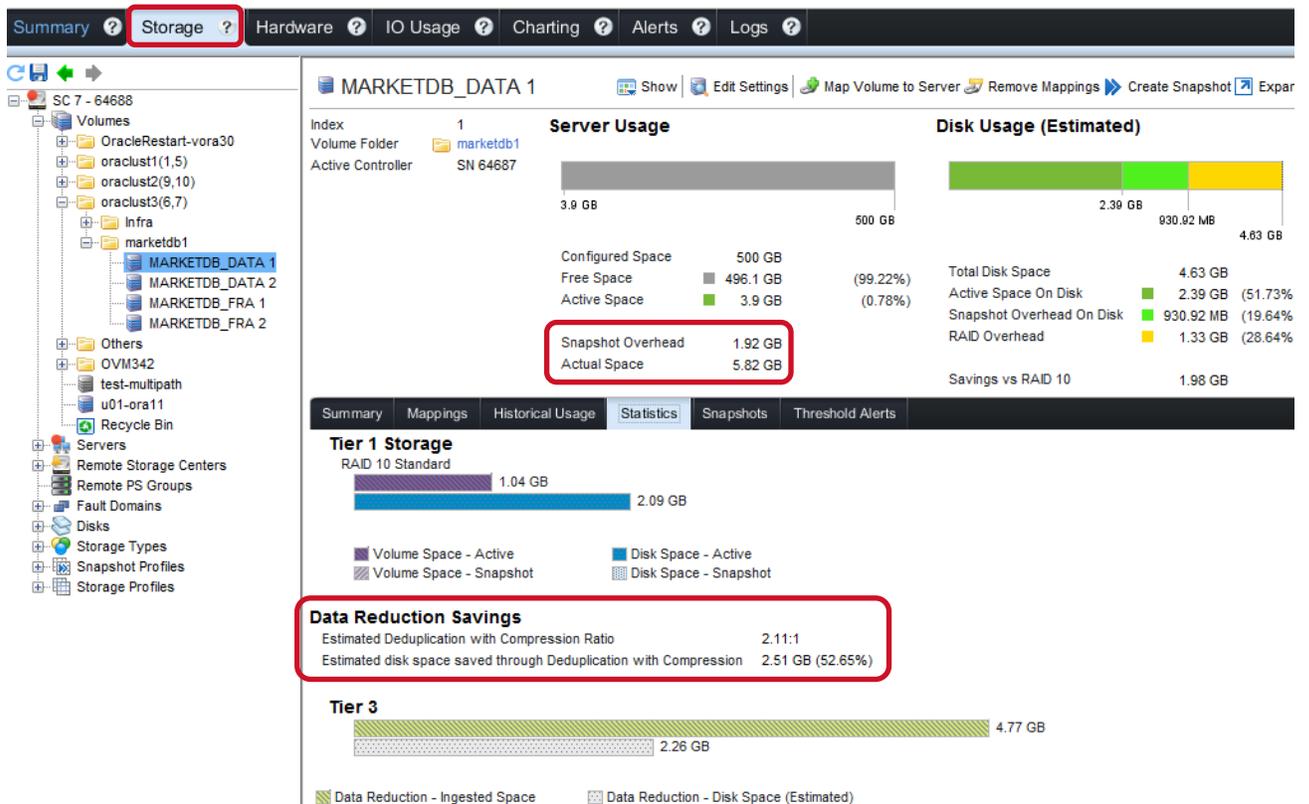


Figure 1 Data reduction savings information in DSM

### 3.3.2 Protecting Oracle with snapshots and a consistency group

The SC Series storage snapshot feature can be incorporated into the existing backup/restore strategy. Enabled through the **snapshot profile**, it protects an Oracle database by creating fast and space-efficient snapshots of the storage volumes. To access or restore data from a snapshot, a **view volume** is created and mounted with full access on any recovery system. A view volume shares the frozen pages with the parent volume and only changed data consumes storage. Changes to the view volumes do not affect their parent volumes. A view volume is treated like a regular volume in that it has its own volume attributes. A view volume is useful for:

- Offloading the backup processing from the primary server
- Creating a thin clone of a full-size production environment for testing, support, or troubleshooting
- Allowing for fast data recovery

If multiple storage volumes are used for a single Oracle database, the consistency group feature must be used along with the snapshots. If the entire Oracle database resides on a single volume, using a consistency group is not required.

The **consistency group** feature allows storage administrators to take a database-consistent snapshot when the **BEGIN/END BACKUP** database commands are invoked before and after each snapshot is taken. Make sure that all storage volumes (LUNs) that make up the database have the same **consistent snapshot profile** assigned. On the Oracle side, use **ALTER DATABASE BEGIN BACKUP** and **END BACKUP** before and after the snapshot is taken. Otherwise, Oracle might not be able to recover from a multi-volume snapshot.

### 3.3.3 Achieve greater storage efficiency with storage profiles

Automatic intelligent data placement is a stable feature of SC Series storage. Administrators only need to associate the volumes with one of the pre-defined **storage profiles** and SCOS handles the movement of data accordingly. Some storage profiles become available when certain storage media types are installed in an SC Series array. Table 1 and Table 2 summarize the available storage profiles.

Table 1 Storage profiles available with write SSDs and HDDs, or with HDDs only

Name	Initial write tier	Tier (T) and RAID levels	Progression
Recommended (All Tiers)	1	Writes: T1 RAID 10 Snapshots: RAID 5/RAID 6	To all tiers
High Priority (Tier 1)	1	Writes: T1 RAID 10 Snapshots: T1 RAID 5/RAID 6	Stay in tier 1
Medium Priority (Tier 2)	2	Writes: T2 RAID 10 Snapshots: T2 RAID 5/RAID 6	Stay in tier 2
Low Priority (Tier 3)	3	Writes: T3 RAID 10 Snapshots: T3 RAID 5/RAID 6	Stay in tier 3

Table 2 Storage profiles available with both write SSDs and read SSDs

Name	Initial write tier	Tier (T) and RAID levels	Progression
Flash Optimized with Progression (Tier 1 to All Tiers)	1	Writes: T1 RAID 10 Snapshots: RAID 5/RAID 6	To all tiers
Write Intensive (Tier 1)	1	Writes: T1 RAID 10 Snapshots: T1 RAID 10	Stay in tier 1
Flash Only with Progression (Tier 1 to Tier 2)	1	Writes: T1 RAID 10 Snapshots: T2 RAID 5	To tier 2
Low Priority with Progression (Tier 3 to Tier 2)	3	Writes: T3 RAID 10 Snapshots: T3 RAID 5/6 or T2 RAID 5	To tier 2
Low Priority (Tier 3)	3	Writes: T3 RAID 10 Snapshots: T2/T3 RAID 5/6	Stay in tier 3

To maximize the economics of storage and achieve a balance between performance and space efficiency, it is recommended to use a storage profile that allows data to progress to all tiers, such as **Recommended** or **Flash Optimized with Progression**. When a volume uses the **Recommended** profile, new data is written to tier 1 RAID 10 storage. Over time, less-active data is moved to tier 1 RAID5/RAID6 and lower tiers of storage.

For environments where performance is critical, ensure there are a sufficient number of drives and capacity in tier 1, then set the storage profile to **High Priority** or **Write Intensive**. This guarantees data is written to tier 1 RAID 10 storage and less-active data can only move to RAID5/RAID6 in tier 1. In the event that tier 1 storage is full, SCOS migrates data off to lower tiers to free up space.

More details on storage profiles can be found in the DSM *Storage Center Administrator's Guide*.

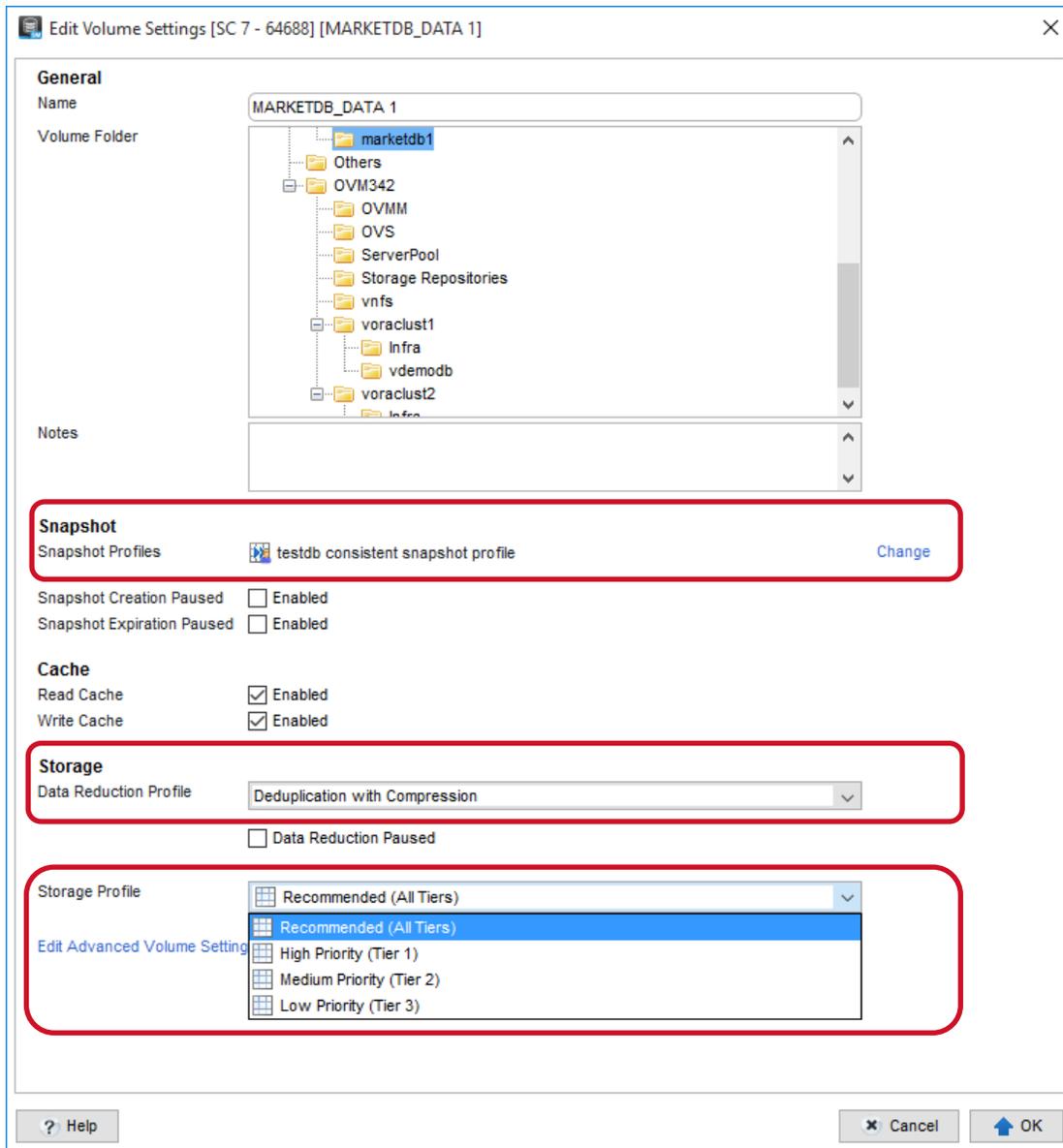


Figure 2 Volume attributes in DSM

### 3.4 Ingest data

By default, data ingestion goes to tier 1 in an SC Series array, but it might not be desirable to consume all tier 1 storage for the migration. A common practice is to direct data during ingestion to the lowest tier where capacity is abundant. In DSM, set the storage profile to **Low Priority** on each volume for the duration of the ingestion. After the migration is complete, change the storage profile to **Recommended** or **Flash Optimized with Progression**. This will allow Data Progression to start relocating the data to different tiers or RAID levels based on actual I/O patterns in the subsequent progression cycles.

## 3.5 Configure Oracle disk groups

This section describes some common practices when creating disk groups on an SC Series array.

### 3.5.1 Automatic Storage Management (ASM)

Oracle ASM is the preferred storage management system since Oracle version 11. It provides three levels of storage redundancy which allows data to be mirrored through its software. ASM distributes data files across all disks in an ASM disk group to maximize performance and can dynamically restripe data files when additional disks are added. In general, it is not necessary to mirror the data on the OS or inside ASM because the Data Protection is already provided by the SC Series array natively. Therefore, in most Oracle environments, it is recommended to use **External Redundancy** for ASM disk groups which reduces overall IOPS and results in better I/O performance. Additional guidelines include:

- Separate diskgroups should be used for data and archive logs.
- A database can span across multiple diskgroups.
- At least two volumes should be configured in each diskgroup.
- All volumes in the same diskgroup should have the same capacity and performance attributes.
- Diskgroups should be mounted and used by a database exclusively and not shared with other databases if possible. This simplifies using array-based snapshots for backup and recovery.

For more information on Oracle best practices with SC Series storage, see [Dell SC Series Storage with Oracle ASM Best Practices](#).

### 3.5.2 Linux Logical Volume Manager (LVM)

Similar to ASM, it is not necessary to mirror logical volumes in LVM. LVM allows striping data files across multiple volumes in a volume group. Unlike ASM, the striping needs to be configured by administrators explicitly, and automatic restriping is not available when extending a volume group in LVM.

### 3.5.3 Oracle data files

Oracle ASM works with SC Series volume thin provisioning by enabling the data file auto extensible feature. This allows the data files to start with a small size and to grow incrementally as data is written to the data files.

## 3.6 Understanding endian formats

Endianness refers to the format of how bytes of numeric values are ordered within memory. It is an important determining factor in the ability to migrate a database or transport tablespaces across platforms. There are several endian formats: little-, big-, or mixed-endian (middle-endian). Of the three formats, mixed-endian is rare and does not appear in the Oracle list of supported endian types for platform migrations. See section 3.6.2.

With little-endian, a numeric value is written or stored in memory with the smallest part (byte), or least significant part (byte), of the value first, followed by more significant parts (bytes) in successive order. In contrast, with big-endian, a numeric value is written or stored in memory with the most significant part (byte) first, followed by lesser significant parts (bytes). For example, given the value 4321<sub>10</sub> (10D7<sub>16</sub>), and 8-bit memory words, the value would be stored as follows:

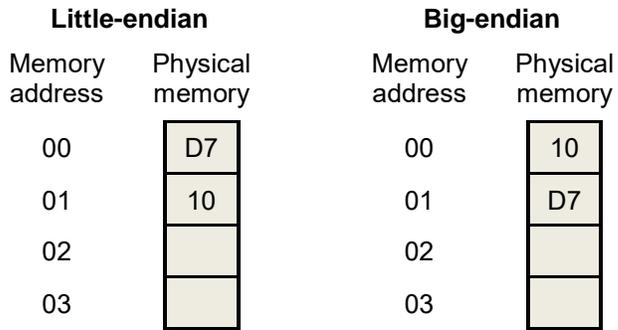


Figure 3 Little-endian and big-endian

Because endianness changes how numeric values are represented in memory, failures or corruption can occur during a migration if endianness is ignored. For further information on endian formats and descriptions, refer to the [Wikipedia Endianness page](#).

### 3.6.1 Determine the system endian format

There are many different methods to find out what the endianness is for a platform. Here are just a few examples to query the systems:

#### Using Linux command `lscpu` (provided by `util-linux` package)

```
lscpu | grep -i "byte order"
```

Return: Little Endian or Big Endian

#### Using Perl

```
perl -V:byteorder
```

Return: `byteorder='12345678'` for little endian  
`byteorder='87654321'` for big endian

#### Using Python™

```
python -c "import sys;print sys.byteorder"
```

Return: little or big

#### Using `od` command on Linux or Unix® systems

```
echo -n I |od -to2 |head -n1|awk '{print substr($2,6,1); exit}'
```

Return: 1 for little endian

Return: 0 for big endian

### 3.6.2 Determine the database endian format

To determine the endianness of the source 11gR2 or 12c database, the following query can be executed against dynamic views V\$TRANSPORTABLE\_PLATFORM and V\$DATABASE in both databases.

#### Query the endian format of a database

```
SQL> col platform_name format a36
```

```
select tp.platform_name, tp.endian_format from
       v$transportable_platform tp, v$database d where
       tp.platform_name = d.platform_name;
```

PLATFORM_NAME	ENDIAN_FORMAT
Linux x86 64-bit	Little

#### Show all Oracle-supported platforms and their endian formats

```
SQL> col platform_name format a36
```

```
SQL> set pages 50
```

```
select platform_name, endian_format from v$transportable_platform
order by platform_name;
```

PLATFORM_NAME	ENDIAN_FORMAT
AIX-Based Systems (64-bit)	Big
Apple Mac OS	Big
Apple Mac OS (x86-64)	Little
HP IA Open VMS	Little
HP Open VMS	Little
HP Tru64 UNIX	Little
HP-UX (64-bit)	Big
HP-UX IA (64-bit)	Big
IBM Power Based Linux	Big
IBM zSeries Based Linux	Big
Linux IA (32-bit)	Little
Linux IA (64-bit)	Little
Linux x86 64-bit	Little
Microsoft Windows IA (32-bit)	Little
Microsoft Windows IA (64-bit)	Little
Microsoft Windows x86 64-bit	Little
Solaris Operating System (x86)	Little
Solaris Operating System (x86-64)	Little
Solaris[tm] OE (32-bit)	Big
Solaris[tm] OE (64-bit)	Big

20 rows selected.

If the endianness of the source and target platforms have different endian formats, an additional step must be executed to correct data conversion of numeric values during a database. The additional step can be performed on either the source or target platform. Omitting this critical step will result in failures or corruption and unsuccessful migration. Refer to the Oracle knowledge base article, [How to Migrate to different Endian Platform Using Transportable Tablespaces With RMAN](#) (Doc ID 371556.1), for step-by-step instructions.

## 3.7 Selecting and executing the migration methodology

While there are many different ways to migrate a database, there is not one method that can address all situations. In many cases, it is not uncommon to use multiple methods in a complex database migration. To decide which method(s) to use, consider the following factors:

- System and database endian formats of source and target systems
- System OS on source and target systems
- Database version on source and target systems
- Windows of downtime

Table 3 summarizes some of the popular migration methodologies available. A brief description of each methodology follows after the table. Administrators are encouraged to explore each one and review the vendor's documentation as each method has its advantages and limitations.

Table 3 Migration methodology

OS platform/endian format	Migration methodology
Source and target are different	<ul style="list-style-type: none"> <li>• Transportable tablespaces (including cross-platform and full transportable, section 3.7.5)</li> <li>• Export/import facilities (including Data Pump, section 3.7.6)</li> <li>• RMAN (section 3.7.7)</li> <li>• Oracle Data Guard (section 3.7.8)</li> <li>• Oracle Golden Gate (section 3.7.9)</li> <li>• Streams Replication (section 3.7.10)</li> <li>• Oracle ASM (section 3.7.1)</li> </ul>
Source and target are the same	<ul style="list-style-type: none"> <li>• Oracle ASM (section 3.7.1)</li> <li>• Linux LVM (section 3.7.2)</li> <li>• Linux utilities (section 3.7.3)</li> <li>• Including the methodologies in the preceding row (source and target are different)</li> </ul>

### 3.7.1 Oracle ASM

When the database uses Oracle ASM, the storage can be swapped out in the following sequence using ASM online addition/removal and rebalance features:

1. New SC Series volumes are added to the existing disk groups and original volumes are dropped from the disk groups at the same time with a single command.
2. Data is rebalanced automatically by ASM.
3. No application/database outage occurs during the operations.
4. Progress can be monitored by querying the V\$ASM\_OPERATION.

The Oracle ASM command utility (ASMCMD) is a Unix-like command utility provided with Oracle ASM software. The **ASMCMD cp** command allows copying files between disk groups, ASM instances, and operating systems. It might be used in the following scenarios:

- When copying files between disk groups
- When copying files between ASM instances of the same or different endian formats
- When copying files from disk groups to the OS or from the OS to disk groups, which allows file-system-based data files to be migrated into ASM disk groups
- If the source consists of ASM files, ASM automatically converts the endian format when they are written to the target ASM disk group
- If the source consists of non-ASM files and the target ASM disk group has different endian format, the files must be copied or transferred to the target platform using other utilities such as the ones listed in section 3.7.3, and then the files are converted

**Note:** OCR and SPFILE file types cannot be copied with the ASMCMD cp command. Use the ocrdump, spcopy, or other database commands to copy these file types.

For more information on Oracle ASM, refer to *Oracle Automatic Storage Management Administrator's Guide* on the [Oracle Documentation Portal](#).

### 3.7.2 Linux LVM

When the database uses Linux LVM, the data on the LVM physical volume can be moved to a new volume online using the following steps:

1. Use the **pvcreate** and **vgextend** commands to add new SC Series volumes to the existing LVM volume group
2. Use the **pvmove** command to relocate the data online. For example:

```
pvmove /dev/mapper/LUN1 /dev/mapper/LUN2
```

3. Use the **pvremove** command to remove old volumes after migration is done.

### 3.7.3 Linux utilities

When the database uses the file system, Oracle data files might be copied to new storage on another system using native OS commands. Popular commands include: tar, cpio, cp, scp, and rsync.

Rsync is a very versatile file copying tool. It can be used to copy files locally or to or from a remote system. It can transfer data over the ssh protocol to protect the data during the transfer. It also uses a delta-transfer algorithm to identify and transfer only the differences between the source and target files.

Make sure to retain the original ownerships and permissions of the source files. Application and database downtime are necessary during the file transfer to ensure the consistency of the data.

### 3.7.4 Oracle SQL Developer

This is a free developer tool developed by Oracle. The Oracle SQL Developer tool:

- Includes a simple graphical user interface that eases management of the Oracle database.
- Has gone through many significant changes over the years as Oracle continues to advance and introduce new features.
- Provides a simple visual presentation of data, table, indexes, and other database objects; it is useful for analyzing and scoping of the data migration
- Supports migrating non-Oracle databases to Oracle; a list of supported non-Oracle databases to migrate to the Oracle database can also be found at <http://www.oracle.com/technetwork/developer-tools/sql-developer/supportedmigplatforms-086703.html>.
- Has a dedicated Oracle website that addresses migrating to a non-Oracle database; SQL Developer downloads, white papers, documentation, and video tutorials can be found at <http://www.oracle.com/technetwork/database/migration/index.html>

### 3.7.5 Transportable Tablespaces

Transportable Tablespaces (TTS) is a powerful feature designed to ease the movement or migration of databases between versions and platforms. The following describes the different types of TTS:

**Transportable Tablespaces (TTS):** Originally introduced in Oracle 8i, this is considered to be the fastest way to move large amount of data between two Oracle databases up to Oracle 11gR2. Data files are copied between the two databases instead of exporting and importing. However, objects in SYSTEM and SYSAUX tablespaces cannot be copied and must be rebuilt in the target database during the migration. It does not support cross-platform, cross-endianness migration.

**Cross-platform Transportable Tablespaces (XTTS):** An improvement over TTS was introduced in Oracle 10g which added the support of cross-platform and cross-endianness migration. RMAN Convert is invoked, either on the source or target database, to convert the data. However it still cannot migrate objects in SYSTEM and SYSAUX tablespaces.

**Full Transportable Export/Import:** New in Oracle 12c, Full Transportable combines the best of TTS, XTTS, and Data Pump Export and Import features. It addresses the complexity and the speed of the migration process and the inability of transport objects in SYTEM and SYSAUX tablespaces. RMAN Convert is invoked to convert the data across platform and endianness. When combined with RMAN incremental backups, database downtime can be further reduced.

Refer to the following documents and knowledge base articles for more information. Some references may require an Oracle login.

- [Master Note for Transportable Tablespaces -- Common Questions and Issues \(Doc ID 1166564.1\)](#)
- [Transportable Tablespace Restrictions and Limitations: Details, Reference, and Version Where Application \(Doc ID 1454872.1\)](#)
- [UPGRADING FROM ORACLE 11GR2 TO ORACLE 12C USING FULL TRANSPORTABLE EXPORT AND IMPORT](#)
- [Full Transportable Export/Import with RMAN Incrementals](#)

### 3.7.6 Oracle export and import facilities

These facilities include the original Export and Import, Data Pump Export and Import, and the Full Transportable Export and Import features as mentioned in section 3.7.5.

- Full Transportable Export/Import is the preferred choice when migrating into an Oracle 12c database.
- For other Oracle versions, Data Pump Export and Import (introduced in 10g) is preferred over the original Export and Import feature because Data Pump offers faster speed and better efficiency in processing large amount of data.
- Use the original Export and Import feature only when the first two choices are not possible. See [Oracle Database Utilities](#) for more information.
- For administrators who prefer a graphical interface with a step-by-step guide, Oracle SQL Developer offers an easy-to-follow Data Pump Export and Import Wizard.

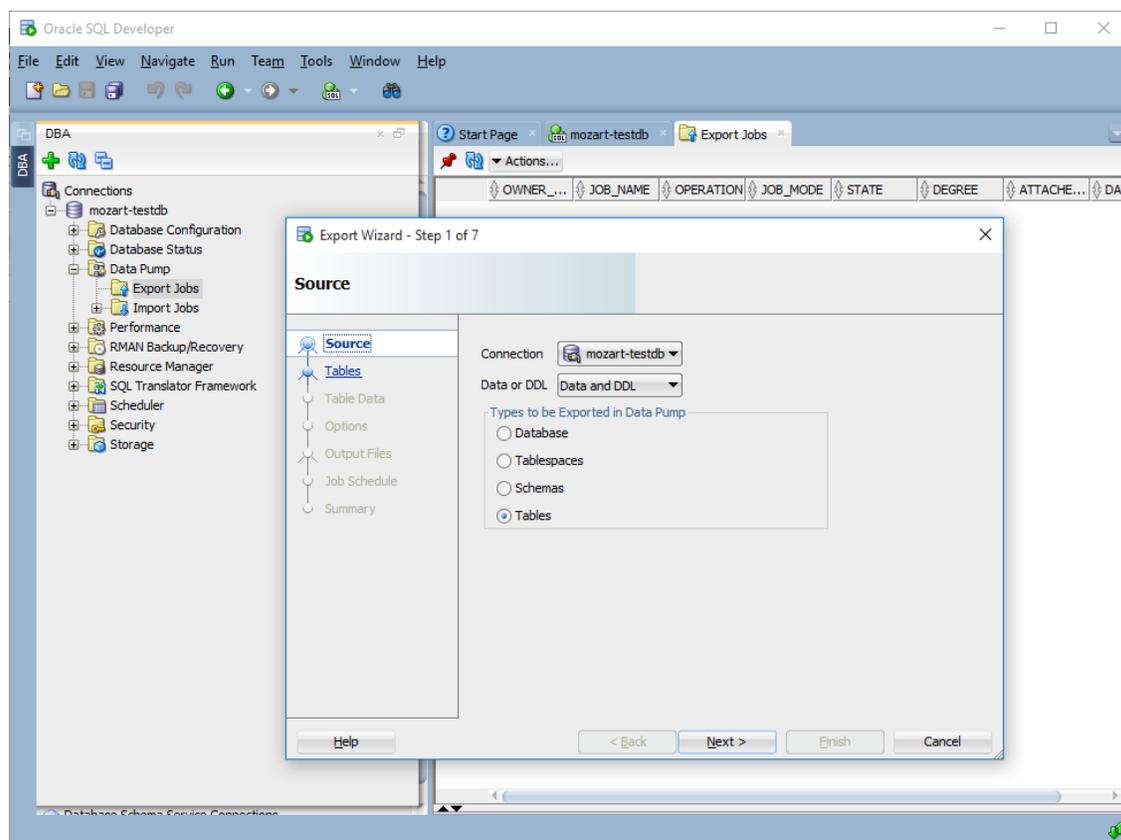


Figure 4 Oracle SQL Developer Export Wizard

### 3.7.7 RMAN

RMAN is a very versatile database backup restore utility that works on versions of Oracle database from Oracle 8 onward. It can be paired with Transportable Tablespaces feature to achieve minimal downtime database migration as mentioned in section 3.7.5. Other RMAN options might be considered to assist in the migration process.

- Use the RMAN FOR TRANSPORT or TO PLATFORM clause to create a cross-platform backup which can be restored and recovered on the target platform that has a different endian format. Supported target platforms are listed in V\$TRANSPORTABLE\_PLATFORM view.
- Use the RMAN CONVERT DATAFILE or RMAN CONVERT TABLESPACE clause to convert the endianness of data files or tablespaces on the target host.
- Use the RMAN CONVERT DATABASE clause to transport an entire database to the new platform but the target platform must have the same endian format as the source.
- Leverage existing RMAN database backups and use the RMAN RESTORE and RECOVER clauses to permanently move a database to a new host.
- Oracle 12c added support for cross-platform database transport using RMAN backup sets to different endian platform. See the Oracle knowledge base article [Doc ID 2013271.1](#) for more information.
- Use the RMAN RESTORE FROM PLATFORM clause to restore a pre-12c backup to a 12c database on a different endian platform. See the Oracle knowledge base article [Doc ID 1644693.1](#).

For more information on using RMAN, refer to the *Oracle Database Backup and Recovery User's Guide* on the [Oracle Documentation Portal](#).

### 3.7.8 Oracle Data Guard

Oracle Data Guard is typically deployed as a high availability solution in an environment where the primary and physical standby databases are running on the same OS platform. However Data Guard can also be deployed in certain heterogeneous configurations and is useful as a cross-platform database migration method. The Oracle knowledge article [Data Guard Support for Heterogeneous Primary and Physical Standbys in Same Data Guard Configuration \(Doc ID 413484.1\)](#) details the supported cross-platform combination in the same Data Guard configuration.

To migrate a database, first set up a physical standby on the target platform and let it fully sync up to the primary. After it is fully in sync, perform a role swap which turns the standby database into the primary database. Because of this, it is one of the most seamless migration methods which requires little to no downtime to the applications.

### 3.7.9 Oracle GoldenGate

Oracle GoldenGate is a powerful software that allows information exchange, transformation, and replication between heterogeneous platforms. With its replication features, administrators can copy the database, keep the source and target databases in sync, and upgrade the database on the target without affecting the primary database. The Oracle white paper, [Zero Downtime Upgrade Using Oracle GoldenGate](#), explains how it can be achieved with GoldenGate.

### 3.7.10 Oracle Streams Replication

Oracle Streams has been deprecated in Oracle 12c, though it is still available in 11g. Oracle positions GoldenGate as its successor. It is designed to share information by capturing and queuing messages in one database, propagating them to another database, and then consuming them in the target database. Data can also be transformed as part of the workflow. Similar to GoldenGate, the replication is continuous and therefore application downtime is minimal to switch over the application and users.

For more information on Oracle Streams, refer to [Master note for Streams Setup and Administration \(Doc ID 789445.1\)](#) and [Streams Replication Administrator's Guide](#).

### 3.7.11 Quest Shareplex

Shareplex by Quest is a high-performing, feature-rich database replication alternative to Oracle GoldenGate and Oracle Streams. It offers many high availability features, data migration functionalities, and flexible heterogeneous replication of different OS platforms and databases. Find out more about its capability at the official website: <https://www.quest.com/products/shareplex/>.

## 4 Conclusion

Dell EMC SC Series storage works with many different OS platforms and the simplicity in management helps reduce the complexity of storage management in the migration process. This frees up valuable time for administrators to focus more on the migration work that is performed mostly on the OS and Oracle layers and uses many of the Oracle and Linux native tools. Once the database is migrated to SC Series storage, it benefits immediately from the advanced storage virtualization feature which ensures that the data is automatically spread evenly across all drives at all times and intelligently places data at the most optimal tier while maximizing data efficiency with features like compression and deduplication. Compared to traditional storage arrays, the SC Series enhances Oracle databases by eliminating the need to manually organize the data files or tables in different storage media and the data is continuously self-optimizing with Data Progression and storage profiles. The fast and space-efficient thin snapshots provide additional database protection which improve data recovery time objective dramatically. SC Series hardware is fully redundant to handle hardware failure and most of the storage operations can be performed online transparent to the Oracle database, hence increasing the uptime and reliability of the environment.

# A Technical support and resources

[Dell.com/support](http://Dell.com/support) is focused on meeting customer needs with proven services and support.

[Storage technical documents and videos](#) provide expertise that helps to ensure customer success on Dell EMC storage platforms.

## A.1 Additional resources

Referenced or recommended Dell EMC publications:

- *Dell Storage Center OS 7.0 Data Reduction with Deduplication and Compression*
- *Oracle Backup and Recovery Best Practices for Dell SC Series Storage*
- *Oracle OLTP with Dell Storage SC4020 All-flash Optimized Arrays*
- *Dell Storage Center Replication and Oracle Data Guard*
- *Dell SC Series Storage with Oracle ASM Best Practices*
- *Dell EMC SC Series Arrays and Oracle*
- *Dell SupportAssist for SC Series Arrays*
- *Dell Storage PowerShell SDK Cookbook*
- *Dell SC Series Storage: Synchronous Replication and Live Volume*

Referenced or recommended Oracle publications:

- [Migrate to Oracle Database with SQL Developer](#)
- [Oracle SQL Developer Migrations: Supported Platforms](#)
- [Migration Of An Oracle Database Across OS Platforms \(Doc ID 733205.1\)](#)
- [Migrating Non-Oracle Databases and their Applications to Oracle Database 12c](#)
- [Successful Data Migration](#)
- [How to Create Transportable tablespaces Where the Source and Destination are ASM-Based \(Doc ID 394798.1\)](#)
- [Master Note for Transportable Tablespaces \(TTS\) – Common Questions and Issues \(Doc ID 1166564.1\)](#)
- [Transportable Tablespace Restrictions and Limitations: Details, Reference, and Version Where Application \(Doc ID 1454872.1\)](#)
- [How to Migrate to different Endian Platform Using Transportable Tablespaces With RMAN \(Doc ID 371556.1\)](#)
- [UPGRADING FROM ORACLE 11GR2 TO ORACLE 12C USING FULL TRANSPORTABLE EXPORT AND IMPORT](#)
- [Full Transportable Export/Import with RMAN Incrementals](#)
- [Transporting Tablespaces Between Databases – Oracle Database Administrator’s Guide 11g Release 2](#)
- [Platform Migration Using Transportable Tablespaces: Oracle Database 11g Release 1](#)
- [Database Backup and Recovery User’s Guide 12c Release 1](#)
- [12c How Perform Cross-Platform Database Transport to different Endian Platform with RMAN Backup Sets \(Doc ID 2013271.1\)](#)
- [How to restore a pre-12c backup to a cross-platform, cross-endian 12c database \(Doc ID 1644693.1\)](#)
- [Oracle Database Utilities \(Export/Import, Data Pump\)](#)
- [SQL Developer User’s Guide 12c Release 1](#)

- [Data Guard Support for Heterogeneous Primary and Physical Standbys in Same Data Guard Configuration \(Doc ID 413484.1\)](#)
- [Methods for Upgrading to Oracle Database 11g Release 2](#)
- [Upgrading to Oracle Database 12c \(12.1.0.2\)](#)
- [Changing between 32-bit and 64-bit Word Sizes \(Doc ID 62290.1\)](#)
- [Zero Downtime Upgrade Using Oracle GoldenGate](#)

Other references:

- [Wikipedia Endianness page](#)