Dell Compellent Data Progression & Thin Provisioning with Oracle Databases

Dell Compellent Best Practices

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Document Revision

Table 1. Revision History

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<tr>
<td>11/14/2011</td>
<td>A</td>
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<td>B</td>
<td>Content and format change</td>
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**Introduction**

Today's databases are increasing in magnitudes of size when compared to what was a very large database ten years ago. A leading publication specializing in database management indicated that in 2004 the largest database was 30 TB, three-fold in size to the top decision-support database of 2001. Just a year later in 2005, a consulting firm that specializes in scalability of data management systems indicated that from 2003 to 2005 the largest data warehouse tripled in size exceeding 100 TB. Then in 2008, it was reported that a solutions provider in the telecommunications industry had a 310-TB Oracle database. McKinsey & Company, a consulting firm, stated that the average investment firm with fewer than 1,000 employees has 3.8 petabytes of stored data. \(^1,2,3\)

It’s no surprise then that there is much attention given by business and IT decision makers to primary storage in terms of the pressures the vast amounts of storage places on IT infrastructure, capacity, performance, data deduplication, compression, archiving, as well as IT staff responsibilities for storage administration, and lastly, perhaps the largest issue: allocated but unused storage. Of the allocated and used storage, one will see a percentage of the data not being accessed over a period of time and would-be candidate for some sort of lower tiered storage, which in many data centers is not being performed.

This document discusses how Dell Compellent Storage Center features: Thin Provisioning and Data Progression, eliminate the pressures of allocated but unused storage, and the improper use of more expensive disk being used to store infrequently used data.

**Customer support**

Dell Compellent provides live support 1-866-EZSTORE (866.397.8673), 24 hours a day, 7 days a week, 365 days a year. For additional support, email Dell Compellent at support@compellent.com. Dell Compellent responds to emails during normal business hours.

**Document Conventions**

<table>
<thead>
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<th>Item</th>
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<tr>
<td>Menu items, dialog box titles, field names, keys</td>
<td><strong>Bold</strong></td>
</tr>
<tr>
<td>Mouse click required</td>
<td><strong>Click</strong></td>
</tr>
<tr>
<td>User Input</td>
<td><strong>Monospace Font</strong></td>
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<tr>
<td>User typing required</td>
<td><strong>Type:</strong></td>
</tr>
<tr>
<td>System response to commands</td>
<td><strong>Blue</strong></td>
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</table>

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Notes are used to convey special information or instructions.

Timesavers are tips specifically designed to save time or reduce the number of steps.

Caution indicates the potential for risk including system or data damage.

Warning indicates that failure to follow directions could result in bodily harm.

**Audience**

This paper is intended for storage administrators, database administrators, system administrators and architects who analyze, design, and manage database and storage systems.

Readers should be familiar with Compellent Storage Center and have knowledge with and prior experience in configuring and operating the following:

- Oracle Architecture
- Oracle 10g and 11g
- General understanding of SAN technologies
Features of Dell Compellent Storage Center

Dynamic Capacity (Thin Provisioning)

Dell Compellent thin provisioning software, Dynamic Capacity, delivers the highest enterprise storage utilization possible by eliminating pre-allocated but unused capacity. Dynamic Capacity completely separates allocation from utilization, enabling users to provision any size volume upfront yet only consume disk space when data is written. Thin Write technology assesses the incoming payload and designates capacity for each write on demand, leaving unused disk space in the storage pool for other servers and applications. For more in-depth information, refer to Dell Compellent technical white paper available on the website⁴.

Data Progression™

Dell Compellent Data Progression dynamically moves enterprise data to the optimal tier based on actual use. The most active blocks reside on high-performance SSD, Fibre Channel or SAS drives, while infrequently accessed data migrates to lower-cost, high-capacity SAS drives. The result is network storage that remains in tune with application needs, with overall storage costs cut by up to 80%. For more in-depth information, refer to Dell Compellent technical white paper available on the website⁵.


⁵
Overview of Oracle Storage

Oracle requires the use of both physical and logical structures for storage. Physical structures are the files that make up the database. They consist of control files, redo logs, archive logs, datafiles, tempfiles and other miscellaneous files. Datafiles store the application data, indexes, and meta-data that describe application data. There are several different logical structures used by Oracle to store this information. At the highest logical level is the tablespace. Its existence is purely logical and is nothing more than a collection of one or more logically related datafiles. At the next logical level is the segment. Segments define a particular type of data collected or used by the database. The two most known segments are the table and index. A single segment or multiple logically related segments of the same type should reside in the same tablespace. Progressing to the next logical level is the extent. An extent is a collection of contiguous Oracle blocks and is the smallest unit of storage allocated by Oracle. Within the extent is the smallest logical unit, the Oracle data block, which represents a specific number of bytes of physical storage. The Oracle data block contains the actual user data, indexes, or metadata of an application.

When Oracle receives a request to increase its physical storage, such as adding a 100 GB file to an existing tablespace, Oracle does not thin provision the storage. Oracle pre-allotizes and formats all space within the file. Assuming an application requests a 5 GB portion of the file, the disk consumption of that file on disk remains at 100 GB.

A more efficient way to allocate storage in the above example would be to use Oracle’s AUTOEXTEND clause and create a 5 GB file. Oracle would then only extend the file size should it have a need to.

Figure 3: Oracle Allocated and assigned file space

A more efficient way to allocate storage in the above example would be to use Oracle’s AUTOEXTEND clause and create a 5 GB file. Oracle would then only extend the file size should it have a need to.

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There may be performance considerations when using AUTOEXTEND if Oracle frequently extends files in very small pieces. Also, appropriate infrastructure architecture should be in place to support the AUTOEXTEND feature.

With traditional storage, data is written to the same RAID type and tier. If one creates an oracle tablespace on the most expensive RAID and tier (RAID 10 tier 1), all application data in that tablespace, including less frequently accessed data which is suited for a less costly RAID and tier, would experience the same cost to the business. Using more expensive RAID and tier 1 storage for less frequently access data normally occurs in databases as data ages and is never migrated to a lower storage tier.
Merging Thin Provisioning, Data Progression and Oracle

Putting It together
An Oracle Real Application Cluster (RAC,) or standalone database, contains multiple physical files, which can reside on either traditional file systems or on raw devices. With traditional file systems, LUNs are created and managed by a volume manager like LVM, and the storage for that volume is allocated even though it contains no data. If additional storage is needed, UNIX and storage administrators have to perform numerous and repetitive tasks to change the disk geometry.

Dell Compellent Thin Provisioning allows one to manage storage more effectively and efficiently, giving the UNIX and storage administrators more time to concentrate on business-critical needs. With Thin Provisioning, storage administrators are able to initially create volumes as large as possible and have the system only consume the amount of disk actually consumed by the data. Although Oracle does not thin provision storage, it works in harmony with Dell Compellent Thin Provisioning. If Oracle’s AUTOEXTEND clause is used, Oracle will only request additional disk space from the file system when a segment, like a table, requests it and only in the size determined by the extent size of the segment.

Thin provisioning can be used with any of the volumes used by an Oracle database. An argument could be made that Dell Compellent should be configured with at least three volumes for every Oracle database. The three volumes would be delegated to redo logs, archive logs, and datafiles. Additional volumes can be shared between databases, providing there is application and business justification. In the example to the left, Oracle was requested to create a 5 GB file and to store 5 GB data in the file. After the initial 5 GB of data was written to the file, when Oracle tries to write the next 8 kb, Oracle will request the OS to allocate another 5 GB to the file. The OS in turn requests Thin Provisioning to allocate the requested size to the file, making the total file size 10 GB.
Dell Compellent automated tiered storage is automatically and optimally aligned with business needs and offers substantially more return on investment, including lower drive counts, power consumption and cooling costs than traditional storage. With its holistic approach to managing storage, Data Progression seamlessly eliminates the manual data classification and migration of inactive blocks of data between tiers.

In an Oracle database there are varying degrees of inactive data ranging from infrequently accessed tables to archive logs. Archive logs, which are copies of redo logs, are created by Oracle’s background process ARChive and are used only for database recoveries. As such, they are excellent candidates for Data Progression. ARChive receives requests to copy redo log files to designated media on a frequency prescribed by the volume of updates. Under heavy database processing one could see numerous archive logs being generated. Unless archive logs are manually managed, they will consume a tremendous amount of tier-one storage. However, using Data Progression’s holistic approach they will automatically progress to less costly disk, which is more appropriately aligned with their infrequent usage, and free up tier one disk for frequently accessed data.

Infrequently accessed tables are candidates for Data Progression as well, but remember that once data has been migrated to lower-tiered disks, one might encounter higher read latency due to different disk characteristics. If the same data on lower-tiered disks is read multiple times, it will migrate back to higher-tier disks, thereby eliminating the higher latency times.

Generally speaking, aside from archive logs and infrequently accessed tables, the remaining Oracle file types (control, system, sysaux, undo, rollback, temp, redo) are candidates for higher-tier storage.

**Conclusion**

Integrating Dell Compellent features in an Oracle environment reduces the total cost of ownership for the database and application, improves data protection and performance over traditional storage solutions, and provides greater efficiencies in storage management, yielding greater ROIs to the business.