Reduce Costs and Improve Operations by Upgrading to Oracle Database 11g with Oracle Storage
Executive Summary

With extended support for Oracle Database 10g only a few months away (July 2013 as of this writing), it’s time to consider a strategy for upgrading to Oracle Database 11g. Oracle Database 11g enables IT professionals to deliver more information with higher quality of service while making more efficient use of IT budgets and reducing the risk that changes in the IT environment will disrupt the production database. In many cases, the servers and storage systems running Oracle Database 10g (or earlier versions) are also nearing end of life, making now an ideal time to upgrade not only the database but also the server and storage infrastructure. To get the highest performance and best TCO from Oracle Database 11g, Oracle recommends deploying it with Oracle’s Sun ZFS Storage Appliance and Pillar Axiom storage platforms.

Oracle’s optimized storage platforms have been engineered to work together with Oracle Database and related applications to reduce costs and optimize overall system and application performance. Competitive storage systems lack integration with the database and application software, so they do not have the capability to deliver the performance and cost savings that can be achieved with an optimized environment from Oracle. Oracle storage solutions can increase the benefits of Oracle Database 11g by:

• Increasing performance through Oracle’s optimized hardware and software stack

• Reducing complexity, resulting in improved operations and lower operating costs

• Reducing storage costs with a smaller storage footprint made possible by 6-15x greater storage efficiency

This white paper gives a high-level overview of the major benefits of Oracle Database 11g and then explains why deploying Oracle Database 11g with Oracle’s optimized storage systems enables higher service levels and much lower costs than previously possible.
Why Upgrade to Oracle Database 11g?

Upgrading to Oracle Database 11g provides the latest in efficient, reliable, secure data management for mission-critical online transaction processing applications and query-intensive data warehouses as well as content management and Web 2.0 applications. Many readers may already be familiar with the capabilities in Oracle Database 11g that enable greater consolidation to reduce server hardware costs by up to 5x. Oracle Real Application Clusters (Oracle RAC) and the Oracle Exadata Database Machine are two common approaches for deploying consolidated applications within a single shared database grid or private cloud. Both approaches can help reduce hardware costs by enabling consolidation while offering increased availability, faster performance, and flexible scalability.

What is less known is that the storage environment chosen for Oracle Database 11g deployments can also have a big impact on cost savings and operational efficiency. The following Oracle Database 11g advanced features are key to delivering these benefits:

- **Oracle In-Memory Database Cache**
  Oracle In-Memory Database Cache allows data to be cached and processed in the memory of the applications themselves, offloading the data processing to middle tier resources. This not only takes advantage of underutilized resources that may be available in the application (or middle) tier but also removes any network latency between the middle tier and the back-end database. As a result, individual transactions can often be executed up to 10 times faster.

- **Oracle Direct NFS**
  Oracle Direct NFS (dNFS) is an integrated, high-performance NFS client for Oracle Database 11g. dNFS optimizes NFS for database performance and includes load balancing technology that makes it easier for administrators to get maximum performance out of multiple I/O ports that connect storage systems to Oracle Database. It also simplifies management by eliminating the need for complex NFS and TCP tuning. In addition, dNFS dramatically increases CPU efficiency for transferring data with the NFS protocol. The result is shorter I/O response time, higher I/O throughput, less CPU consumption, and less management effort.

- **Oracle Advanced Compression Option**
  Oracle Advanced Compression Option (ACO) includes multiple compression technologies and is specifically designed to address performance and space requirements for both transactional data (OLTP) and data warehousing environments. ACO typically provides a 2x to 4x reduction in structured and unstructured data storage across all environments such as production, standby, test, development, disaster recovery, or backup. Both Oracle and third party storage platforms can take advantage of Oracle Advanced Compression Option.

- **Hybrid Columnar Compression**
  Oracle’s Hybrid Columnar Compression (HCC) is typically used with read-only data such as data warehouse tables. It provides generous space savings but does require some CPU overhead. A logical construct, called the compression unit, is used to store a set of HCC-compressed data. When data is loaded, groups of rows are stored in columnar format, with the values for a given column stored and compressed together. After the column data for a set of rows has been compressed, it is
fit into the compression unit. Storing column data together, with the same data type and similar characteristics, dramatically increases the storage savings achieved from compression. Typical HCC compression ratios range from 6x to 15x, depending on the type of HCC compression used. HCC not only generates a storage efficiency savings of 6x to 15x but using HCC also means that I/O traffic to and from storage can typically be reduced by 6x to 15x. The reduction in I/O traffic can yield a significant improvement in query performance. These dramatic gains in performance and space efficiency, due to Hybrid Columnar Compression, are only available when Oracle Database 11g is deployed with Oracle storage platforms.

- **Oracle Advanced Security**
  Oracle Advanced Security provides a comprehensive, easy-to-deploy solution for protecting all communication to and from an Oracle Database. It can be used to transparently encrypt data at all levels: data in transit on the network, data at rest on physical storage, and data contained in backups. A new security feature in Oracle Database 11g is tablespace encryption. Tablespace encryption is integrated with Hybrid Columnar Compression and Oracle Advanced Compression Option so that database tables can be both compressed and encrypted, enabling secure in-database archiving. Compression is applied before the encryption so that encryption does not negatively impact the compression ratio. Both native network encryption and SSL-based encryption are supported.

- **Oracle Database Vault**
  Oracle Database Vault controls access to applications and database data. Access controls can be transparently applied underneath existing applications. Users can be prevented from accessing specific application data or given specific time windows, such as not being able to access the database outside of normal business hours. Separation-of-duty requirements can also be enforced for different DBAs and other highly privileged users without a costly “least privilege” exercise.

- **Oracle Database Firewall**
  Oracle Database Firewall provides a first line of defense to prevent sophisticated internal and external attacks from reaching their enterprise databases. Oracle Database Firewall establishes a defensive perimeter around databases, monitoring and enforcing normal application behavior in real-time, helping to prevent SQL injection attacks and unauthorized attempts to access sensitive information.

- **Oracle Exadata Database Machine**
  Oracle Exadata is an optimized and preconfigured package of software, servers, and storage that has been engineered and optimized to deliver extreme performance for Oracle Database with online transaction processing (OLTP), data warehousing, and mixed workloads. Oracle Exadata can offer 10 to 100 times faster performance than traditional database server infrastructures and is an ideal platform for private cloud database consolidation.

- **Optimizations for increased parallelization and in-memory execution of data queries**
  Oracle Database includes optimizations such as parallel operations, bit-mapped indexing, and integrated ETL, OLAP, and data mining capabilities. These optimizations have been extended in Oracle Database 11g Release 2 to include automatic optimization of parallelization. The database uses current resource availability to determine whether it is more effective to queue a query for later
execution or immediately queue parallel statements. Oracle Database 11g also automatically distributes tables into available memory across all the servers in the cloud to enable parallel query processing using data in memory on the individual nodes.

The remaining sections of this paper describe how migrating to Oracle Database 11g can be of even greater value when the database is paired with Oracle’s optimized storage, which includes Pillar Axiom 600 storage systems and Sun ZFS Storage Appliances.

For further information about the benefits of Oracle Database 11g, refer to the Oracle white paper “Lowering Your IT Costs with Oracle Database 11g Release 2,” which is listed in the resources at the end of this paper.

**Improve Query Performance Without DBA Tuning**

One of the primary benefits of using Oracle storage platforms with Oracle Database 11g is that they provide more efficient handling of I/O and faster performance because of Oracle’s optimized hardware and software stack. Less data is being moved to and from the storage platform during query requests, so response time is much faster. Faster query performance means that DBAs can focus on other important tasks rather than spending time tuning and optimizing query performance.

Oracle Advanced Compression Option and Hybrid Columnar Compression are “database-aware” compression technologies that allow the data to be transferred between the storage and server in the native compressed format. The data remains compressed not only on disk but also in the Database Smart Flash Cache, on the network, and in the database server buffer cache. Compressed data is even transferred during Oracle Recovery Manager (Oracle RMAN) backups and log shipping with Oracle Active Data Guard. Figure 1 illustrates some of the primary ways that compressed data creates space and performance efficiencies when flowing between the various components of an enterprise database environment based on Oracle technologies.
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Figure 1. Database tables are maintained in compressed format throughout Oracle systems and for network transfers.

In some cases, performance improvements can be so dramatic that completely new ways of using enterprise applications and data are enabled. Hybrid Columnar Compression can typically provide significantly higher performance, making it possible to use much larger data sets or add reports that would have been impractical at yesterday’s performance and cost levels. Some examples of incremental revenue opportunities include the following:

- The extra capacity for reports means that businesses can consider offering new services such as customized reports at premium rates.
- The ability to get real-time responses to complex queries on large data sets can change the way that marketing promotions are done, allowing them to be more targeted and/or more accurate.
- Faster performance improves user productivity and enables better, faster decision making for demand generation activities. The results of an initial query often lead to more questions, so fast query performance can allow for additional investigation that helps provide the right evidence to support good decision-making in real-time.

Reduce Storage Costs with Oracle Compression Technologies

Oracle's optimized storage platforms enable organizations to purchase less storage capacity because database tables are stored and maintained in compressed formats. It is quite common for organizations to make use of both Hybrid Columnar Compression and Advanced Compression Option for the same database. Cold data (infrequently modified, mostly query-only data) can be compressed using Hybrid
Columnar Compression to achieve big space savings while warm (OLTP) data compressed using Oracle Advanced Compression Option enables additional savings.

Database tables that have been created with Hybrid Columnar Compression can retain their space savings when stored on Oracle’s optimized storage platforms whereas third party storage platforms cannot take advantage of Hybrid Columnar Compression. Advanced Compression Option works across all storage platforms, providing space and cost savings for both Oracle and third party storage platforms. Based on Oracle testing, the savings from Hybrid Columnar Compression alone can often provide approximately a 40 percent storage efficiency advantage for Oracle storage platforms.

6x to 15x Capacity Savings Typical with Hybrid Columnar Compression

The use of Hybrid Columnar Compression typically results in a 6x to 15x storage capacity savings for the compressed tables and often yields total storage capacity savings of 40 percent or more compared to competitive storage platforms. Third party storage platforms often support other compression techniques and deduplication approaches, but these “database-unaware” approaches typically do not provide a significant efficiency gain for Oracle database tables. Only Oracle storage platforms provide “database-aware” integration with the Hybrid Columnar Compression enabling database tables to be stored in HCC compressed format.

As mentioned in the previous section, Hybrid Columnar Compression is typically used with query-only or historical data where writes or modifications are limited or not expected. More active data can be compressed using the compression techniques available in the Oracle Advanced Compression Option.

2x to 4x Storage Efficiencies with Oracle Advanced Compression Option

Advanced Compression Option reduces storage costs not just for database files, but for backups (via a better RMAN compression algorithm) and data pump dumpfiles. It also can be used in a Data Guard environment to reduce network traffic by compressing the redo stream. Compressing the redo stream is a technique primarily used by organizations that have high-latency or low-bandwidth connections between their primary and standby databases.

An important new feature in Advanced Compression Option with Oracle Database 11g is OLTP Table Compression, which allows table data to be compressed during all types of data manipulation operations. OLTP Table Compression leverages a sophisticated and intelligent algorithm that minimizes compression overhead during write operations, thereby making it viable for both data warehouse and highly transactional workloads.

The Advanced Compression Option of Oracle Database 11g also includes compression and deduplication technologies that drastically reduce the storage footprint of SecureFiles data. SecureFiles, a feature included in Oracle Database 11g, offers an architecture for storing unstructured content, such as documents, spreadsheets, and XML files. SecureFiles is specifically engineered to deliver high performance for file data to achieve throughput that is comparable to traditional file systems. Yet it retains the advantages of managing the data within the Oracle database.

It is quite common for applications to store exact replicas of files, such as when multiple users save the same email attachment. SecureFiles Deduplication is an intelligent technology included with the
Advanced Compression Option, and it eliminates duplicate copies of SecureFiles data. Advanced Compression Option also provides another mechanism to control the size of SecureFiles data. SecureFiles Compression utilizes industry-standard compression algorithms to further minimize the storage requirements of SecureFiles data.

The typical compression ratio for data compressed using Advanced Compression Option is in the range of 2x to 4x. With SecureFiles Compression, files such as documents or XML files experience a size reduction of 2x to 3x. SecureFiles Compression automatically avoids compressing data that would not benefit from compression. For instance, a document that was compressed via a third party tool before being inserted into the database as a SecureFiles file would not be compressed again.

Operational Improvements That Yield Additional Savings and Advantages

Deploying Oracle Database 11g with Oracle storage platforms can also help improve operations through network efficiencies and easier management of the database storage environment. While storage costs are an obvious tangible benefit of compression as described above, the innovative technologies in Hybrid Columnar Compression and Advanced Compression Option are also designed to reduce resource requirements and costs for all components of the IT infrastructure, including memory, backup media and network bandwidth. This is accomplished because data is utilized in compressed format throughout the entire suite of Oracle hardware and software components that are used with Oracle Database 11g.

There is less storage to manage because of the high compression ratios achievable with Oracle storage platforms. Smaller files, fewer LUNS, and shorter backups mean that administrators have less work to do to manage the environment. In addition, Oracle Automatic Storage Management can automate many tasks so that storage administrators can let the database manage its own storage. The result is that both DBAs and storage administrators can manage a greater number of Oracle Databases, allowing database implementations to keep growing without the need to grow administrator resources at the same pace.

The following subsections provide additional details about Oracle tools that can help increase management efficiency and improve operations.

Simplify File System Management with Oracle Automatic Storage Management

Oracle Automatic Storage Management is an integrated, high-performance database file system and disk manager that simplifies management of block-based storage such as database tables. It is based on the principle that the database, rather than an administrator, should manage the database storage area. Oracle Automatic Storage Management eliminates the need for administrators to directly manage potentially thousands of Oracle Database files.

Automatic Storage Management is a very compelling solution for a volume manager, enabling organizations to save thousands of dollars in software license costs for third party volume managers while taking advantage of many features in Automatic Storage Management that simplify management
to help reduce costs. Some of the key features in Oracle Automatic Storage Management that help simplify management for DBAs and storage administrators include:

- **Automated striping, mirroring and load balancing**
  As data volumes increase, more disks can be added and Automatic Storage Management will automatically reconfigure and rebalance the data across available disks to help ensure optimal performance.

- **Oracle Automatic Storage Management Dynamic Volume Manager**
  Oracle Automatic Storage Management Dynamic Volume Manager provides volume management services and a standard disk device driver interface to clients. File systems and other disk-based applications can send I/O requests to volume devices registered with Oracle Automatic Storage Management Dynamic Volume Manager just as they would to other storage devices on a vendor operating system.

- **Oracle Automatic Storage Management Fast Mirror Resync**
  The Oracle Automatic Storage Management Fast Mirror Resync feature quickly resynchronizes disks within a disk group after transient disk path failures. Any failures that render a failure group temporarily unavailable are considered transient failures so long as the disk drive media is not corrupted. Such transient failures are typically caused by disk path malfunctions, such as cable disconnections, host bus adapter or controller failures, or disk power supply interruptions.

- **Oracle Automatic Storage Management Cluster File System (Oracle ACFS)**
  Oracle Automatic Storage Management Cluster File System (Oracle ACFS) is a multi-platform file system designed for both single-node and cluster systems. It extends Oracle ASM technology to support all application data in both single host and cluster configurations. Additionally, Oracle ACFS provides snapshot functionality for a point-in-time copy of an Oracle ACFS system. Users and applications can access and manage Oracle ACFS using application programming interfaces (APIs) and command-line interface (CLI) tools that are native to the Oracle Solaris operating system and ZFS file system. Users can also manage Oracle ACFS with Oracle Enterprise Manager.

- **Realm-based security for Oracle ACFS**
  Oracle ACFS security enables administrators to create “realms” to specify security policies for users and groups. These security policies, which specify access controls for file system objects, provide fine-grained access controls on top of the existing access controls provided by the operating system.

- **File system encryption**
  Oracle ACFS security supports encryption to protect the contents of realm-secured files stored in file systems based on Oracle ACFS.

Secure In-Database Archiving Helps DBAs Avoid the Task of Purging Old Data

Secure in-database archiving can be achieved by combining with Hybrid Columnar Compression and Advance Security features of Oracle Database 11g. A secure in-database archive can relieve DBAs of the task of purging or extracting old data from the database. This is because it provides big savings in storage space while also protecting the data from unauthorized access, making it both cost-effective and safe to retain the data in the database.
Many organizations make a practice of purging data by archiving it to tape where it can be protected with encryption. This practice also attempts to prevent the database from getting so big that performance slows and management becomes much more challenging. The in-database archiving capability in Oracle Database 11g makes this practice unnecessary, giving DBAs more time and simplifying the environment by keeping all of the data in the database. In-database archiving also gives users easy access to data that may have been purged in the past.

Eliminate NFS and TCP Tuning with Oracle Direct NFS

Oracle Direct NFS (see description on page 2) simplifies management by eliminating complex NFS and TCP tuning. It optimizes NFS for database performance and also eliminates RPC and other system bottlenecks. In addition, its load balancing technology makes it easier for administrators to get maximum performance out of multiple I/O ports that connect the storage systems to Oracle Database.

Increase DBA Efficiency with Oracle Snap Management Utility for Oracle Database and Oracle Data Protection Manager/3

The Oracle Snap Management Utility for Oracle Database simplifies, accelerates, and automates the process of copying, cloning, and protecting Oracle Databases. It allows DBAs to do their jobs more effectively in less time, with greater flexibility and less dependence on storage administrators.

Snap Management Utility is a standalone management tool specifically engineered to work with Sun ZFS Storage Appliances. It combines the underlying snapshot, clone, and rollback capabilities of the Sun ZFS Storage Appliance with standard host-side processing so that all operations are consistent. With the Snap Management Utility, DBAs no longer need to depend on IT personnel to backup, restore, recover, or clone databases. They can perform these tasks right from their DBA console.

For Pillar Axiom 600 storage systems, Oracle offers a similar tool called Oracle Data Protection Manager/3 (DPM/3). Like Snap Management Utility, DPM/3 allows for the automated creation of application-consistent snaps and space-efficient clones of Oracle Database. DPM/3 also supports all major Microsoft Windows subsystems such as Microsoft SharePoint and Microsoft Exchange.

Together, Snap Management Utility and DPM/3 enhance the power of Oracle's applications to disk stack based on Oracle hardware and software components. Oracle's integrated approach enables better overall performance and reduced operational complexity as compared to using fragmented data protection solutions from multiple third party vendors.

Enterprise Management with Oracle Enterprise Manager 12c

All of the tools for managing Oracle Database are integrated with the Oracle Enterprise Manager framework, which provides a complete management environment for IT infrastructures and cloud services. Oracle Enterprise Manager 12c includes self-service provisioning along with centralized, policy-based resource management and integrated chargeback and capacity planning. It provides complete visibility of the physical and virtual environment from applications to disk.
Conclusion

Oracle Database 11g enables IT organizations to increase service levels and reduce costs through efficient, reliable database management. These benefits can be further extended by deploying Oracle Database 11g on Oracle’s optimized storage platforms and using Oracle management tools.

This integrated hardware and software environment enables organizations to achieve the following benefits:

• Query performance gains ranging from 2x to 20x
• Cost savings of up to 40 percent or more by reducing the required storage capacity
• Streamlined operations through simplified management

Learn More

For more information about Oracle Database 11g and Oracle storage solutions, visit http://www.oracle.com/storage/ or call 1-800-ORACLE1 to speak to a representative. Table 1 also provides links to additional Web resources.

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