

Innovate Faster with Oracle Database 11g

*An Oracle White Paper
August 2007*

Innovate Faster with Oracle Database 11g

Executive Overview	3
Growing the Grid.....	4
Insight Into All Your Information	5
Support for Unstructured Data	5
Integrated Business Analytics.....	6
Managing Information Growth.....	7
Information Lifecycle Management.....	8
Highest Quality of Service at the Lowest Cost.....	9
Performance	9
Security and Compliance	9
Maximum Availability	10
The Ability to Manage Change.....	10
Conclusion.....	12

EXECUTIVE OVERVIEW

Over the past 30 years, information technology has matured to the point that the global economy almost completely depends on the ability to electronically capture, analyze, and share information.

Organizations continue to expand their information infrastructure to meet the growing demands of the business for timelier access to information. A desire for expediency combined with the immaturity of technology and processes led to significant complexity and inefficiency in the information technology (IT) infrastructure of virtually every organization. This complexity threatens the business's ability to adapt quickly just when its dependence on IT infrastructure is at an all-time high.

Oracle Database 11g offers innovation that enables organizations to adapt faster. Burdened by the high costs traditionally associated with changing business requirements, organizations can look to Oracle Database 11g for innovation that enables change within IT in a controlled, cost efficient manner.

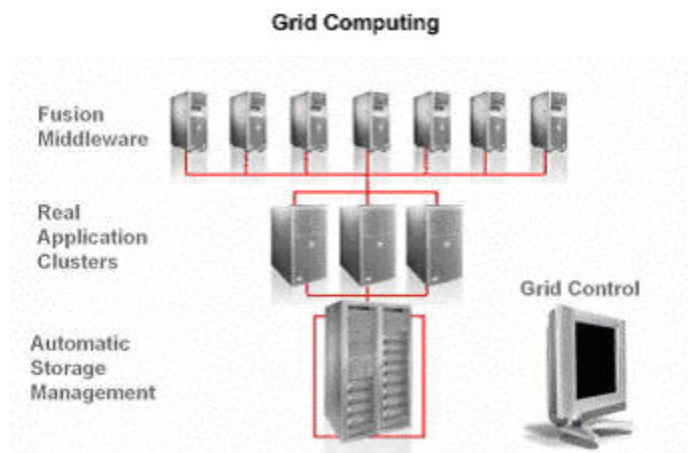
Oracle Database 11g addresses the very heart of what slows every IT organization: the ability to make changes with confidence. Using Oracle Database 11g, organizations can simplify your information infrastructure by enabling consolidation of all your information. Oracle Database 11g also continues to free up valuable technical resources for the higher value tasks of planning and implementing new business processes by automating administrative workloads.

Oracle Database 11g alters the very notion of what forward-looking companies will demand from their database platform. With Oracle Database 11g and enterprise grid computing, business is now free to innovate.

GROWING THE GRID

Oracle introduced *enterprise grids* to attack the high costs of implementing and sustaining a business's IT infrastructure. Enterprise grids, using Oracle Database 11g and commodity servers and storage, enable organizations to simplify their infrastructure and adapt to change. Instead of managing silos of expensive scale-up servers, Oracle enterprise grids offer a unique combination of performance, availability, and infrastructure agility at the lowest cost.

Oracle enterprise grids consist of Oracle Fusion Middleware to scale applications, Oracle Real Application Clusters (Oracle RAC) to provide scalability and high availability, and Automatic Storage Management (ASM) to simplify and automate the task of managing the underlying storage infrastructure. Enterprise Manager Grid Control simplifies the management of enterprise grids and end-to-end business processes to ensure a fast, secure, and reliable quality of service.



Thousands of customers in every country and industry, and across every size of business, are benefiting from the performance, reliability, and scalability of Oracle enterprise grids to run their business. Oracle Database 11g aims to further expand this benefit to more businesses by managing the highest levels of data volume and transactions, further automating and simplifying database and grid management, and lowering the risk and cost of moving to the grid.

INSIGHT INTO ALL YOUR INFORMATION

To truly gain insight into all your corporate information, your organization must be able not only to perform deep analytics against structured data but also to consolidate all potential forms of corporate information into a centralized repository.

More than 80% of corporate information consists of unstructured data such as spreadsheets and business documents. To simplify the information infrastructure and significantly lower the cost of managing all your corporate data, Oracle Database 11g introduces several enhancements for the efficient management of unstructured data.

Along with the need to consolidate information is the need to further automate your business processes. Oracle Database 11g introduces advances in the area of business analytics and data mining so that the massive amount of data being collected can be turned into useful information capable of arming Oracle users with the ability to stay ahead of their competition.

Simply put, Oracle Database 11g provides a single platform to consolidate all your data: one repository to manage, back up, and secure your data, with several ways to access it.

Support for Unstructured Data

Oracle Database 10g provides native support for storing and retrieving XML documents in the database. The XML documents may be accessed using industry standard SQL, XML, and file/folder interfaces. The XML documents may be stored in one of two formats: CLOB's for unstructured and semi-structured documents (e.g., MS Word documents) and Object-relational for structured documents (e.g., purchase orders). Oracle Database 11g introduces a new storage representation and indexing method for unstructured/semi-structured XML documents: *binary* XML and XML Index. Binary XML greatly improves storage efficiency and, in combination with an XML index, can provide up to a 15x performance improvement in accessing XML documents.

XML is only one example of unstructured data. Companies need to manage all types of unstructured data. Data such as geospatial and multimedia are being integrated by diverse organizations to improve business insight and processes. Oracle Database 11g adds additional support for industry-specific data types such as DICOM for the medical industry, RFID for supply chain logistics, and new 3D spatial for engineering and a host of other industries. By consolidating all types of information, Oracle Database 11g helps you pull together and process very large data sets of both unstructured and traditional structured data, enabling a truly integrated information platform.

The performance of accessing unstructured information has long been an obstacle to widespread acceptance of this important infrastructure simplification step of unifying management of both structured and unstructured data in the database. To solve this issue Oracle Database 11g introduces *SecureFiles*, a new and improved storage infrastructure for LOB data types. SecureFiles enables the read and write performance of LOB data in Oracle Database 11g to be equal to or faster than that of native file system storage. In addition, SecureFiles provides compression, deduplication and transparent data encryption of LOB data types. All applications and datatypes that use LOB's can transparently benefit from new SecureFiles LOB's.

Integrated Business Analytics

The need for increased business insight, not only from the historical point of view but also insight into the organization's current and future state, demands a new and increasingly dynamic information infrastructure. Oracle has employed the approach of deeply embedding OLAP, Data Mining, and statistical capabilities within the database engine. This integration reduces the need to move data to separate analytic engines. This reduces system complexity, enhances data security, and enables true real-time analytics on operational data.

The most exciting enhancement for business analytics in Oracle Database 11g is *Cube-organized materialized views*. Business analysts often do multi-dimensional querying. Multi-dimensional queries allow analysts to answer questions about measures (e.g., sales) across a variety of dimensions (e.g., product, region, date). An example query might be "Show me the top 5 sales regions for selling milk during the months of January and February last year." There are traditionally two different technological approaches for doing multi-dimensional querying. There are SQL queries against a star schema in a relational database, and there are OLAP queries against cubes in OLAP servers like Oracle Database 10g and Hyperion Essbase. The SQL approach has the advantage that there are huge numbers of developers and tools that know how to use and generate industry standard SQL. OLAP has the advantage that a SQL developer may need to create hundreds of materialized views to achieve the same performance level as one OLAP cube. Oracle Database 11g has breakthrough technology that for the first time unifies these two technologies to get the best of both worlds. With 11g *Cube-organized materialized views*, an OLAP cube in the database may serve as a materialized view behind a star schema. Now all existing database applications and tools that do multi-dimensional querying (e.g., Oracle EBS, Oracle BI EE, Cognos, Business Objects) can transparently benefit from high performance OLAP cubes.

Of course, your users also need data to analyze. Oracle Database 11g continues to add enhancements to its industry-leading data integration tool, Oracle Warehouse Builder, to speed the extraction, load, and transformation of data so that users can analyze timelier and more accurate information. New in 11g is integrated support for extracting information from Siebel applications.

With Oracle Database 11g it is now possible build a unified information infrastructure -- one that provides a single availability, security, and management model for all your corporate information to simplify and reduce the cost of sustaining that infrastructure.

MANAGING INFORMATION GROWTH

As the global economy has become increasingly dependent on information, the amount of information the business demands has significantly increased the amount of data that must be managed. Contributing to this growth are issues such as compliance, mergers, and the growing demand for business analytics. This growing volume of data creates several problems for IT organizations. Issues such as consistent query performance and availability complicate the manageability of the information infrastructure and contribute to higher costs.

Data partitioning is one of the most successful innovations introduced by Oracle to deal with the unique issues presented to administrators of very large databases. Oracle Database 11g enhances existing data partitioning capabilities by adding new functionality to ease the maintenance and improve the versatility of how data can be organized across different partitions.

Interval and *REF* partitioning are examples of the improved manageability of partitions in Oracle Database 11g. Interval partitioning enables the administrator to define equal ranges of information such as monthly or quarterly ranges. The database then automatically creates new partitions as qualifying data is inserted into a table. REF partitioning handles the issue of automating the partitioning scheme for parent-child tables so that the child table simply inherits the parent's partitioning scheme. Both enhancements eliminate manual tasks while improving performance.

Oracle is the only database vendor to offer *composite* partitioning, which is the ability to physically partition data along two dimensions. Oracle Database 11g offers additional capabilities in this area, increasing the flexibility of how tables are partitioned to increase performance of a wide variety of business queries.

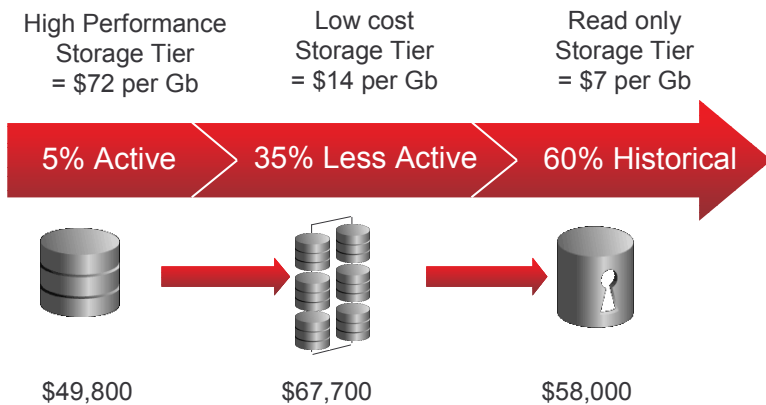
Of course greater amounts of information translate to increased volumes of required storage hardware, which in turn adds to the cost of maintaining the information infrastructure. Oracle Database 11g introduces an enhanced compression algorithm that speeds the overall performance of the compression operation, and maintains compression for all types of processing workloads, including online transaction processing (OLTP). With Oracle advanced table compression, organizations typically realize storage savings of three times versus uncompressed data. Equally important, the performance gained through more efficient physical I/O may actually boost the performance of application queries.

Information Lifecycle Management

Information Lifecycle Management (ILM) is a methodology for greatly reducing the cost of storage under an Oracle Database while still preserving quality of service. The traditional approach is to put all database data in a single high performance storage tier. With ILM, the approach is to place database data in multiple storage tiers: as data ages and becomes less active, it is placed on lower cost storage media. Oracle Partitioning makes it very easy to implement ILM in the database. For example, let's say we're now in Q3 of the calendar year, and we're partitioning the Orders data for an order entry application by month. The high performance storage tier is where all the frequently accessed data would be stored, so the partitions holding the Q3 Orders would be stored here. This tier would use a high performance storage device. The low cost storage tier is where the less frequently accessed data is stored, so the partitions holding the Orders for say Q1 and Q2 would be stored here. This tier would use a significantly lower cost storage technology such as a SATA disk array. The online archive storage tier is where all the data that is seldom accessed or modified is stored, so the partitions for orders for previous years would be stored here.

Let's work through an example to demonstrate the potential cost savings with ILM. Assume the cost per GB is \$72 on the high performance tier, \$14 on the low cost tier, and \$7 on the online archive tier. If you have 13.5 TB worth of data to store, and all the data were stored on the high performance tier, the cost would be close to \$1M. Now let's assume the ILM methodology is used instead and we place 5% of data on the high performance storage tier, 35% of data on the low cost storage tier, and 60% of data on the online archive storage tier. The following diagram illustrates the cost using ILM.

Information Lifecycle Management Reduce storage costs accordingly



As you can see, the cost is reduced from \$1M to just \$175,000. In addition, by implementing Oracle Advanced Compression, this cost can be reduced 3x to under \$60,000. This is a 94% reduction in cost, while preserving quality of service.

Oracle provides an *Information Lifecycle Management (ILM) Advisor* that helps you to create lifecycle policies, estimate storage cost savings, and generate scripts for moving, archiving, and deleting data.

HIGHEST QUALITY OF SERVICE AT THE LOWEST COST

It has been estimated that 80% or more of an organization's total cost of ownership is related to the tasks involved in sustaining the information infrastructure. The Oracle enterprise grid vision has always been focused on achieving significant cost reduction in this key area. The inherent ability of the grid infrastructure to adapt to current needs and remove the requirement for expensive and underutilized hardware has enabled organizations to achieve increasing levels of service without increasing cost.

Performance

Oracle Database 11g introduces a host of performance breakthroughs. New server and client-side *result caching* has improved the performance of often-repeated statements by 25% or more. New *native compilers for PL/SQL and Java* have drastically improved performance, up to 2 times faster for PL/SQL and 11 times faster for Java. Oracle Real Application Clusters (Oracle RAC) performance has been improved up to 70% over the previous release for certain classes of workloads. Oracle Automatic Database Diagnostic Monitor (ADDM) has been enhanced to automatically diagnose performance issues in Oracle RAC environments. More performance enhancements have been added in other areas as well: Oracle Streams is up to 2 times faster, and optimizer statistics gathering is both faster and more accurate. Finally, noticeable speedup will be apparent in many business intelligence applications with the use of the new partitioning methods and cube-organized materialized views, as previously described.

Security and Compliance

Oracle has been the leading innovator in information security for over a decade. In addition to security enhancements in the main database releases, Oracle has delivered new key security functionality in a timely fashion through the following integrated products and options:

- Oracle Secure Backup offers tape data protection for the Oracle database and file system in an encrypted and compressed format.
- Oracle Database Vault addresses common regulatory compliance requirements and reduces the risk of insider threats by enforcing separation of duty and offering multi-factored access control.

- Oracle Audit Vault automates the collection of database security audit trails across the enterprise into a central audit data warehouse to enable monitoring of compliance with security policies.

Now Oracle Database 11g enhances existing industry leading transparent data encryption with the new ability to encrypt data at the tablespace level, easing the management burden that often results in sensitive data being left unprotected on disk. In addition, Oracle Database 11g adds support for hardware security module (HSM) devices for securing encryption keys and providing high performance data encryption.

Maximum Availability

Oracle has led the way in protecting your data from any form of failure. For example, Oracle Real Application Clusters (Oracle RAC), Oracle Data Guard, and Oracle Flashback technology have revolutionized the very concept of availability and business agility. Oracle Database 11g continues to enhance these innovations. Oracle Data Guard now enables customers to use their standby database to improve performance in their production environments as well as provide protection from system failures and site-wide disasters. Oracle Data Guard uniquely enables simultaneous read and recovery of a single standby database. So a standby database is now available for real-time reporting, backup, testing and online upgrades to production databases. By offloading workloads from production to a standby system, Oracle Data Guard helps enhance the performance of production systems and provides a more cost-effective disaster recovery solution.

The Oracle Flashback technology is unique in offering easy recovery from the most common cause of unplanned downtime: human error. New in 11g is *Oracle Flashback Transaction*, which makes it easy to back out a transaction made in error, as well as any dependent transactions. Also new in 11g is *Parallel Backup and Restore* which helps improve the backup and restore performance of very large databases; and 'hot patching,' which improves system availability by allowing database patches to be applied without the need to shut databases down. In addition, a new advisor - *Data Recovery Advisor* - helps administrators significantly reduce recovery downtime by automating problem investigation, intelligently determining a recovery plan and handling multiple failure situations.

THE ABILITY TO MANAGE CHANGE

A flexible infrastructure enabled by innovations such as Oracle Real Application Clusters and ASM provides the capability to change, but does not necessarily ensure that change will not impact the stability of the information infrastructure. As change is perhaps the biggest obstacle to achieving agility, Oracle Database 11g introduces several new features to address the need to enable change while maintaining stability.

The ability to test changes to the infrastructure -- such as hardware changes, software upgrades, and patches -- has always been the cornerstone of change

assurance. The comfort you get from being able to test a change and its impact before propagating it to your production environment is invaluable. Many businesses use simulation software to attempt to test the impact of changes, but many issues go undetected because existing tools cannot rigorously perform stress testing using production level workloads.

Oracle Database 11g introduces *Real Application Testing*, comprising of two main features. The first is called *Database Replay*, which captures the actual production database workload, including exact timing, concurrency, and transaction characteristics, for replay on a test environment after changes have been made. Database Replay can analyze and report on any divergence it finds, such as performance improvement or regression, data divergence, and of course errors. Unlike simulation testing software, Real Application Testing eliminates the need to develop simulation workloads or scripts, resulting in reduced testing effort with a much higher degree of confidence.

The maintenance of the test environment is also made easier through Oracle *Data Guard*. Oracle Database 11g introduces a new capability of Data Guard called *Snapshot Standby*. Data Guard is a disaster recovery tool, but it is also commonly used to create read-only instances of production databases for reporting and backup purposes. In Oracle Database 11g, a Data Guard standby database can be easily converted into a Snapshot Standby for testing purposes. After the conversion to snapshot standby, the test instance is open for full read-write capability and the workload captured by Database Replay can be executed. None of the changes occurring to production during testing are lost, because Data Guard queues them up and synchronizes the standby database with production when testing is complete. As a result, not only do you get true change assurance, you also get maximum usage out of your standby infrastructure.

The other feature of the Real Application Testing option is *SQL Performance Analyzer*. This feature captures the production SQL workload, including plan and execution statistics, and enables the replay of the workload on the changed test instance. SQL Performance Analyzer can report on any changes to execution plans and show which statements became faster due to the change and which statements became slower. With one click of the mouse in Enterprise Manager, the administrator can send regressed statements to the database's existing SQL Tuning Advisor, available within the Enterprise Manager Tuning Pack, for further analysis.

Oracle Database 11g innovations in areas such as information consolidation, performance and scalability, quality of service, and of course change management continues Oracle's drive towards a low cost and agile information infrastructure.

CONCLUSION

Over the past 30 years Oracle has delivered virtually every noteworthy innovation that exists today in the area of database and information management. Our innovations are not simply for the benefit of very large organizations, but for every organization that plans to grow and change. Simplicity and agility are planned events. Simplifying – that is, consolidating and rationalizing your information infrastructure -- does not automatically provide infrastructure agility. The platform must be functionally rich enough to stay ahead of your organization's innovation curve, which itself is accelerating.

Our development objectives have always been to attack and solve the largest total cost of ownership (TCO) issue that your organization faces, maintaining your information infrastructure's stability while enabling it to adapt to improved technologies, economic change, and any other factor that affects the business. Oracle innovation has enabled a fundamental change in the cost of hardware infrastructure by supporting dynamic scalability even on the lowest cost servers, utilizing all assets to their fullest capacity and even adding new and unique capabilities – such as Flashback, Data Guard, XML DB, Application Express, and Oracle RAC -- which continue to change the very notion of what database software should provide.

Oracle Database 11g innovations in areas such as information consolidation, performance and scalability, quality of service, and of course change management continue the Oracle drive toward a low-cost and agile information infrastructure. Let our innovation enable your organization's innovation.



Innovate Faster with Oracle Database 11g
August, 2007

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200
oracle.com

Copyright © 2007, Oracle. All rights reserved.

This document is provided for information purposes only and the contents hereof are subject to change without notice.

This document is not warranted to be error-free, nor subject to any other warranties or conditions, whether expressed orally or implied in law, including implied warranties and conditions of merchantability or fitness for a particular purpose. We specifically disclaim any liability with respect to this document and no contractual obligations are formed either directly or indirectly by this document. This document may not be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without our prior written permission.

Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.