

Oracle9i Database vs. Microsoft SQL Server 2000: Understand How Oracle Reduces IT Costs

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INTRODUCTION

In order to survive and remain competitive, today's modern organizations must focus on:

- Improving their efficiency and productivity
- Better understanding their business, their customers and their partners
- Seizing new opportunities and enabling change

For the modern business, information is the most valuable asset it has at its disposal in its effort to drive competitiveness. Organizations that can effectively use their business information are the ones most likely to profit and survive in today's tough economic climate. How effectively an organization can use its information depends on what it has at the heart of its information infrastructure. Data is just bits and bytes on a file system. Only a database can turn the bits and bytes of data into business information.

The Oracle9i Database is the current release of Oracle's information management solution, built on over 20 years experience of providing industry-leading solutions that allow organizations to efficiently store, manage, integrate and use business information. The Oracle9i Database has been designed to provide the most complete and low cost solution for any business information management requirement, and is the only solution available today that can:

- Provide proven performance, scalability, and capacity on demand for any business requirement.
- Guarantee that critical business information is available when needed.
- Secure and protect the privacy of sensitive business information.
- Reduce the time it takes for a business to make better business decisions.
- Enable an organization to develop and deploy business solutions quickly.
- Do more for less.

This paper illustrates how Oracle9i Database delivers on each of these value propositions by highlighting key enabling technologies and measurable proof

points. These value propositions will be examined in terms of the value each brings to minimizing the total cost of ownership, which is comprised of the following:

- software license
- hardware costs
- operational support cost (includes network, system, and database administration)
- development cost
- consulting service cost
- training cost
- cost of planned and unplanned downtime
- maintenance and upgrade cost

To more clearly portray the uniqueness of Oracle9i Database's strengths, comparisons will also be made against Microsoft's SQL Server 2000.

PROVIDE PROVEN PERFORMANCE, SCALABILITY, AND CAPACITY ON DEMAND FOR ANY BUSINESS REQUIREMENT

Business Value

A scalable system avoids the need to build an entirely new system with new software and hardware components each time the system has reached its capacity limits. The system continues running the same software and only requires hardware resources to be added as required to support the increase in activity. Applications do not need to be rebuilt or redesigned when resources are added.

If a business cannot implement transparently scalable solutions, every attempt to grow these solutions will meet with increased costs, as well as inevitable time and availability delays. When a system becomes overloaded, the lack of resources will result in a degradation of performance when the workload exceeds the system's limitations. In this way, a lack of scalability can directly affect overall performance.

A typical example is a retailer's Web site accessing catalog data. If the number of concurrent users accessing the web site exceeds the anticipated demand and if the system is not scalable then the response time degrades rapidly to reach unacceptable levels. Statistics have shown that the average customer visiting a web site will wait no more than 20 seconds before losing patience and going elsewhere, often to a competitor. A lack of scalability means customer dissatisfaction, just as unacceptable levels of performance will invariably lead to lost customers – a cost no business can afford.

Oracle9i Database versus SQL Server 2000

The Oracle9i Database is the only information management solution that is proven to scale to meet all business requirements on all hardware platforms, from single processor and mid-range multiprocessor systems to large scale SMP, MPP, mainframe, and clustered environments. This proven scalability unlocks the full potential of any hardware and operating system investment and ensures any organization will be able to meet all business requirements in the future.

SQL Server only runs on the Windows platform, so any future growth of a business is then also limited to the Windows platform! Outgrowing Windows means a huge investment of time and money to upgrade all the hardware and software systems to Unix, migrate the data to a more scalable database, and rewrite all the applications to run against the new database. With Oracle, you never need to worry about outgrowing your hardware, since Oracle data and applications are fully compatible and portable across all hardware and operating systems platforms.

Oracle is the only database vendor to run benchmarks on the largest systems. Oracle has TPC-C results on the largest symmetric multi-processor systems from HP, Compaq and IBM. Oracle's best TPC-C to date, delivered over 389,434 tpmC on a 64 CPU HP Superdome¹. SQL Server 2000 is not proven to scale on SMP machines, in fact their TPC benchmarks show DECLINING scalability across CPUs.²

Oracle partnered with Sun to deliver world record breaking DSS performance with 18,802.1 QphH@1000GB on the TPC-H benchmark.³ Oracle's benchmark leadership includes great TPC-H 3000GB results as well, while Microsoft is no where to be found beyond scale factor 300GB.⁴

In addition to TPC benchmarks, Oracle also runs real-world enterprise class applications benchmarks such as those on Oracle Applications and SAP. As of this publication:

- Oracle holds the top three 2-tier Assemble to Order ATO benchmark⁵ with 34,260 orders per hour. SQL Server 2000 does not have any SAP 2 tier ATO benchmark results recorded.⁶

¹ TPC Benchmark - HP9000 Superdome, 389,434.40 tpmC, \$21.24/tpmC, available 5/15/02.

² TPC Benchmarks, www.tpc.org

³ Sun Fire 15K, 72-processor; Oracle9i Database, 18,802.1 QphH@ 1000GB, \$287/QphH@1000GB, available July 17, 2002.

⁴ <http://www.tpc.org/>

⁵ SAP Benchmark — Certification Number 2001018 Oracle 8.1.7, 128 way, Sparc64 560Mhz, 128GB, Solaris8, 2-tier. http://us.fujitsu.com/news/2001_07/20010716_01.html

⁶ http://www.sap.com/benchmark/HTML/ATO_2_tier.htm

- Oracle holds the top four SAP SD 2-tier⁷
- Oracle holds the top performance result for SAP BW (Business Information Warehouse)⁸

Oracle Database outperforms SQL Server on all three of these very important, and according to SAP, the most popular benchmarks. Clearly, Oracle is more capable of fully exploiting available processing power than SQL Server.

Why is Oracle9i Database the Fastest and Most Scalable?

Multi-Version Read Consistency Model

Oracle9i Database's unique multi-version read consistency model minimizes internal contention for data. By avoiding contention, the number of users who can simultaneously access data increases. SQL Server 2000's flawed architecture can only offer this level of concurrency at the price of data accuracy. Oracle can support more concurrent users than SQL Server 2000, thus reducing the need for hardware upgrade costs.

Oracle Real Application Clusters

Real Application Clusters, breakthrough technology unique to Oracle, allows cheap, commodity hardware to be clustered together to provide a highly scalable but low-cost platform that supports more users online, without incurring the cost and time to re-develop or re-deploy existing business applications

SQL Server 2000 has no clustered database architecture. The earliest projected dates of a true clustered database, according to Gordon Mangione, Microsoft Vice President of SQL Server, is the year 2003.⁹ The only means to achieve real scalability with SQL Server 2000 is to implement a federated group of databases, which requires designing the applications and dividing the data across the federated group of databases. The loss of any one of these databases means that the applications are unable to run, so availability of data is greatly impacted. Additionally, any change to the data structure, the applications, or to the number of nodes requires re-designing the application as well as the layout of the data on the disks. This configuration only runs a TPC-C benchmark, or custom applications. It can not run real world business applications without significant tailoring of the configuration and the applications, thereby greatly increasing the costs of development and deployment.

⁷ <http://www.sap.com/benchmark>

⁸ <http://www.sap.com/benchmark>

⁹ SQL Server Magazine, August, 2001 - Foundation for the Future

Conversely, Oracle Real Application Clusters allows any organization to start small, grow quickly and immediately react to increased demand for business services, without the cost of additional application development and database administration efforts.

GUARANTEE THAT CRITICAL BUSINESS INFORMATION IS AVAILABLE WHEN NEEDED

Business Value

Today's e-businesses are increasingly reliant on technology to provide competitive advantage, increase productivity, reduce costs and empower their users to make faster informed decisions. Increased reliance on technology introduces new challenges for e-businesses. Should applications become unavailable, entire e-businesses are exposed. Revenue and customers may be lost, penalties incurred, and bad press can have a lasting effect on both customers and stock prices. Providing continuous data availability is essential for today's e-businesses. It is not always easy to place a direct cost on downtime. Disgruntled customers, idle employees, and bad press are all costly, but not directly measured in terms of hard currency. Over recent years there have been various efforts to quantify the revenue cost of downtime, planned or unplanned. According to The Standish Group's DARTS studies, one minute of system downtime can cost an organization anywhere from \$2,500 to \$10,000 per minute. Using that metric, even 99.9 percent data availability can cost a company nearly \$5 million dollars a year. (DARTS = Demand Assessment Requirements Tracking Study, an ongoing study by the Standish Group).

Oracle9i Database versus SQL Server 2000

Oracle9i Database is the most cost effective database for ensuring minimal downtime and zero data loss. It takes care of most scenarios that might lead to data unavailability, such as system failures, data failures, disasters, human errors, system maintenance operations and database maintenance operations. In addition, Oracle Real Application Clusters provides high availability for mission critical applications.

SQL Server 2000 does not provide equivalent functionality for high availability or data protection. To provide even a minimal approximation of some of the same functionality as Oracle9i Database, SQL Server 2000 requires more hardware, additional third-party software or extensive custom development—all leading to increased cost of ownership.

In an INPUT cost of ownership study¹⁰, Oracle is found to be 97.5% cheaper than SQL Server when the cost of downtime is taken into consideration. Oracle is also the database that powers such e-businesses as Amazon.com and

¹⁰ Total Cost of Ownership for Oracle8i Appliance, INPUT, 2000

eBay, which depend on Oracle database's reliability to provide continuous service to their large customer base.

Why Oracle9i Database Delivers the Highest Availability

System Failure Protection

Oracle database recovery allows the DBA to provide service level guarantees for the system, ensuring the database availability meets the business needs. Oracle Real Application Clusters and Oracle Failsafe provide continuous availability to a database in the event of a system failure. Automatic application failover masks the failure from the users so their work continues uninterrupted.

SQL Server has only minimal database functionality for recovering from system failures, such as normal crash recovery after a system failure and active-passive failover on a cluster using Microsoft Cluster Server. Beyond that, it doesn't provide any of the more powerful capabilities offered by Oracle9i such as Fast Start Time-Based recovery, Mean Time to Recover (MTTR), Real Application Clustering with Transparent Application Failover, file multiplexing, partitioned backups and partitioned recovery, etc. They provide the bare minimum system recovery capabilities, with no optimizations for fastest possible restart of the system. Every minute counts in terms of money while waiting for the system to restart!

Online Maintenance Operations

Oracle9i Database server almost completely eliminates the need to bring down a database while an administrator is performing maintenance operations on the database. The online data redefinition features improves data availability,

database performance, response time and disk space utilization. Indexes can be added, rebuilt or de-fragmented. Tables can be relocated, de-fragmented, reorganized or have their storage parameters changed. Schema evolution allows table definitions to be modified while the data table is in service. The Oracle9i Database recovery manager can make full or incremental backups of data while the database server is online. Additionally, table partitioning can be used to take just a portion of a table off-line, while the rest of the table is in-use, thus improving availability of the data even further.

SQL Server 2000 does not support the extensive set of online operations and recovery operations that Oracle9i Database does. It is missing online schema evolution, table partitioning, table reorganizations, table re-definitions and secondary index creations on index-organized tables. As a result, the data is unavailable while these operations are being performed. Since maintenance operations are done quite frequently and can take hours to complete, SQL Server 2000 applications can suffer significant data unavailability. Most modern businesses cannot afford to halt their business operations for an undetermined

length of time while the tables are being reorganized. Any amount of downtime can translate into lost productivity as well as revenue loss.

Protection from User Errors

Users can make mistakes such as entering the wrong values or deleting the wrong set of rows. To recover from this type of mistake the database administrator has to go through backups to retrieve the correct information. Oracle9i Database's flash-back query allows an administrator or a user to view the database at a point-in-time in the past. Developers can use this feature to build self-service error correcting applications, empowering end-users to undo and correct their errors without delay.

SQL Server 2000 does not have this feature. Therefore, SQL Server 2000 administrators have to get involved in correcting end user errors. They need to perform a point-in-time recovery, which is a very tedious, time-consuming operation. SQL Server 2000 has significantly higher administrative costs in recovering from end-user errors.

Standby Databases

A common high availability technique is to maintain a separate standby database. Oracle9i Data Guard completely automates the task of setting up standby databases. It continually ships logs from the primary to the standby across the network. When the primary database becomes unavailable, applications can fail over to the standby databases transparently and continue processing. To perform system maintenance operations, it is easy to switch over to a standby database.

Oracle9i Data Guard guarantees that all changes to the production database are recorded in the standby database to ensure no loss of data. It is also possible to specify a delay of application of the redo log data once it arrives at the standby site. This feature provides the ability to detect and recover from human errors.

SQL Server 2000 does not offer a comparable standby solution, so it can not fully protect you from site disasters. It has no ability to provide zero data loss mode, or multiple standby sites with delayed application times. Also, it does not provide the graceful switch over and switch back to and from the production site and the standby site.

SECURE AND PROTECT THE PRIVACY OF SENSITIVE BUSINESS INFORMATION

Business Value

The fact that modern organizations can derive exceptional competitive advantage from their business information is a double-edged sword. Competitors can use the very information that a business uses to ensure its competitiveness. In addition, the push towards more and more consolidated

customer information being shared with larger numbers of users dramatically increases the requirement to guarantee the privacy of sensitive personal information. Also, as more and more users are brought online both inside and outside an organization, the ability to strongly authenticate and centrally manage a large user population becomes paramount.

Oracle9i Database versus SQL Server 2000

In 1999, corporations lost \$1.6 billion in security breaches. Ninety percent of large corporations and government agencies had detected computer security breaches within the last 12 months, and 74% acknowledged financial losses due to breaches, according to the Computer Security Institute's fifth annual Computer Crime and Security Survey¹¹.

Oracle9i Database offers all the features and functionality required to secure and protect all important business information. It addresses all major security hazards, providing a wide choice of authentication and authorization mechanisms and protecting data from prying, even by the database administrator. It supports a number of different application architectures including two-tier, three-tier, Internet-based and hosting. The Oracle database has completed more independent security evaluations¹² (9) than SQL Server 2000 (1). The one security evaluation SQL Server 2000 passed is the **obsolete** C2 certification. In contrast, Oracle's database is fully certified with industry standard security evaluations.

Oracle9i Database centralizes and simplifies administration of security within an enterprise. For large enterprises with lots of users, databases, applications, passwords, access privileges and roles, Oracle9i Database offers the most cost effective solution for administering security.

Security is not a hallmark of Microsoft and SQL Server 2000 carries on that tradition. SQL Server 2000 lacks most key security features needed for enterprise use. As a result:

- SQL Server 2000 is unsuitable for many deployment scenarios.
- Developers have to compensate for the missing features by implementing them in their applications. This increases development costs and makes the application more difficult to maintain, and increases security risks.
- The SQL Server 2000 database itself provides very little security, unlike Oracle9i where security is built into the data server and cannot be bypassed.
- Compared to Oracle9i Database, administering security in a SQL Server 2000 environment costs more. Microsoft recommends a federated or

¹¹ <http://www.bestreview.com/2000-06/risky.html>

¹² http://www.oracle.com/ip/dep/otn/database/oracle9i/index.html?se_dbcomp.html

distributed database approach for scalability, yet this environment is the costliest in terms of enforcing security. It is much more difficult to enforce consistent security across many small, possible geographically distributed databases. In a single, centralized database installation, enterprise level security is implemented just once, and can be modified and maintained quickly and easily as needed.

Why Oracle9i Database Provides a Strong Security Infrastructure

Enterprise User Security

Oracle9i Database is LDAP (Lightweight Directory Access Protocol) directory enabled. It can retrieve security objects such as user roles, password information, and wallets containing digital certificates from a central LDAP compliant directory server. Centralized management of user and security information in a directory server simplifies management and reduces the cost of managing security for an enterprise. This is especially useful for large enterprises with large number of databases, applications and users.

Virtual Private Database and Oracle Label Security

Within the enterprise, the Virtual Private Database (VPD) results in lower cost of ownership in developing and deploying applications. Row-level security can be built once, in the data server, rather than in each application that accesses data. Security is stronger, because it is enforced by the database, no matter how a user accesses data. That is, data is protected even from users who subvert the application security and execute queries directly against the RDBMS.

This feature is particularly useful for application service providers. They can offer “virtual private databases” and host multiple companies in a single database instance resulting in economies of scale. Oracle Label Security provides VPD “out-of-the-box,” as well as automatic labeled data management, thus increasing the ease of deploying secure web-based e-business systems to customers, employees, and partners. SQL Server 2000 has no comparable functionality to VPD and would require extensive development effort to implement row-level security.

Encryption in the Database

Prevent prying with encryption of data in the database. Encryption ensures that sensitive information such as credit card numbers or salaries can not be seen even by the database administrator. Unauthorized agents that break into a system can not misuse private information. The cost (in time, money and lost credibility) of an illicit break in of a computer system is incalculable. Encryption sensitive data in the database is not available in SQL Server 2000.

Fine Grained Auditing

Auditing helps deter unauthorized user behavior that may not otherwise be prevented. It is particularly useful for ensuring that authorized system users do not abuse their privileges while simultaneously preventing excessive logging of audit information. Oracle9i Database's fine-grained auditing capability enables organizations to define specific targeted audit policies that can immediately alert administrators. Audit policies specify the data access conditions that trigger the audit event and can use a flexible event handler to notify administrators that the triggering event has occurred. SQL Server 2000 does not provide such a fine granularity of auditing functionality.

REDUCE THE TIME IT TAKES FOR A BUSINESS TO MAKE BETTER BUSINESS DECISIONS

Business Value

Good business intelligence operations are built on data repositories that handle geometrically increasing information requests because of a vastly expanded Internet audience. It also provides customers instant information regardless of where the data resides. Whether a business is small, medium or large, brick and mortar or dotcom, business intelligence systems will consistently encounter these two requirements. In fact, AMR Research has recently determined that the challenges of providing a growing population of users with instant information, supported invisibly by large amounts and sources of data, are driving the consolidation of data stores into larger data warehouses at a growth rate of 40% per year. This means that data warehouses will store larger volumes of data, support more users, and require faster performance—without losing quality of service. The core requirements for data warehousing—performance, scalability and manageability—remain key factors in the successful implementation of data warehouses.

Oracle9i Database versus SQL Server 2000

Oracle9i Database not only brings with it over 20 years of technical innovation in the core data warehousing requirement areas, it also changes the technology landscape for business intelligence servers. Oracle9i Database is a single, standards-based platform that addresses all of the server-side business intelligence and data warehousing requirements, including Extraction, Transformation and Loading (ETL), Online Analytical Processing (OLAP) and data mining. Oracle9i Database's capabilities eliminate the need for multiple engines in the business intelligence environment. This new business intelligence architecture provides numerous benefits:

- **Rapid deployment:** There is no longer any need to integrate multiple server components when implementing a business intelligence system.

- **Reduced management costs:** A single server means that all data is stored in one place, and is managed via a single tool. Moreover, there is no longer a need to manage the process of synchronizing the data stored in various servers; once new data is loaded into Oracle9i Database, it is accessible for all business intelligence needs.
- **Better decision-making:** With a single data store, all data in the business intelligence system is available to all business intelligence users more rapidly, since there is no need to percolate data from one server to another.
- **Security:** With all data in a single database, IT managers are assured of having consistent security for all business intelligence data regardless of how it is accessed.
- **Availability:** Oracle9i Database provides robust availability capabilities, which far exceed the availability characteristics of many other business intelligence products.

With Oracle9i Database, IT administrators have a simpler data warehouse environment to administer, and can then spend more time supporting business issues. The net result is a business intelligence system that focuses on providing timely, insightful information to support accurate business decisions.

Microsoft claims a fully integrated business intelligence platform, when in reality the OLAP data is kept in a separate data store. While SQL Server 2000 acts as the data warehouse repository, OLAP analyses are performed in the separate data store. This requires additional time in extraction of the data from SQL Server 2000 and storage of transformed analytical data in other data stores. Also, administrative and management overhead increases as the number of these business intelligence repositories expands.

Many IT professionals agree that Oracle provides a superior business intelligence solution, as evidenced in the 2000 *DM Review 100* business intelligence vendor ranking survey¹³ in which Oracle placed third while Microsoft was in seventh place. The 2000 Winter Corporation VLDB survey¹⁴ results show the Oracle database is used by three of the top ten largest Decision Support Systems on Unix platforms while SQL Server 2000 of course is not even listed since SQL Server can not support a Unix environment. In fact, the world's largest data warehouse (82 terabytes) uses a single Oracle database with IBM NUMA-Q server¹⁵. For large scale, high throughput DSS systems, Oracle is the top choice.

¹³ 2000 DM Review 100, <http://www.dmreview.com/awards/top100/2000/>

¹⁴ Winter Corporation 2000 VLDB Survey, May 2001, http://www.wintercorp.com/VLDB/2001_VLDB_Survey/winners/

¹⁵ <http://www.ibm.com/Press/prnews.nsf/jan/6329C24C567EBA5185256880004E6F39>

How Oracle9i Database Enables Timely Decision Making

Flexible Data Partitioning

Oracle Partitioning allows tables and indexes to be partitioned into smaller, more manageable units, providing database administrators with the ability to pursue a "divide and conquer" approach to data management. Four partitioning schemes - range, hash, composite, and list - are supported.

A typical usage of range partitioning for manageability is to support a 'rolling window' load process in a data warehouse. Suppose that a DBA loads new data into a table on a weekly basis. That table could be range-partitioned so that each partition contains one week of data. The load process is simply the addition of a new partition. Adding a single partition is much more efficient than modifying the entire table, since the DBA does not need to modify any other partitions. Also, data in the other partitions continue to be available while the new partition is being built and added.

In contrast, SQL Server 2000 has no ability to do any kind of table or index partitioning whatsoever. So, they can't provide a "rolling window" operation for a data warehouse, nor can they do anything like hash partitioning. This greatly limits the types of operations that can be done efficiently with SQL Server.

Scalable ETL Infrastructure

Oracle9i Database provides a scalable infrastructure to improve the performance, scalability, and manageability of typical ETL operations. Not only does this infrastructure lower the time required to build and maintain the data warehouse, it effectively combines the ETL stages, eliminating the cost of additional storage for data staging. Some of the major Oracle9i Database ETL capabilities include:

- **Transportable tablespace:** Bulk transfer of large volumes of data is accomplished through simple and fast copying of necessary data files from the operational data store to the data warehouse. SQL Server 2000 has no comparable capability.
- **Change data capture:** Change Data Capture provides the capability not only for capturing change data but also for publishing it and allowing applications to subscribe to the change data in a controlled fashion.
- **External tables:** External tables will commonly be used in the ETL process to combine data-transformations (via SQL) with data loading into a single step.
- **MERGE and multi-table inserts:** These DML commands allow for data to be populated into target tables in a more efficient fashion. SQL Server 2000 has no comparable capability.

- Table functions: Table functions provide the support for pipelined and parallel execution of complex data transformations implemented in any language supported by Oracle9i Database.

Oracle also provides a complete ETL solution with Oracle Warehouse Builder (OWB). OWB provides a complete, integrated and open solution for the design, deployment and management of enterprise data warehouses, data marts and e-business intelligence applications. Since OWB relies upon Oracle9i Database for all data transformations, OWB can fully leverage all of Oracle9i Database's ETL features.

Complete Summary Management

Summary management enhances query performance by storing pre-aggregated data and dynamically re-writing queries to use this data, thereby avoiding the overhead of scanning very large tables, often several gigabytes in size, at runtime. Oracle9i Database's robust summary management implementation allows the creation of dimensions, or summary hierarchies, so that only the most frequently used summary tables need be physically stored while less frequently used summary information can be derived based on stored summary tables. This reduces the amount of storage required for summary tables.

Another summary management feature that saves on storage requirements is the Summary Advisor tool. This tool provides summary table creation recommendations and is used to assess the cost effectiveness of each summary table already created or to be created.

SQL Server 2000 provides only rudimentary summary management functionality, with no subqueries, UNIONs, outer joins or functions such as AVG and STD supported in their indexed view definitions. There is also no Summary Advisor capability. As a result of these limitations, SQL Server 2000 requires more investment in storage hardware for summary management.

Compressed Bitmapped Indexing

As most DSS queries rely essentially on set operations, the bitmapped index is one of the most useful and important indexing schemes in a DSS environment. Oracle9i Database uses a revolutionary technique for maintaining and compressing stored bitmap indexes. In addition, bitmapped join index and parallel bitmapped star join further improves query performance.

SQL Server 2000 does not support bitmapped indexing of any kind. Instead, it relies solely on the use of b-tree indexes to optimize query performance, even in a business intelligence environment. This not only imposes more runtime processing overhead, which means slower query performance, but also requires more storage hardware for the b-tree indexes.

In-place Data Analysis

Oracle9i Database eliminates the need to extract data from the data warehouse and load the data into another repository for analysis. Since advanced SQL analytic functions, an OLAP engine and a data mining engine are integrated into the Oracle9i Database engine, complex business intelligence analysis can be performed in-place. This enables real-time access to information that can play a critical role in better business decision making as well as reduces administration overhead and data storage costs. Microsoft's business intelligence solution requires maintaining a separate data store for OLAP data, thereby greatly increasing overhead, disk consumption, administration costs, and performance impact.

SQL Analytic Functions

Oracle9i Database provides SQL analytic functions that enhance both developer productivity and database performance. Basic business intelligence calculations such as moving averages, rankings and lead/lag comparisons can be done without requiring extensive programming. This makes it much faster and easier to develop Business Intelligence applications with much less coding. Key benefits are:

- *Improved Query Speed* - The processing optimizations supported by these functions enable significantly better query performance.
- *Enhanced Developer Productivity* - The functions enable developers to perform complex analyses with much clearer and more concise SQL code.
- *Minimized Learning Effort* - The analytic functions minimize the need to learn new keywords as the syntax leverages existing aggregate functions, such as SUM and AVG, so they can be used in extended ways.
- *Standardized Syntax* - As part of the ANSI SQL standard, these functions are attractive for independent software vendors.¹⁶

None of these analytic functions are in SQL Server 2000, so application development for comparable functionality requires extensive programming outside of standard SQL, thereby extending the development time. In addition, the complex application coding impedes performance since the operations are not performed in native SQL.

¹⁶ ISO/IEC 9075-1:1999/Amd.1:2000(E)
Information Technology - Database languages - SQL - Part 1:Framework

ENABLE AN ORGANIZATION TO DEVELOP AND DEPLOY BUSINESS SOLUTIONS QUICKLY

Business Value

Enterprises everywhere are developing Internet-based applications to take advantage of the ubiquity, affordability and the open standards of the Internet. However developing these applications is very challenging, placing numerous additional requirements on the development platform. Choosing the right development platform is critical to ensuring the success of these applications.

Oracle9i Database versus SQL Server 2000

Unlike other vendor solutions, the Oracle9i Database provides 100% support for all industry standards across all the major operating system and hardware architectures available today - from Linux to Windows to Unix to OS/390. The superior portability of Oracle9i Database empowers an organization to easily change its preferred hardware and operating system infrastructure, ensuring the right of an organization to choose the best price/performance offering from different vendors now and into the future. Any organization can leverage the Oracle9i Database to lower initial deployment costs and also remain flexible enough to meet future needs. The choice of Oracle as a database solution does not bind them to a particular hardware or operating system. This is particularly useful for independent software vendors because they can develop just once on Oracle9i Database and deploy anywhere.

SQL Server 2000 supports fewer hardware platforms than Oracle9i Database, and of course is limited to only the Windows operating system. Oracle supports all major hardware platforms and operating systems. SQL Server 2000 customers cannot develop once and deploy anywhere, due to their restriction to Microsoft platforms only.

Surveys indicate that most major packaged application vendors support Oracle databases first. This is true across all categories, including ERP, CRM, Procurement and Supply Chain. There are also more packaged applications deployed on Oracle than SQL Server 2000¹⁷. Due to the larger Oracle installed base, there are significantly more implementers with experience deploying packaged applications on Oracle than SQL Server 2000 .

Why Oracle9i Database Reduces Development Effort

Multi-Version Read Consistency Model

Oracle9i Database's unique multi-version read consistency model minimizes internal contention for data. By avoiding contention, the number of users who can simultaneously access data increases. SQL Server 2000 's flawed

¹⁷ According to Gartner report of May 2001, over 71% of SAP applications are deployed on Oracle, whereas only about 14% are deployed on SQL Server.

architecture can only offer this level of concurrency through application code, at the price of data accuracy, while lengthening both development time and code path.

Non-Escalating Row-Level Locking

Oracle9i Database's innovative method of row-level lock tracking eliminates the need for lock escalation, thus reducing the potential of deadlocks and increasing concurrency especially as the volume of transactions increases. In addition, application developers do not need to compensate for potential deadlock situations through application code, thereby reducing development time. SQL Server 2000's row-level locking model is constrained by the amount of available memory.¹⁸ Thus, SQL Server 2000 relies on lock escalation to conserve memory usage, at the expense of data concurrency. This translates into decreased data availability, especially during peak usage periods, and more extensive application coding to avoid dead lock scenarios.

Java Development

With Oracle9i Database stored procedures in the database can be implemented in PL/SQL or industry standard Java, which can then be executed in compiled or interpreted mode. Java stored procedures can embed SQL statements using the SQLJ syntax, which simplifies database programming in Java (for productivity and concise code) or they can use the usual JDBC syntax, using the embedded JDBC driver. J2EE components running in the middle tier will leverage Java stored procedures in the back-end database for handling data-bound and application-independent logic. It can also reduce network traffic. These Java stored procedures can then leverage the J2EE functionality provided in the middle tier with Oracle9i Application Server. Application developers can choose the language in which they are most proficient or which is most suitable for a task. PL/SQL is more suitable for SQL intensive procedures while Java would be preferred for more algorithmic or complex (logic) procedures. Java stored procedures in the database enable your complex business logic to be located close to the data, to minimize overhead.

This leverages the existing knowledge base of your developers, so retraining is minimized and existing skill sets are easily transferred. Additionally, Java developers are a growing population in the workforce, and so are more readily available. Native compilation of stored procedures in either Java or PL/SQL enhances performance. Additionally, the Java Virtual Machine in the database allows your java development efforts to leverage the functionality of the robust architecture of Oracle9i. The Java applications have full access to all the XML,

¹⁸ SQL Server 2000 Performance and Reliability presentation, <http://www.microsoft.com/usa/centralregion/sql10.ppt>

object, and multi-media data types resident in the database. This greatly simplifies database application development.

SQL Server 2000 does not support stored procedures in any language except their proprietary Transact-SQL language, so they can not write the complex business logic that is supported by Java. There is also no capability for native compilation, so it lacks the key performance benefits of compilation of Java or PL/SQL stored procedures.

In addition, Oracle9i Database supports Oracle JMS which is a standard implementation of the Java Messaging Services API, so developers can leverage that capability through a standard Java API, as well as leverage the existing message queuing capability of the Oracle9i database.

DO MORE FOR LESS

Business Value

In today's "round-the-clock" Internet economy, the importance of IT infrastructure to modern businesses needs no explanation. Enterprises are increasing their reliance on the Internet to reach new customers as well as to manage their operations more efficiently. A well-managed IT infrastructure, therefore, has become critical to the success of any business. A profitable business today not only needs reliable, high-performing applications to service its customers, but also must minimize its cost of operation to maximize profitability. This coupled with ever increasing shortage of skills in this area can quickly lead to spiraling management costs and can even hinder an organization's ability to remain competitive.

Oracle9i Database versus SQL Server 2000

Recognizing these demands, Oracle has made improved manageability of its products one of the primary goals of Oracle9i. The most significant manageability enhancement in Oracle9i is the complete integration of various components of the Oracle product stack. The components of Oracle9i Application Server and Database not only integrate seamlessly with each other but can also be managed from a single point of control using Oracle Enterprise Manager. In addition, the Oracle 9i Database has been significantly enhanced to simplify database administration and provide a high degree of self-management. From client to application server to database to host to network, Oracle9i has simplified, automated and centralized the monitoring and management of the complete e-business infrastructure, resulting in a higher quality of service and reduced management costs.

Microsoft's recommended implementation of SQL Server is either in a distributed database environment, or in a federated database architecture, where many different databases are connected together while a single application

accesses data across all these databases. The cost of management goes up dramatically when there are 32 databases to manage, administer, maintain, backup and upgrade! (That's the number of databases Microsoft required to achieve a high TPC-C benchmark.) Microsoft's approach is to distribute complexity. This would be a nightmare to implement in a real world business, compared to implementing and administering a single, more scalable database. Brian Moran, SQL Server Magazine editor says it all: "Microsoft sells ease of use and hesitates to point out that a SQL Server environment is often just as complex--and expensive--to manage as its UNIX counterparts."¹⁹

SQL Server 2000 lacks the depth of end-to-end management and self-management and tuning capabilities of the Oracle9i Database. For example, SQL Server Enterprise Manager does not allow for management and diagnostics of the entire system from a single Console.

Why Oracle9i Database Does More for Less

Service Level Reporting

Oracle Enterprise Manager can generate business level service reports covering service levels like application response time or system availability. These reports make it easy to see where potential performance problems may be developing. They also provide a record of your system's service over time. Administrators can also be alerted automatically when a service level has degraded too much. SQL Server Enterprise Manager does not provide this comprehensive level of reporting.

End-to-End Problem Diagnosis and Resolution

Starting from the point of the application user's experience, Oracle Enterprise Manager can drill down the application stack to diagnose problems at any point in the system: from application, middle-tier, database, host to network. Extensive monitoring, diagnostics and tuning tools allow administrators to quickly pinpoint and solve problems. Oracle Enterprise Manager's charts and graphical displays provide a complete view of the performance of the system. Problem areas are highlighted with visual alarms so potential performance issues are easily seen. Powerful diagnostics and tuning tools then enable diagnosis of the problem, whether it is in the application, middle-tier application server, database, host or network. As noted earlier, SQL Server Enterprise Manager is not capable of managing and diagnosing the entire stack from a single convenient Console.

¹⁹ SQL Server Magazine UPDATE News Editor, Jan. 2001

Built-In Expertise Reduces Overall Management Overhead

Oracle 9i includes built-in expertise and intelligence that guide administrators through many management tasks. Easy-to-use wizards and dialogs help new administrators become highly productive with little or no training. Most significant, however, is the intelligent monitoring, diagnostics and tuning provided by Oracle9i.

Oracle Enterprise Manager includes a comprehensive set of events that automatically monitor the entire Oracle environment. Administrators do not need to decide how to monitor their systems or what to monitor. Oracle9i also includes guided advice driven diagnostics that allow administrators to diagnose and resolve performance problems without extensive research or training. SQL Server does not provide monitoring and diagnostics guidance and thus requires its administrators to invest time in training.

Intelligent Workload Management

Oracle9i features a significantly enhanced Database Resource Manager with new capabilities such as automatic prioritization and proactive governance of any SQL statement. With its automatic prioritization feature, an Oracle9i database can detect long running operations and limit their resource consumption ensuring that the online users do not experience slow performance. Oracle9i Database Resource Manager also provides the ability to limit the number of concurrent long operations and prevent execution of highly resource intensive queries during certain times of the day. These capabilities allow for prioritization of work and provide almost unlimited system scalability without compromising performance.

SQL Server 2000 has no ability to prioritize work.

Lights-out Monitoring and Management

Oracle Enterprise Manager includes an advanced event management system which allows administrators to automatically monitor the system overall, as well as any of its components. For example, an administrator can be emailed or paged if the overall application response time goes above a threshold or when resource use is too high on specific host. In fact, the administrator can setup fixit jobs so that the event can be handled without any human intervention. Of course, this reduces the cost of administration tremendously since fewer administrators will be required to manage a larger number of Oracle databases. SQL Server's event monitoring is much less comprehensive and flexible, requiring administrators to set up additional monitoring to completely cover the entire managed environment.

CONCLUSION

Oracle9i Database's unique value propositions enable substantial IT cost savings that result in lower total cost of ownership. The following table summarizes the areas of cost reduction achieved through each of the value propositions:

	Software	Hardware	Support	Development	Consulting	Training	Downtime	Upgrade
Provide proven performance, scalability, and capacity on demand for any business requirement		✓	✓	✓			✓	✓
Guarantee that critical business information is available when needed	✓	✓	✓	✓			✓	✓
Secure and protect the privacy of sensitive business information	✓		✓	✓			✓	
Reduce the time it takes for a business to make better business decisions	✓	✓	✓	✓	✓			
Enable an organization to develop and deploy business solutions quickly				✓	✓			
Do more for less	✓	✓	✓			✓	✓	

The Oracle Database, backed by 20 years of technical innovation and experience, remains the number one database choice in the market.²⁰ With the Oracle Database, not only can immediate cost savings be realized, but the investment is also guaranteed for the future.

²⁰ 2000 DBMS Market Share analysis, Gartner DataQuest, May 2001



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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
www.oracle.com

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