August 2009

MANAGEMENT BRIEF

VALUE PROPOSITION FOR IBM DB2 9.7

Cost Savings Potential Compared to Oracle Database 11g

International Technology Group

4546 El Camino Real, Suite 230
Los Altos, California 94022-1069
Telephone: (650) 949-8410
Facsimile: (650) 949-8415
Email: info-itg@pacbell.net

TABLE OF CONTENTS

List of Figures

EXECUTIVE SUMMARY

Challenges and Opportunities

The pressure is on IT organizations to contain costs. Yet business demands must still be met, and in many cases, these are magnified by today's economic conditions. The mandate is to "do more with less."

Even if businesses are not growing, databases continue to expand, and costs for database software, storage systems and servers to support them continue to increase. Overall growth in data and storage volumes is routinely in the range of 30 to 50 percent per year, and may be higher in individual organizations.

At the same time, a broader shift is occurring. Demand for information now extends beyond specialist communities to include mass populations of internal users, as well as customers and business partners. Organizations must deal not only with data growth, but also with increasing database complexity, more frequent changes and updates, and the need to deliver new applications to increasingly diverse user groups.

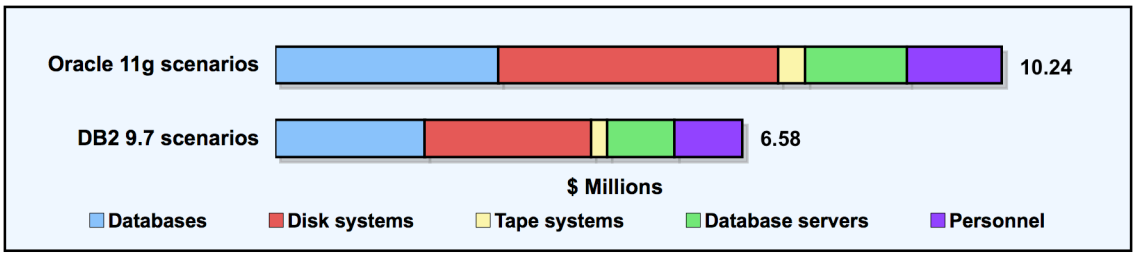
Demand for information is not reduced by a weak economy. As businesses seek to increase competitiveness and improve efficiency, the reverse is occurring. Informational applications have become one of the most critical areas of IT activity at a time of budgetary constraints and hiring freezes.

How will these challenges be met?

This report examines an option – use of IBM DB2 9.7 for Linux, UNIX and Windows as an alternative to Oracle Database 11g – that represents a major new opportunity for organizations to meet escalating demand while reducing IT costs.

In three installation examples presented in this report, use of DB2 9.7 results in combined three-year costs for database software, disk and tape storage systems, servers and personnel that average 36 percent less than those for use of Oracle 11g. Figure 1 illustrates these results.

Figure 1
Three-year Costs for Oracle 11g and DB2 9.7 Deployments: Averages for All Installations



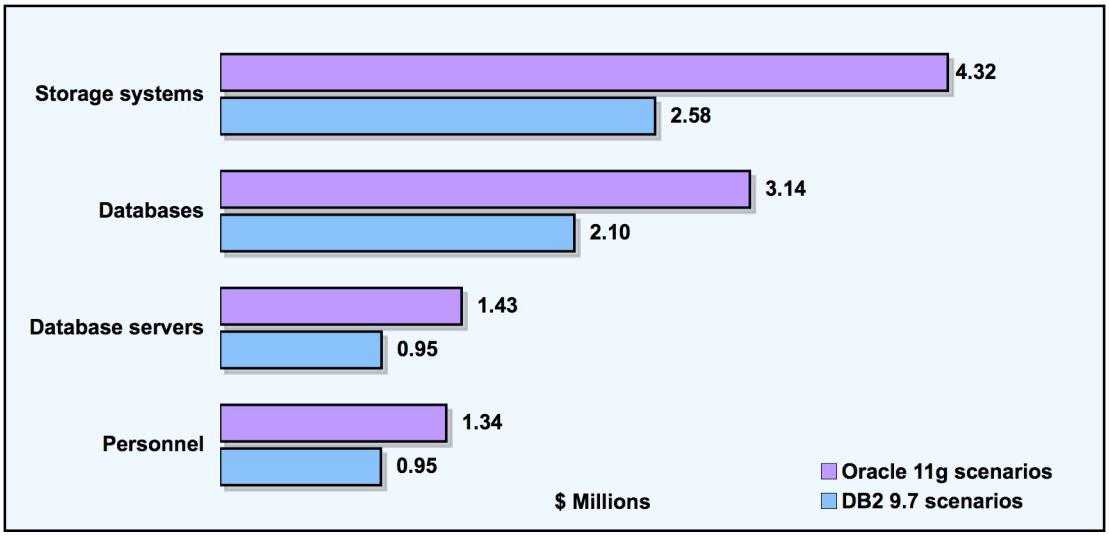
For most organizations, it will come as no surprise that DB2 9 databases are less expensive. IBM pricing has generally been more aggressive than Oracle, and DB2 incorporates tools that are available from Oracle only as separately charged options. Higher levels of database administrator (DBA) productivity for DB2 9 than for Oracle environments have also been widely documented, resulting in lower personnel costs.

The overall cost savings picture, however, is significantly broader. Higher levels of compression mean that less disk capacity is required than for Oracle-based systems. This generates savings in storage hardware and administration overhead and reduces costs for storage software tools priced on a per terabyte basis. Further economies are realized in tape systems and in replication and backup operations.

Higher compression levels as well as more efficient DB2 9.7 software structures also mean that less database server capacity is required. Further reductions in hardware, software, personnel, energy and cooling costs occur.

In the examples presented in this report, the largest savings are realized in storage (disk and tape) system costs. Figure 2 illustrates this picture.

Figure 2
Storage System, Database, Database Server and Personnel Costs for Oracle 11g and DB2 9.7 Scenarios: Averages for All Installations



The installations upon which these comparisons are based include billing, customer relationship management (CRM) and operational systems in a telecommunications company; a retail data warehouse; and an Extensible Markup Language- (XML) enabled core banking system.

Cost calculations are based on use of IBM Power servers, DS8100 and DS5300 disk systems, and TS3500 tape libraries, along with software typically employed with these. Calculations allow for database and workload growth over a three-year period.

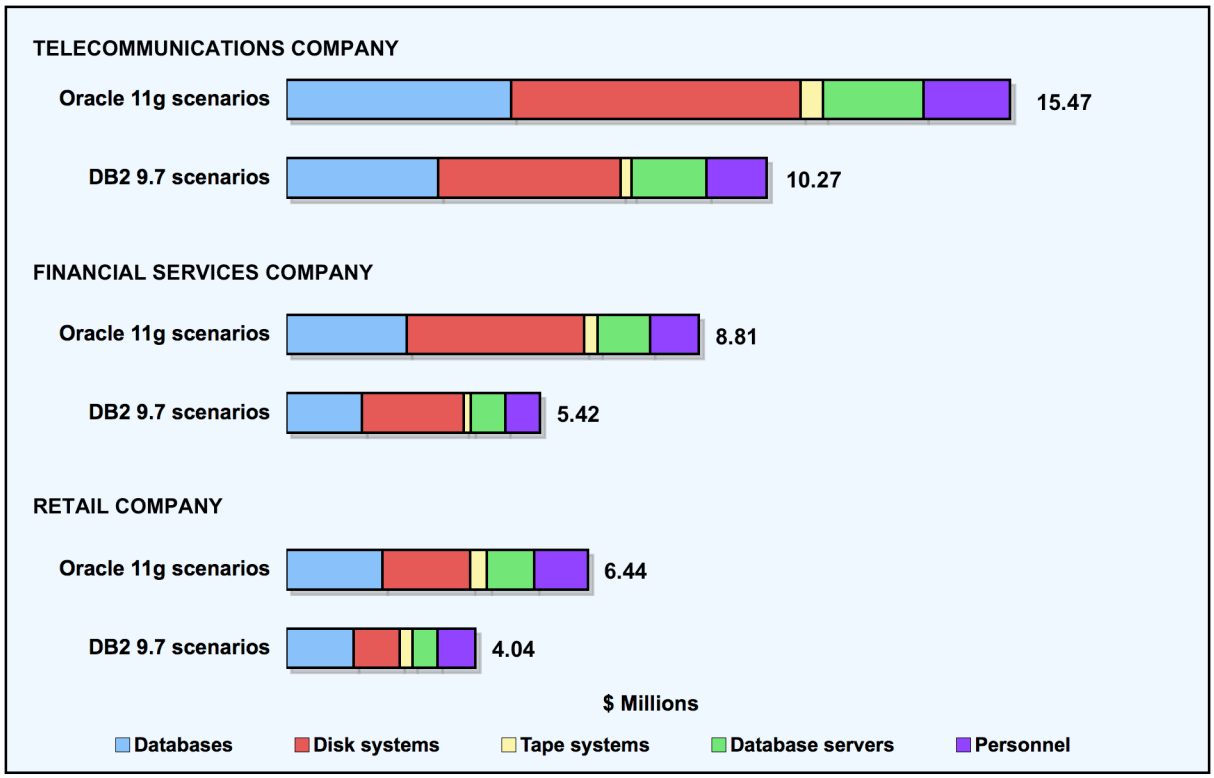
These platforms are recognized industry price/performance leaders, and IBM pricing for systems software and maintenance is generally more aggressive than that of competitors. Costs – and cost disparities – would typically be larger if equivalent storage systems and servers from other vendors were employed. In most cases, IBM platforms are also more-energy efficient than competitive equivalents.

There are some variations in comparative costs between installations that are illustrated in figure 3. Three-year costs for use of DB2 9.7 ranged from 34 to 39 percent less than for use of Oracle 11g.

Generally, however, differences in comparative costs were consistent across different types of application, including transactional as well as business intelligence (BI) systems.

Descriptions of installations, configurations, methodology and assumptions may be found in the Basis of Calculations section of this report.

Figure 3
Three-year Costs for Oracle 11g and DB2 9.7 Deployments by Installation



Positioning DB2 9.7

Operational Functions

The advantages of DB2 9 over Oracle 11g in compression, performance and DBA productivity that affect operational functions and costs became apparent after the introduction of version 9.1 in 2007. The latest version 9.7 extends these advantages.

The level of compression that may be realized is increased in DB2 9.7 with the addition of new index and temporary space compression capabilities, while a number of functions improve performance. This is particularly the case for larger, more complex database structures. Enhancements to automatic storage as well as in-memory monitoring further reduce the amount of time and effort required for DBA tasks.

Users have also found that higher levels of full time equivalent (FTE) DBA staffing for Oracle compared to competitive databases remain the norm with 11g. For a number of years, the industry "rule of thumb" has been that 25 to 35 percent more DBA time is required for Oracle than for DB2 environments.

It is likely that this disparity will increase with DB2 9.7. A key focus of DB2 9.7 productivity enhancements has been to reduce the amount of time required to perform ongoing changes to database schemas. Where such changes occur frequently, time savings will be significantly greater than in more stable environments.

XML Applications

DB2 9 capabilities designed to optimize performance and functionality for XML data content have also been enhanced in DB2 9.7.

DB2 9 pureXML provides full support for XML storage, indexing, queries, updates, and data management. The full range of DB2 9 capabilities – including database and range partitioning, multidimensional clustering, compression, query optimization and automation – have been extended to XML data content.

Oracle 11g also supports XML and has been adopted by a number of organizations for XML database applications. Users report, however, that DB2 9 typically delivers higher levels of performance.

XML capabilities are more deeply embedded in DB2 9.7 than is the case for Oracle 11g, and benefit from more advanced optimization functions. DB2 9.7 performance advantages are, again, particularly significant for more complex databases and queries.

Early experiences with DB2 9.7 also suggest that disparities in DBA productivity for XML-related tasks are, if anything, wider than for pure relational environments. This is particularly the case where it is necessary to perform frequent changes to data structures.

These strengths will become more significant over time. XML applications are, in most industries, at an early stage of development. Databases are typically small, and data structures, queries and transactional workloads are comparatively simple. However, this picture will clearly change.

Emerging industry standards such as Financial products Markup Language (FpML) and Financial Information eXchange (FIX) Protocol in financial services, ACORD XML in insurance, and Health Level Seven (HL7) in health care all employ complex schemas. It can be expected that applications implementing them will undergo frequent changes and enhancements.

From this perspective, DB2 9.7 is – by a wide margin – better designed and optimized to deal with the future evolution of the XML world than any competitive database.

Conclusions

In comparing the capabilities of Oracle 11g and DB2 9.7, certain themes recur. First, DB2 9.7 is designed to deliver high levels of system efficiency and administrator productivity across the entire infrastructure of servers, storage systems and software that support database applications.

Second, the strengths of DB2 9.7 are particularly relevant to database environments that are characterized by complex database schemas, large data volumes, diverse workloads, and frequent changes and enhancements. This is the case for pure relational as well as XML environments.

In particular, key DB2 9.7 capabilities in automation, workload management and related areas are better optimized for such environments than is the case for Oracle 11g.

Third, to a much greater extent than Oracle 11g, DB2 9.7 is designed to handle large-scale XML databases and applications with the same levels of performance and functionality as for relational environments.

The cost comparisons presented in this report are based on present-day applications. However, DB2 9.7 design parameters are geared more closely to the way in which data structures, application portfolios and workload mixes will evolve over the next five years than is the case for Oracle 11g. It can be expected that cost disparities in favor of DB2 9.7 will widen over time.

COST VARIABLES

Costs of Ownership

General Picture

Decades of experience have shown that, in comparing the costs of different platforms or solutions, it is important to address overall costs of ownership over time. Cost of ownership comparisons typically include not only initial hardware and software acquisitions, but also costs of upgrades as well as maintenance, software support, personnel, facilities and other recurring items over multi-year periods.

Cost of ownership analysis is particularly useful in evaluating database-related costs. The performance and efficiency of a database management system generate "ripple effects" that extend through and affect multiple segments of organizational IT infrastructures.

In the comparisons presented in this report, database software costs – meaning licenses and support – for Oracle 11g represent less than a third of overall three-year costs. Storage systems, database servers and personnel costs account for the remainder.

As the results presented in this report indicate, capability differences between Oracle 11g and DB2 9.7 affect a wide range of cost components.

The effects of these differences tend to overlap. Two examples of such overlaps – in the areas of compression and automation – are discussed below.

Certain conclusions may be drawn. One is that differences in database capabilities may affect a wide range of IT costs. Another is that the combined impact of these differences may be such that "the whole is more than the sum of the parts." This is clearly the case for DB2 9.7.

Compression

DB2 9.7 compression enables higher levels of physical capacity utilization and reduces memory and I/O costs for storage systems and database servers. Compression also increases I/O throughput, which translates into faster query and transaction performance; i.e., the same amount of work may be performed with fewer resources.

Further economies may be generated in systems, media and administrator time for backups, replication, and other data management and movement processes. Costs of wide area network bandwidth may also be materially reduced.

Higher compression levels overlap with the lower overhead of DB2 9.7 software structures in improving performance and reducing database server costs. In addition, DB2 9.7 compression operates in a highly efficient manner. Although high levels of compression may also be realized using Oracle 11g Advanced Compression, the impact on performance is significantly greater.

Oracle 11g compression rates are typically in the 20 to 30 percent range – many users find performance degradation at higher levels to be unacceptable – while early DB2 9.7 users have routinely employed 60 to 80 percent compression rates with negligible effects on processor performance.

Automation

DB2 9.7 automation capabilities affect infrastructure as well as personnel costs. Automated tuning and optimization functions, as well as workload management enhancements introduced by IBM in DB2 9.5, allow for more efficient use of server resources over time. This may be reflected in lower server costs or improved quality of service for the same cost.

The effects of workload management should be highlighted. DB2 9.7 workload management capabilities are derived from mainframe architecture, and draw upon mainframe strengths in managing diverse concurrent workloads. These capabilities are significant not only for transactional systems, but also increasingly for BI applications.

One of the key transitions that has occurred in BI deployment is that numbers of applications and users have expanded rapidly. Organizations are faced with the need to handle increasingly diverse queries with varying workload characteristics, priorities and degrees of time sensitivity.

Challenges are magnified by the growth of "operational BI" applications supporting front-line personnel such as customer service representatives and salespeople. Such applications typically require response times measured in seconds.

The overall query mix may thus become highly complex. Figure 4 shows an example of such a mix in a large financial institution. Numbers of queries refers to queries that are in the data warehouse job queue during peak hours.

Figure 4
Data Warehouse Mixed Query Workload: Example

Query Type	Operational	Small	Medium	Large
Number of queries	200	1,500	1,000	200
Required response time	0.3 to 5 seconds	30 seconds to 14 hours	30 seconds to 14 hours	30 minutes to 24 hours

If there is inadequate automation, administrator staffing levels and costs will expand. It will be necessary to monitor and tune performance continuously to avoid bottlenecks resulting in unacceptable response times. Administration tasks will become more difficult and time-consuming as numbers of users and applications expand, query patterns change, and workload complexity increases.

DB2 9.7 workload management capabilities are designed to deal with such environments. They enable highly granular, automated prioritization, resource allocation, queuing, and real-time monitoring and management of workloads generated by hundreds to thousand of separate query jobs. Priorities may be set based on user group, query type, time of day and/or other variables.

The DB2 self-tuning memory manager (STMM), for example, automatically adjusts memory configuration parameters and buffer pool sizes as workload characteristics change. This feature, which represents one of the industry's most advanced self-tuning technologies, maintains continuous performance optimization without administrator intervention.

Key benefits include highly efficient use of system resources, as well as the ability to set and realize service level agreement (SLA) objectives even for large user populations employing a wide range of diverse applications.

Cost Components

Storage Systems

Higher levels of compression mean that less physical disk and tape capacity is required for DB2 9.7-based systems. This translates into lower hardware acquisition and maintenance costs.

In addition, storage software products are commonly priced on a per terabyte basis. Where this is the case, savings can be expected in license and support fees.

Examples of such products, which are employed for calculations presented in this report, include IBM FlashCopy (point-in-time copy), Global Mirror (asynchronous replication), Metro Mirror (synchronous replication) and Tivoli Storage Productivity Center (storage management). Comparable products from other vendors are priced in a similar manner in most cases.

Reductions in costs for backup tape media, and for handling and secure storage of cartridges can be expected. Savings also occur if disk systems are employed for backup and archival storage.

Database Servers

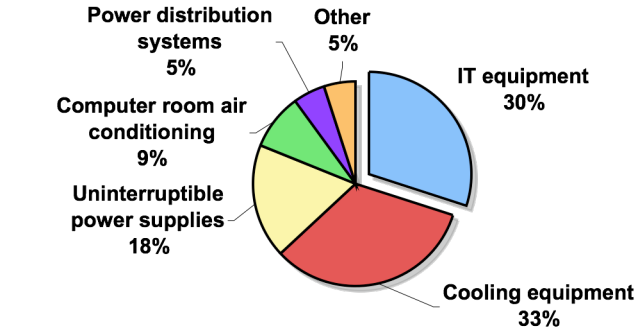
Higher levels of server performance, along with more streamlined memory and I/O configurations, translate into hardware and maintenance savings. License and support costs for systems software products that are priced based on numbers of processors or equivalent metrics may also be reduced.

For storage systems as well as database servers, smaller configurations result in lower facilities costs for data center occupancy, power and cooling.

The impact is particularly significant if allowance is made for acquisition, maintenance, support and occupancy costs of uninterruptible power supplies (UPS), power distribution systems (PDS), chillers and other equipment. Power consumption by such equipment is proportional to the systems it supports.

One industry estimate, illustrated in figure 5, is that approximately 70 percent of typical data center energy consumption is accounted for by data center infrastructure equipment.

Figure 5
Typical Data Center Energy Consumption by Type of Equipment



Source: American Power Conversion

The actual power impact of a server or storage system may thus be three to four times higher than appears to be the case. The implications for overall facilities costs are correspondingly greater.

Use of DB2 9.7 provides opportunities not only to lower energy costs, but also to contribute to the realization of broader environmental objectives such as reducing organizational carbon footprints.

Personnel Costs

Lower FTE staffing levels for database and storage administration tasks translate into lower personnel costs. Realistic calculations would include not only salaries, but also such items as bonuses, benefits and training. Some organizations also allow for occupancy, overhead and other costs per FTE.

Organizations that have migrated to DB2 9.7 have realized DBA productivity gains primarily by reducing the amount of time spent on comparatively low value repetitive tasks. It makes little sense that database administrators – who are among the most highly trained, highest-paid individuals in IT organizations – should spend much of their time performing manual labor.

Even if FTE staffing levels could be reduced, few organizations would lay off experienced administrators. Organizations that have migrated to DB2 9.7, however, have found that higher levels of productivity make it easier to meet new challenges without increasing headcounts, and to apply the skills of key personnel to other projects and operational tasks.

The benefits of lower DB2 9.7 staffing may thus in practice translate into cost avoidance (it is not necessary to add personnel to deal with increasing database complexity, new application deployment and storage growth), improvements in quality of service experienced by users, or – if the transition to DB2 9.7 is properly managed – both may be realized.

Network Costs

High levels of compression mean that less bandwidth is required to transfer data between systems and locations. This may result in incremental savings in local area network costs, although the effects of this would typically be small and difficult to quantify. The potential impact on wide area network costs, however, may be a great deal more significant.

Many organizations practice remote real-time replication using synchronous or asynchronous technologies to guard against the effects of an outage disabling or destroying an entire data center. As data is transmitted continuously, and at high speed between sites, telecommunications carrier costs may represent a major component of overall costs of ownership.

Network infrastructure costs may also be substantial. High-speed Dense Wave Division Multiplexer (DWDM) or Coarse Wave Division Multiplexer (CWDM) technology will often be required to provide sufficient bandwidth, and network components are usually duplexed to ensure redundancy. Reductions in data volumes may lower all of these costs.

(Comparisons presented in this report do not include network costs. However, organizations with high remote replication volumes may wish to consider the potential effects of, say, a 40 to 60 percent capacity reduction on their carrier and network infrastructure expenditures for disaster recovery.)

Migration Costs

A further area of potential cost reduction should be highlighted: functions built into DB2 9.7 minimize the costs and difficulties that organizations are likely to experience migrating from Oracle databases.

Experiences with database migrations have shown that these typically involve a range of costs, including conversion of data and applications, as well as retraining of DBAs and developers to work with new tools, or hiring of new specialists. A loss of productivity may also be expected as organizations adapt to new technologies and practices.

Early experiences with migration from Oracle databases to DB2 9.7, however, have shown that these effects are minimal. This reflects a number of DB2 9.7 features, including native support for Oracle Procedural Language/Structured Query Language (PL/SQL) and the Oracle SQL dialect, along with a wide range of code, tools and functions commonly employed by Oracle developers.

Oracle compatibility functions are built into the DB2 9.7 engine rather than implemented in the form of a software overlay. Organizations migrating applications from Oracle thus benefit from the same levels of performance as native DB2 9.7 users.

Organizations that have migrated Oracle applications to DB2 9.7 have routinely found that more than 95 percent of code has remained unchanged, and 98 percent and higher levels have been reported. Few or no changes to existing Oracle development tools and skills have been required, and transition periods have been short – in some cases, less than two weeks – and largely non-disruptive.

Migration costs and difficulties thus do not represent a significant offset to the savings that Oracle users may realize by moving to DB2 9.7.

BASIS OF CALCULATIONS

Overview

The cost comparisons presented in this report were developed using a three-phase approach. First, three profiles of installations in telecommunications, retail and financial services companies were prepared.

Second, scenarios were developed for use of Oracle 11g and DB2 9.7 in each installation. Allowance was made for differences in database, storage and server configurations, and in staffing levels for database, server and storage administrators due to the DB2 9.7 capabilities described earlier. Third, three-year costs were calculated for each installation and scenario.

These phases are described below.

Installations

Installation profiles are summarized in figure 6.

Figure 6
Installation Profiles Summary

	Telecommunications Company	Retail Company	Financial Services Company
Business Profile	Wireless & Internet access services provider $1.5 billion sales 2 million subscribers 5,000+ employees	Grocery retailer $10 billion sales 50,000+ employees 600+ stores	Diversified retail bank $30 billion assets 7,500 employees 200+ branches 5+ million accounts
Applications	Billing, CRM, operational systems & data store	Analytical data warehouse	Core banking system

Installations are composites drawing on the experiences of multiple companies of approximately the same size, in the same industries, with generally similar application, database and workload profiles employing Oracle as well as DB2 databases.

This approach was adopted to ensure that installation details were generally representative of the industries, applications and workloads upon which comparisons were based; and to protect the confidentiality of individual organizations.

Overall, 10 companies supplied data on applications, database sizes, workloads, server and storage configurations, software stacks, staffing levels, growth rates and other variables, which was used to construct installations and scenarios.

Scenarios

Scenarios include database, disk system and tape system configurations, along with FTE staffing levels for database, storage and server administration tasks affected by capability differences between Oracle 11g and DB2 9.7.

Oracle 11g scenarios for each installation represent baselines for calculations. For DB2 9.7 scenarios, configurations and staffing levels were reduced using the following values:

- ***Data compression***. Calculations assume a DB2 9.7 compression rate of 50 percent relative to Oracle 11g. User experiences indicate that this value is generally applicable.

  Compression rates are, however, highly dependent of the both the nature of the data and the database environment, and results may vary. Organizations should ask vendors to assist in measuring actual rates for their installations.

  Compression affects calculations for disk and tape system capacities, backup operations and tape media consumption, and contributes to database server performance.

- ***Database server performance***. Calculations assume that database servers in DB2 9.7 scenarios deliver 20 percent higher performance net of processor compression overhead.

  This is a conservative value. Some users have reported improvements of up to 40 percent.

- ***FTE staffing***. Calculations assume a 25 percent lower FTE headcount in DB2 9.7 scenarios for DBA tasks, while storage and server administrator FTE staffing is reduced in DB2 9.7 scenarios to reflect differences in used capacity for each scenario.

  This is again a conservative value. FTE headcounts of up to 43 percent less have been reported.

These values assume that database software, server and storage resources for Oracle 11g as well as DB2 9.7 scenarios are configured and managed in an efficient, best practice manner.

Configurations

Configurations were developed as follows:

- ***Databases***. Calculations were based on Oracle 11g Enterprise Edition with Advanced Compression and DB2 9.7 Enterprise Server Edition with Storage Optimization Feature. Oracle management tools providing capabilities equivalent to DB2 9.7 were included in Oracle 11g scenarios. For the retail data warehouse, Oracle 11g Partitioning and DB2 9.7 database partitioning feature (DPF) were also employed.

- ***Disk systems***. Calculations were based on use of IBM DS8000 and DS5300 disk systems equipped with 450-gigabyte (GB) Fibre Channel drives operating at 15,000 revolutions per minute (15K rpm). Systems were configured and upgraded in increments of 7.2 TB, corresponding to 16 x 450 GB drives.

  Allowance was made for capacity growth rates of 30 percent per year for telecommunications company systems, 40 percent per year for the retail data warehouse, and 33 percent per year for the core banking system employed by the financial services company.

  Systems were equipped with IBM Operating Environment License (OEL), FlashCopy and Tivoli Storage Productivity Center (TPC) software. IBM Global Mirror and Metro Mirror tools were also employed for business-critical systems for the telecommunications and financial services company installations respectively.

- ***Tape systems***. Calculations were based on use of IBM TS3500 Tape Library systems employing Linear Tape Open Ultrium Generation 4 (LTO-4) drives and 800 GB Data Cartridges.

Systems were configured based on size of backup data volumes, and on the frequency and duration of backup operations. Allowance was made for growth in backup volumes, which paralleled capacity growth rates for disk storage systems over three-year periods.

- ***Database servers***. Calculations were based on IBM Power 570 or, for larger configurations, 595 servers with 4.2 GHz POWER6 processors, AIX 6.1 operating systems and the IBM PowerVM solution enabling use of logical partitions (LPARs) and other virtualization functions.

  For Oracle 11g and DB2 9 scenarios for the telecommunications and financial services company installations, servers were configured in failover clusters using IBM PowerHA software.

Configurations and staffing levels for Oracle 11g and DB2 9.7 scenarios for profile installations are summarized in figures 7 and 8.

Figure 7
Configurations and Staffing Summary: Oracle 11g Scenarios

Telecommunications Company	Retail Company	Financial Services Company
DATABASES		
Oracle 11g Enterprise Edition Diagnostics Pack, Tuning Pack Configuration Management Pack Advanced Compression	Oracle 11g Enterprise Edition Partitioning, Diagnostics Pack, Tuning Pack, Configuration Management Pack, Advanced Compression	Oracle 11g Enterprise Edition Diagnostics Pack, Tuning Pack Configuration Management Pack, Advanced Compression
DISK SYSTEMS		
Initial Configuration		
2 x DS8100 x 64.8 TB *Global Mirror, FlashCopy, TPC* 1 x DS5300 x 21.6 TB *FlashCopy, TPC*	1 x DS5300 x 64.8 TB *FlashCopy, TPC*	2 x DS8100 x 36.0 TB *Metro Mirror, FlashCopy, TPC*
End of Period Configuration		
2 x DS8100 x 136.8 TB *Global Mirror, FlashCopy, TPC* 1 x DS5300 x 50.4 TB *FlashCopy, TPC*	2 x DS5300 x 93.6 TB *FlashCopy, TPC*	2 x DS8100 x 79.2 TB *Metro Mirror, FlashCopy, TPC*
TAPE SYSTEMS		
Initial Configuration		
TS3500 6 x LTO-4	TS3500 4 x LTO-4	TS3500 3 x LTO-4
End of Period Configuration		
TS3500 12 x LTO-4	TS3500 9 x LTO-4	TS3500 7 x LTO-4
DATABASE SERVERS		
Initial Configuration		
2 x 570 (32 x 4.2 GHz) *AIX, PowerHA*	1 x 570 (16 x 4.2 GHz) *AIX*	2 x 570 (12 x 4.2 GHz) *AIX, PowerHA*
End of Period Configuration		
2 x 595 (40 x 4.2 GHz) *AIX, PowerHA*	1 x 570 (32 x 4.2 GHz) *AIX*	2 x 570 (24 x 4.2 GHz) *AIX, PowerHA*
PERSONNEL		
Initial FTEs		
4.25	2.5	2.35
End of Period FTEs		
5.05	3.1	2.8

Figure 8

Configurations and Staffing Summary: DB2 9.7 Scenarios

Telecommunications Company	Retail Company	Financial Services Company
DATABASE		
DB2 9.7 Storage Optimization Feature	DB2 9.7 Database Partitioning Feature Storage Optimization Feature	DB2 9.7 Storage Optimization Feature
DISK SYSTEMS		
Initial Configuration		
2 x DS8100 x 36.0 TB *Global Mirror, FlashCopy, TPC* 1 x DS5300 x 14.4 TB *FlashCopy, TPC*	1 x DS5300 x 36.0 TB *FlashCopy, TPC*	2 x DS8100 x 21.6 TB *Metro Mirror, FlashCopy, TPC*
End of Period Configuration		
2 x DS8100 x 72.0 TB *Global Mirror, FlashCopy, TPC* 1 x DS5300 x 28.8 TB *FlashCopy, TPC*	1 x DS5300 x 93.6 TB *FlashCopy, TPC*	2 x DS8100 x 43.2 TB *Metro Mirror, FlashCopy, TPC*
TAPE SYSTEMS		
Initial Configuration		
TS3500 3 x LTO-4	TS3500 2 x LTO-4	TS3500 2 x LTO-4
End of Period Configuration		
TS3500 6 x LTO-4	TS3500 5 x LTO-4	TS3500 4 x LTO-4
DATABASE SERVERS		
Initial Configuration		
2 x 570 (24 x 4.2 GHz) *AIX, PowerHA*	1 x 570 (16 x 4.2 GHz) *AIX*	2 x 570 (12 x 4.2 GHz) *AIX, PowerHA*
End of Period Configuration		
2 x 570 (32 x 4.2 GHz) *AIX, PowerHA*	1 x 570 (24 x 4.2 GHz) *AIX*	2 x 570 (16 x 4.2 GHz) *AIX, PowerHA*
PERSONNEL		
Initial FTEs		
3.05	1.85	1.7
End of Period FTEs		
3.45	2.2	2.0

Cost Calculations

All hardware, software, maintenance and software support costs for databases, storage systems and database servers were calculated using discounted "street" prices.

Costs include the following:

- ***Database costs***. These include license acquisition for Oracle 11g and DB2 9.7 Enterprise editions, as well as for related products based on per processor prices; three years of Oracle Software Update License and Support coverage; and two years of IBM Software Subscription and Support coverage (in IBM pricing, the first year of coverage is included in the initial license fee).
- ***Storage system and database server costs***. Costs include hardware acquisition and three-year maintenance coverage, and license and three-year support costs for software products. Costs of IBM OEL for DS8000 systems are included in hardware costs.

Hardware maintenance costs, as well as support costs for FlashCopy, Global Mirror and Metro Mirror software for DS8100 systems were calculated based on four-year warranty options offered by IBM. Calculations for all other IBM hardware and software products assume standard warranties. All maintenance and software support costs are for 24x7 coverage.

Costs for tape systems include costs for acquisition, handling and secure storage of cartridges.

- ***Personnel costs***. These were calculated using annual average FTE salaries of U.S. $97,607 and $95,058 per year for Oracle 11g and DB2 9.7 database administrators respectively, and $79,316 for system administrators and $68,312 for storage administrators for both sets of scenarios. All salaries were increased by 49.7 percent to allow for benefits, bonuses, training and related items.
- ***Facilities costs***. These were calculated for all hardware platforms using IBM specifications. Calculations include costs for data center occupancy and power, including allowance for costs for data center infrastructure equipment.

  Power costs were calculated based on specific utilization levels and hours of operation for each installation. A conservative assumption for average price per kilowatt/hour was employed to determine three-year costs.

  Occupancy costs were calculated using a conservative assumption for annual average cost per square foot for existing facilities (i.e., costs do not include new facilities construction).

All costs are for the United States.

ABOUT THE INTERNATIONAL TECHNOLOGY GROUP

ITG sharpens your awareness of what's happening and your competitive edge . . . this could affect your future growth and profit prospects

The International Technology Group (ITG), established in 1983, is an independent research and management consulting firm specializing in information technology (IT) investment strategy, cost/benefit metrics, infrastructure studies, deployment tactics, business alignment and financial analysis.

ITG was an early innovator and pioneer in developing total cost of ownership (TCO) and return on investment (ROI) processes and methodologies. In 2004, the firm received a Decade of Education Award from the Information Technology Financial Management Association (ITFMA), the leading professional association dedicated to education and advancement of financial management practices in end-user IT organizations.

The firm has undertaken more than 100 major consulting projects, released approximately 160 management reports and white papers, and delivered nearly 1,800 briefs and presentations to individual clients, user groups, industry conferences and seminars throughout the world.

Client services are designed to provide factual data and reliable documentation to assist in the decision-making process. Information provided establishes the basis for developing tactical and strategic plans. Important developments are analyzed and practical guidance is offered on the most effective ways to respond to changes that may impact or shape complex IT deployment agendas.

A broad range of services is offered, furnishing clients with the information necessary to complement their internal capabilities and resources. Customized client programs involve various combinations of the following deliverables:

Status Reports	In-depth studies of important issues
Management Briefs	Detailed analysis of significant developments
Management Briefings	Periodic interactive meetings with management
Executive Presentations	Scheduled strategic presentations for decision-makers
Email Communications	Timely replies to informational requests
Telephone Consultation	Immediate response to informational needs

Clients include a cross section of IT end users in the private and public sectors representing multinational corporations, industrial companies, financial institutions, service organizations, educational institutions, federal and state government agencies as well as IT system suppliers, software vendors and service firms. Federal government clients have included agencies within the Department of Defense (e.g. DISA), Department of Transportation (e.g. FAA) and Department of Treasury (e.g. U.S. Mint).

International Technology Group

4546 El Camino Real, Suite 230
Los Altos, California 94022-1069
Telephone: (650) 949-8410
Facsimile: (650) 949-8415
Email: info-itg@pacbell.net

IML14187-USEN-00