Microsoft® SQL Server™ 2008

Comparing SQL Server 2008 to IBM DB2 9.5

SQL Server Technical Article

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Summary: With the release of Microsoft® SQL Server® 2008, Microsoft has significantly raised the bar in terms of performance, scalability, and security of the SQL Server database platform---enabling it to handle the most demanding data warehouse and business intelligence applications.

Offering industry leading price-performance on commodity hardware, high availability, and improved management tools SQL Server 2008 provides customers with a proven database platform at a cost far less than IBM DB2 v9.5. When coupled with Microsoft's global partner ecosystem that provides solutions, services and support; the SQL Server 2008 database platform offers one of the best return-on-investment platforms for customers.

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Introduction

In this whitepaper, we take an in-depth look at the key aspects of the SQL Server 2008 data platform as compared to the IBM DB2 9.5 data platform.

We begin with an overview of SQL Server market adoption, which is currently the fastest in the industry, and compare the licensing models of SQL Server 2008 over IBM DB2.

In subsequent chapters, we provide detailed discussions of the technical capabilities of the SQL Server data platform covering the key areas of: performance and scalability; high availability; security; manageability; developer productivity; business intelligence, data warehousing; and OLTP capabilities---and how it compares to IBM DB2 9.5. We also include references to relevant customer case studies and present evidence from independent consultant/analyst reviews that are relevant to the use of SQL Server 2008 as a data platform for mission critical enterprise applications.

Background

Microsoft is the fastest growing Database vendor
Microsoft's SQL Server product has consistently maintained a leadership position in terms of growth in the database segment. IDC has recognized Microsoft as the fastest growing database vendor, and among those with the highest revenue earnings from RDBMS license sales. According to Gartner, Microsoft currently has a 17.40% share of the relational database market; and "Microsoft experienced growth rates (in database sales) above the industry average at 28 percent, while IBM trailed in terms of growth". By contrast, the volume of database sales of the IBM DB2 data platform has not seen any significant improvements over the last year.

SQL Server ships more units than Oracle database and IBM DB2 combined
In 2007, Microsoft DB shipments were higher than IBM by more than a factor of 5. The Gartner 2006 report on worldwide RDBMS market share shows that the growth rate for Microsoft SQL Server has been almost twice that of the nearest competitor. This growth is strengthened and supported by Microsoft's global partner ecosystem, which provides a range of solutions and services to empower customers.

Microsoft leads in market share in Business Intelligence and Reporting Tools
Microsoft has shown significantly greater growth in Data Warehousing, and Business Intelligence in comparison to IBM DB2. According to Gartner's 2006 Worldwide Relational Database Market analysis, Microsoft now ranks among the top three database vendors. According to IDC SQL Server Data Warehousing revenue has grown by 23%; Business Intelligence Tools earnings have increased by 28% (the highest among the top 10 vendors ranked by IDC; and revenue from the database has improved by 19.8%. Microsoft has 8 times the market share of the Business Intelligence Tools market compared to IBM, and has shown more than twice the growth of IBM in the Business Intelligence tools market. Microsoft also leads in terms of reporting tools as well, with more than 9 times the market share and more than twice the growth rate of IBM.

In addition, Microsoft SQL Server is recognized as the #1 OLAP Server on the market, according to the OLAP report; and CRN Magazine has recognized Microsoft SQL Server as a Best Seller and Top Growth Best Seller. Thus, Microsoft's distinct lead over competitors including IBM is well established in the Business Intelligence context.

Microsoft offers both stand-alone and attached Business Intelligence Tools
Microsoft's offering in the Business Intelligence market is different from vendors such as IBM in that its Business Intelligence tools revenue is not only made up of standalone software (e.g. ProClarity) but also includes embedded BI tools that are included with Microsoft SQL Server. These database-embedded tools include SQL Server Analysis Services and Reporting Services. As part of its broader business analytics offerings, Microsoft also includes SQL Server Integration Services within SQL Server. Its other related tools that the company positions within the business analytics stack include Microsoft Excel, with specific Microsoft Excel features for Business Intelligence, and Performance Point Server, a set of performance management applications.

Customers are migrating to Microsoft SQL Server from IBM DB2
As a result of the growing capability and maturity of the SQL Server platform and its strong market momentum and partner ecosystem support, a number of customers are transitioning from IBM's DB2 to the SQL Server platform, as evidenced in the following customer case studies:

Case Studies: Customers migrating to SQL Server from IBM DB2	
Scandinavian Airlines (SAS)	*New Data Warehouse Improves Access to Key Business Data, Reduces Costs by 50%*
The Progressive Group	*Progressive Prepares for Future Growth, Gains Agility with SQL Server*
Bovespa: Brazilian stock exchange	*Brazilian Stock Exchange Ushers in New Era with SQL Server–based Infrastructure*

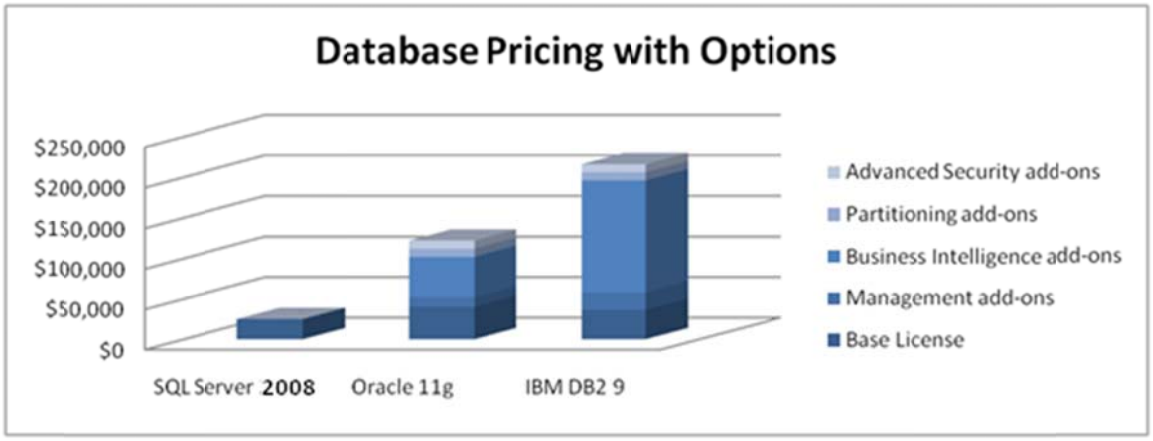
Business Value Proposition

This chapter explains the Microsoft SQL Server customer value proposition, highlighting the key factors influencing customers' decisions about upgrading/migrating their business data platform to SQL Server 2008.

Lowest TCO

SQL Server 2008 offers lower cost than IBM DB2 in each of the major areas that contribute to total cost of ownership (TCO)
SQL Server 2008 has a lower initial acquisition cost than IBM DB2. List price licensing fees are lower for SQL Server than for IBM DB2; and when combined with superior price-to-performance ratio SQL Server also has lower hardware costs than mainframe based solutions. In addition, SQL Server 2008 automates, streamlines, or eliminates many routine database management tasks, reducing the costs associated with database administration.

The chart below presents a comparison of cost components for the SQL Server, IBM DB2, and the Oracle databases.



An Overview of TCO for Leading Database platforms [from the Database Pricing Whitepaper]

SQL Server has a better TCO than IBM DB2 because of its lower cost of administration and services

A review of international trends in payrolls of administrators of popular relational database engines indicates that SQL Server administration services can typically be more economical than those of IBM DB2. Savings in such costs are compounded with the time saving administration tools and wizard driven features included with SQL Server 2008.

SQL Server 2008 provides features that customers of IBM DB2 must buy as add-ins

This includes all the Business Intelligence capabilities, reporting, analysis, ETL, XML capabilities, data warehousing, security and performance optimization.

IBM DB2 is generally considered to be an expensive product to license. When all options are taken into consideration, IBM DB2 could be 5-6 times more expensive than SQL Server. When multi-core licensing is taken into account, the multiple could be even higher. As a result, not only can SQL Server 2008 have a lower purchase price and a lower ongoing TCO, it also can yield a higher return on investment.

Flexible Licensing Model

Microsoft has adopted a simple multi-core licensing policy, which reduces enterprise software costs by licensing physical processors, not cores. For Microsoft software that is licensed on a per-processor basis. Licensing requirements are determined by the number of processors, and not the number of cores. IBM has more complex licensing policies such as licensing per core or by processor value unit, and customers can end up paying substantially more for multi-core systems.

When evaluating different databases, it is important to note what functionality is included in the base product and what can only be obtained through the purchase of additional options. For example, IBM provides only limited functionality in their base DB2 database product, requiring you to separately purchase "options" or "add-ons" to achieve the functionality that is required for real-world deployment. These options can sometimes end up costing more than the base product itself. By comparison, Microsoft customers do not have to buy any additional options or add-ons to meet the deployment requirements for most real-world database applications.

Microsoft SQL Server proves to be a cost-effective solution that meets users' high service-level expectations. With savings across hardware, software, operations, and maintenance, the benefits of SQL Server are substantial.

Simplified Product Line

SQL Server has a single well defined and easily understood database product line. By contrast, the large number of database related product SKUs and options for IBM can make it confusing and expensive for both customers and partners to acquire the products that they need to implement a solution.

Microsoft's easy to understand product offering, tightly interoperable functionality, and lower cost of ownership creates a compelling business case for SQL Server over IBM DB2 for customers assessing the two database platforms. In comparison, there are five families of database servers sold by IBM with no indication of which one is the primary database server or a clear roadmap. IBM DB2 offers nine different tools for DBAs alone, and all of these must be acquired separately.

IBM lacks a tightly integrated/packaged BI tools suite for DB2
Although IBM has recently acquired Cognos and has partnerships with Business Objects in order to offer reporting and analytic capabilities these technologies have not been tightly integrated into the IBM DB2 platform. In addition, this functionality has not been packaged to suit a wide-range of customer needs, and is priced and licensed separately further increasing the overall cost of acquisition of an IBM DB2 solution.

The following case studies illustrate the reasons why customers have selected Microsoft SQL Server over IBM DB2 in a head-to-head comparison of the two platforms:

Case Studies: SQL Server selected over IBM DB2	
State of Alaska Dept of Revenue	*New 7 Terabyte Data Warehouse for the State of Alaska*
Countrywide Home Loans	*Countrywide Home Loans chooses SQL Server over IBM DB2*
Borgata Hotel Casino & Spa	*Hotel/Casino Enhances Operational Efficiency, Business Intelligence; Saves U.S.$400,000*
National Savings Bank of Serbia	*Complex Bank Business Intelligence Solution Developed in Just 8 Months*

Supporting Materials: *Exploring TCO for Database Platforms*	
Database Pricing	*Understanding Database Pricing and Licensing, a whitepaper*
Lowering TCO	*A selection of whitepapers on lowering cost of ownership with SQL Server*
SAP TCO study	*Shows that SQL Server has 55% lower database administration costs and requires 37% less investment than other database platforms*
Total Cost of Ownership	*TCO studies on savings resulting from SQL Server deployment.*
Understanding database pricing	*This white paper describes how different databases are licensed and compares different customer scenarios.*

Performance and Scalability

The recent trend towards data center and server consolidation as well as the proliferation of remote and embedded databases, makes it important for a database server to be scalable and to perform well for a wide variety of applications.

SQL Server 2008 provides a rich database environment that is capable of scaling to increasing data needs. Independent assessments prove that SQL Server 2008 performs better than IBM DB2 in a broad range of benchmarks across platforms. In addition, SQL Server is more than competitive for real world applications, especially on commodity hardware.

In this section we present an overview of the performance and scalability features of Microsoft SQL Server 2008 as compared to other database platforms.

Price-Performance and Scalability

SQL Server 2008 is designed to scale reliably to meet the needs of the largest organizations in the most demanding database environments

Microsoft SQL Server has been shown to be the fastest database on Windows; it is also the fastest database on Intel Itanium processors in a non-clustered environment. On similar hardware SQL Server achieved 7% better performance and 37% lower cost than Oracle 10g.

Microsoft SQL Server has also been a strong performer in high end benchmarks, notably in the 1TB and 3TB range. Recently, SQL Server has scaled past the barrier of 1 million transactions per minute (tpmC)—and is the first database to do so on the Microsoft Windows operating system[1]. SQL Server is recognized among the top vendors in the multi-terabyte segment; and has benchmarks to prove its effectiveness in 100GB/300GB/1TB and now even 10TB both in terms of price and price performance.

SQL Server has improved significantly in terms of performance. Benchmark testing by SAP SD has shown that SQL Server can successfully handle up to 93,000 concurrent users[2] proving its strong scalability capabilities. In real world terms, such a workload is the equivalent of more than 10 times the largest SAP customer in the world.

SQL Server holds the world record for ETL performance, and has been recognized as #1 in the world for ETL speed. SQL Server set this record by processing 1Terabyte of TPC-H data in less than 30 minutes---a throughput rate of approximately 35GB per minute. That is why customers like bwin, one of the largest online gaming companies, trusts SQL Server 2008 to manage 100TB of real-time transactions.

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[1] TPC-C result: HP Integrity Superdome – Itanium2/1.6 GHz-64p/64c, 1,231,433 tpmC, 4.82 $/tpmC, available 6/5/06.

[2] Benchmark done on Nov 7, 2005, with 93,000 concurrent users. Benchmark SAP-SD three-tier, SAP ECC release 5.0, HP Integrity Superdome, 64 processors/64 cores, Windows Server 2003, SQL Server 2005 Enterprise Edition

SQL Server has a lead over IBM DB2 in price/performance
The crucial advantage in price-performance, as evidenced by benchmarks, leads to greater ROI for SQL Server and offers proven performance for high-end real-world demanding customer applications for a lower investment on commodity hardware.

Comparison of TPC benchmark results of SQL Server vs. IBM DB2

Benchmark	SQL Server vs. IBM DB2
TPC-E price/perf*	SQL Server best
TPC-E perf*	SQL Server best
TPC-C price/perf	SQL Server best
TPC-C perf	SQL Server best in Windows
TPC-H 100GB price/perf	SQL Server best
TPC-H 300GB perf	SQL Server best
TPC-H 300GB price/perf	SQL Server best
TPC-H 1TB perf	SQL Server best
TPC-H 1TB price/perf	SQL Server best
TPC-H 3TB perf	SQL Server best
TPC-H 3TB price/perf	SQL Server best in Windows
TPC-H 10TB perf	SQL Server best in Windows
TPC-H 10TB price/perf	SQL Server best in Windows

** IBM has not submitted any benchmark yet.*

SQL Server 2008 incorporates powerful new compression techniques
SQL Server 2008 includes new compression algorithms that are efficient and effective. With SQL Server, Row level compression is available by default. Internal testing by Microsoft has shown compression ranging from 10% to more than 50%, depending on the type of data, translating to immediate savings in hardware requirements, very small impact on performance. These improvements are expected to be even greater in applications such as Utilities and Banking, since these types of industry specific dependent tables contain large volumes of numbers that can now be handled even more efficiently.

Microsoft's own internal testing of the new compression capabilities of SQL Server 2008 has shown improved performance relative to IBM for DB2. Compression testing on SQL Server 2008 show comparable performance to IBM DB2 without including the benefits of table re-organization. This indicates that SQL Server compression techniques can offer significantly greater gains, when assessed under similar conditions to those used to assess IBM DB2.

SQL Server 2008 enables enhanced analytical capabilities and supports more complex computations and aggregations
New cube design tools in SQL Server 2008 help users streamline the development of the analysis infrastructure enabling them to build solutions for optimized performance.

Case Studies: SQL Server Performance and Scalability	
American Power Conversion	*100% faster response times; and savings of US $800,000.*
VHA	*Increased PeopleSoft efficiency by 25%, decreased replication time by 89%, and significant reduction of TCO*
Mobiltel	*Using Microsoft SQL Server to more efficiently analyze traffic and revenue data.*
Multi Terabyte installations	
MSIT ICE (27TB Data Warehouse)	*Microsoft IT uses SQL Server to drive 27TB Global Forensic Security tool*
Unisys UPSS system (23TB Data Warehouse)	*23 TB SQL Server installation is one of the largest and most robust SQL databases in the world---and has won "Top 10" for data warehouse peak workloads*
Premier BankCard (12TB Data Warehouse)	*LLC Premier upgrades its 12-TB data warehouse and OLTP database to SQL Server*
Danske Supermarket (10TB Data Warehouse)	*600GB of multidimensional cubes and more than 10TB of business intelligence data.*

More Information: SQL Server Benchmarks	
Other SQL Server Benchmarks	*Most up-to-date benchmark information for SQL Server*
Performance and scale capabilities	*SQL Server 2008 performance and scale capabilities*
SQL Server 2008 and IBM DB2 UDB	*Comparing SQL Server 2008 and IBM DB2 UDB v8.2 as a Database Platform*

High Availability

With exponential growth in the data environment, it is increasingly important to achieve "always-on" data operations for mission-critical applications. SQL Server 2008 has broken new ground in always-on technologies by including database mirroring and robust backup and restore functionality "out-of-the-box". Microsoft SQL Server 2008 helps reduce downtime on business-critical databases with a wide range of high availability solutions while still delivering cost-effective high performance.

In this section we present an overview of the high availability features of Microsoft SQL Server 2008 as it applies to real-world enterprise scenarios.

High Availability "Out-of-the-box"

SQL Server is more than competitive for providing "High availability" in real world applications, especially on commodity hardware. Existing deployments are providing 24x7 availability for high volume high traffic customers such as NASDAQ, bwin, and Xerox who trust SQL Server 2008 to manage 100TB of real-time transactions, and up to 7 million transactions per day with 99.999% uptime.

SQL Server 2008 offers high-availability features that are not offered by IBM DB2

SQL Server 2008 offers high-availability features such as database snapshot (point-in-time views of the database), and snapshot Isolation (viewing transitionally consistent data) that are currently not offered by IBM DB2 for Unix or Linux.

We present more details of key high-availability features of SQL Server 2008 later in this chapter.

Real-world High Availability Scenarios

Achieving high availability is a common requirement in many businesses. The appropriate solution for a particular scenario depends on a number of factors, and the solution that works best in one case might not be the most suitable solution for another case. For example, consider the following scenarios:

- The largest US electronic stock-market, wants to retire the aging mainframe system that supports its Market Data Dissemination System (MDDS). Every trade that is processed in the marketplace goes through the MDDS system, which translates to more than 5,000 transactions per second when trading begins each day. [NASDAQ]
- A global consumer products giant with a presence in over 100 countries carries products from more than 400 brands and generates revenues of US$50.6 billion, needs to upgrade its SAP R\3 supply chain infrastructure. The organization seeks a solution with lower total cost of ownership (TCO), and the ability to process terabyte level transaction loads with always-on capabilities.[Unilever]
- A world-leading manufacturer of imaging information and document solutions plans to enhance data integration across the group's global holdings of more than 220 companies. They need an enterprise class data platform able to support their SAP application and meet the scalability needs of their global organization needs. [FUJIFILM]

- The second largest container ship line in the world relies on its 5 Terabyte database to tracks more than 15 billion transactions a year. With annual growth of 30 percent and an ever-more data requests from its worldwide customers, MSC needs an enterprise solution that can scale with its growth, simplify database administration, and help ensure high availability. [MSC]

With such a wide range of availability requirements, businesses need a database platform that provides flexible options for high availability solutions. SQL Server 2008 always-on technologies provide these flexible options for high availability, and enables businesses to implement the best solution for their particular requirements.

High Availability Features

Mission-critical applications demand minimum downtime and quick recovery in the event of a disaster. SQL Server 2008 offers a full range of always on technologies to help minimize downtime and achieve the appropriate level of availability. The following features have significantly strengthened the high availability offerings in SQL Server 2008:

- **Enhanced Database Mirroring:** SQL Server 2008 provides a reliable platform with enhanced database mirroring including automatic page repair, improved performance, and enhanced supportability.
- **Automatic Recovery of Data Pages:** SQL Server 2008 enables the principal and mirror machines to transparently recover data page errors by requesting a fresh copy of the suspect page from the mirroring partner transparently to end users and applications.
- **Log Stream Compression:** Database Mirroring requires data transmissions between the participants of the mirroring implementations. With SQL Server 2008, compression of the outgoing log stream between the participants delivers optimal performance and minimizes the network bandwidth used by database mirroring.

Case Studies: SQL Server in Enterprise High Availability Scenarios	
NASDAQ	*SQL Server handles 5,000 transactions per second at market open*
London Stock Exchange	*LSE cuts information dissemination time from 30 to 2 Milliseconds*
Citi	*Supports 200,000 Updates/second with SQL Server*
Unilever	*SQL Server successfully handles 1.5TB of data*
Mediterranean Shipping Company	*MSC deploys SQL Server for* 5 TB mirrored database
FUJIFILM	*Supports Multi-terabyte SAP Deployment with SQL Server*

Case Studies: SQL Server Deployments on 64-Bit (Itanium) architecture	
Crossmark	*3 TB Data Warehouse Set for Growth with SQL Server*
Australian Government Agency	*Expands Services While Streamlining Administration*
Barnes & Noble	*Gains Business Insights Across Sales Channels*

Additional Materials: More about SQL Server 2008 High Availability Features	
HA in SQL Server.	*Read more about SQL Server high availability capabilities.*

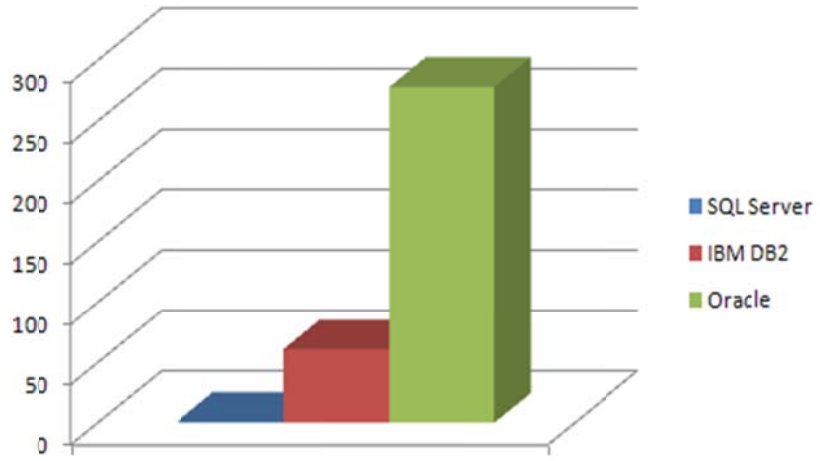
Security

SQL Server 2008 provides a rich set of security features to help protect data and network resources, and includes tools to help customers optimally configure the database to meet their unique security requirements. SQL Server 2008 builds on the security features of SQL Server 2005 and provides customizable security architecture with full event handling, secure storage, transparent data encryption, consolidated enterprise encryption, and security key management.

In this section, we present an overview of security in SQL Server 2008, and compare its capabilities with those of IBM DB2. This analysis helps show that the authentication features in SQL Server 2008 are stronger than that of IBM DB2 on commodity hardware because of its tight interoperability with Windows authentication, flexible policy based access control, and database level encryption.

SQL Server: A Leader in Database Security

SQL Server is a leader in terms of database platform security. According to the National Vulnerability Database, a third party neutral organization that consolidates and analyzes vulnerabilities in different products, there has been 1 SQL Server vulnerability found since 2004 (in SQL Server 7), as compared to 61 for IBM DB2, and several critical Oracle database security vulnerabilities (more than 278 in total).[3]



Security vulnerabilities reported in popular data platforms (2004-2007) as reported by NIST

MSFT has invested, and continues to invest, more resources in improving security and quality of its database products than any other vendor

[3] *This comparison takes into consideration database server engine only and does not include any management tools, O/S, etc.*

This investment is paying dividends, as evidenced by Microsoft's better record on security bulletins (NIST DB security issues). According to a study documented in the Dark Reading article titled "Study: SQL Server Is Safest DB," SQL Server 2008 is one of the safest databases with the least vulnerabilities. SQL Server 2008 also has the Common Criteria certification as well as being FIPS 140-2 compliant.

Out of the box, SQL Server 2008 has more security features than IBM DB2
SQL Server delivers a higher standard of security to all users, from developers to customers, with greater ease of management and programmability. IBM DB2 requires extensive optimization by a security expert before it is considered secure, further adding to the cost of deploying an IBM DB2 solution. Enhanced security features including the advanced security of surface area reduction, data encryption, native encryption, authentication, granular permissions, and user and schema separations help make SQL Server 2008 the most secure database Microsoft has ever built.

Enhancements to SQL Server Security features

Microsoft SQL Server 2008 offers security feature enhancements that help provide effective management of security feature configuration, strong authentication and access control, powerful encryption and key management capabilities, and enhanced auditing. SQL Server 2008 offers advanced security features such as:

- **Transparent Data Encryption:** Enable encryption of an entire database, data files or log files, without the need for application changes. Benefits of this include: search encrypted data using range and fuzzy searches, search highly secure data from unauthorized users, and data encryption without any required changes in existing applications.
- **Extensible Key Management:** SQL Server 2008 provides a comprehensive solution for encryption and key management. SQL Server 2008 delivers an excellent solution to this growing need, by supporting third-party key management and HSM products.
- **Auditing:** Create and manage auditing via DDL while simplifying compliance by providing more comprehensive data auditing. This enables organizations to answer common questions such as "What data was retrieved?"

Additional Materials: More about SQL Server 2008 Security Features	
Security in SQL Server 2008	*About SQL Server 2008 security capabilities*
SQL Server 2008 Security Datasheet	*Read the datasheet on SQL Server 2008 security*

Enhanced Manageability

Having pioneered technologies such as automated management, SQL Server 2008 continues to extend the SQL Server ease-of-use leadership and increases the productivity of database administrators through innovations such as a unified management tool, enhanced self-tuning capabilities, and a powerful management programming model. Such enhancements enable DBAs to focus on high value tasks, like database architecture, while spending less time on routine maintenance, configuration, and tuning.

In this section we present an overview of the manageability features of Microsoft SQL Server 2008 as compared to IBM DB2.

Easier to manage and more productive than IBM DB2

The SQL Server environment is easy to manage and maintain. The benefits of integrated manageability tools is reduced TCO through less time taken to perform standard operations; reducing the need for highly specialized IT support which means customers can support more sites with fewer staff. For SMEs it is feasible to deploy and manage many database applications without requiring external specialist resources. For administrators, capabilities like integrated patching, automated tuning, an easy-to-use management studio, and a GUI-based profiler provide a fast and productive management environment.

SQL Server update tools are integrated with Windows
SQL Server includes automatic updates as part of the service lifecycle management; by comparison internal analysis has shown that IBM only offers rudimentary patching for IBM DB2. This is and example of how SQL Server helps reduce administration overheads through effective day to day database operations and maintenance features.

Policy based system for managing one or more instances of SQL Server 2008
SQL Server 2008 has a re-engineered installation, setup and configuration architecture. This improvement separates the installation of the hardware from the configuration of the SQL Server software enabling organizations and software partners to provide specific installation configurations. This can be combined with SQL Server Management Studio to create policies that manage entities on the server, such as the instance of SQL Server, databases, and other SQL Server objects. In contrast, IBM DB2 has no multi-server management.

With SQL Server 2008 customers can validate and control policies across hundreds of servers, from ensuring all servers have passwords of a certain length, to validating disk space or naming conventions for tables.

SQL Server 2008 can dynamically scale a database on demand by allowing CPU resources to be added (on supported hardware platforms), without forcing any downtime on applications. Note that SQL Server already supported the ability to add memory resources online. **SQL Server 2008 also reduces storage requirements for data.** Data Compression provides significant performance improvements for large I/O bound workloads such as data warehousing.

SQL Server: Automated Maintenance

Through the SQL Server Agent service, SQL Server 2008 gives administrators the flexibility to provide an automated and proactive management and maintenance strategy for their database environment. The SQL Server Agent provides the following components to configure an automated environment:

- **Jobs**. A series of one or more steps to be completed. These steps can consist of Transact SQL statements, SQL Server Integration Services package, or command-line statements.
- **Alerts**. Preconfigured messages that are generated automatically when a particular event occurs on a SQL Server.
- **Operators**. Users defined with additional contact information that may include an e-mail address, pager number, or *net send* address. Alerts are sent to these operators when preconfigured events occur, or to notify them of success, failure, or completion of a job or job step.
- **Schedules**. Specifies when a job runs. A job can be associated with more than one schedule.

Multi-server jobs can be maintained at a centralized server and used to manage SQL Server instances across an organization.

Increased Administrator Productivity

SQL Server 2008 provides advanced performance tuning and optimization functionality:

- **In SQL Server 2008, the Resource governor manages resources used by database applications** (CPU and memory): Resource Governor provides a consistent and predictable response to end users. The Resource Governor allows organizations to define resource limits and priorities for different workloads which enable concurrent workloads to provide consistent performance to their end users.
- **Performance Data Collection:** Performance tuning and troubleshooting are time-consuming tasks for the administrator. To provide actionable performance insights to administrators, SQL Server 2008 includes more extensive performance data collection, a new centralized data repository for storing performance data and new tools for reporting and monitoring.
- **Enables greater query performance stability and predictability:** by providing functionality to lock down query plans enabling organizations to promote stable query plans across hardware server replacements, server upgrades, and production deployments.

Additional Materials: More about SQL Server 2008 Manageability	
SQL Server 2008 Manageability	*Manageability features in SQL Server 2008*

Developer Productivity

A high level of interoperability of the database platform with the development environment is the key to achieving increased productivity for database administrators and applications developers when creating and maintaining database-driven applications.

In this section we present an overview of the capabilities of the Microsoft SQL Server 2008 database platform as compared to IBM DB2 from the perspective of Database applications development. This analysis shows that the deep integration of SQL Server with the Visual Studio 2008 development framework provides a robust and highly productive platform for database development.

.NET the most popular deployment platform

While both SQL Server 2008 and IBM DB2 provide the capability to embed .NET logic in the database, SQL Server 2008 has several significant advantages over IBM DB2. The deeper support of SQL Server 2008 for the common language runtime (CLR) provides a more effective total solution, improving memory use, threading, and garbage collection capabilities of the CLR in ways that IBM DB2 implementation does not allow. In addition, SQL Server 2008 supports more .NET database objects than does IBM DB2. *IDC has found Microsoft's .Net to be "the most popular deployment platform".*

SQL Server provides a single interoperable development environment
SQL Server uses the same environment to develop the database, for reporting and analytics, for ETL and for embedded applications. A single tool is used to manage the SQL Server database and associated Business Intelligence servers. By comparison, IBM requires that customers learn and support different methodologies and tools for the vastly different IBM DB2 versions (Mainframe, AS/400, and IBM DB2 UDB), as well as to use IBM's recommended Business Intelligence and ETL products.

There is tight integration between SQL Server and Visual Developer Studio
Microsoft SQL Server 2008 and Visual Studio 2008 were designed to work together and developed in-sync to help ensure the best integration and optimization possible. These products undergo joint testing and development to help ensure a seamless experience for developers. Together, SQL Server 2008 and Visual Studio create an optimal environment for developers to become productive quickly.

Integrated and Optimized for DB Development

Microsoft has a single consistent set of database development and management tools that can be utilized across a broad range of database applications. Microsoft Visual Studio 2008 offers a complete, integrated developer experience for the entire lifecycle of an application covering conception, design, coding, testing, deployment, management, and support. As a result of this effort, developers can now utilize one development framework for relational, extensible markup language (XML), and online analytical processing (OLAP) applications for faster and more efficient development and debugging. For IBM DB2 different tools must be acquired and adopted for different tasks.

There is control over Microsoft SQL Server databases throughout the application lifecycle. The Microsoft Visual Studio Team Edition for Database

Professionals provides a foundation of change management and process integration through an integrated set of functionality that enables database developers and administrators to be efficient and productive.

Microsoft SQL Server offers advanced capabilities. Key capabilities include: .Net integration, integrated debugging**,** and the availability of *entities,* using the Entity Data Model (EDM) and visual designers and adapters; APIs for Occasionally Connected Systems; SQL change tracking; conflict detection; and capturing geographic data using spatial data types.

Additional Materials: Resources for SQL Server 2008 Developers	
Visual Studio Team System	*Visual Studio 2005 Team Edition for Database professionals*
"Data Dude"	*Visual Studio Team System 2008 Database Edition Power Tools*
Power tools Documentation	*Documentation for Power Tools for Visual Studio Team System 2008 Database Edition*
SQL Server and IBM DB2	*Compare SQL Server and IBM DB2 from a development perspective*

Database Platform for Business Intelligence

In this chapter, we discuss the Business Intelligence (BI) capabilities of Microsoft SQL Server 2008 in comparison with IBM DB2.

Microsoft Business Intelligence Technologies

Microsoft provides a comprehensive Business Intelligence (BI) offering that is based on a scalable data platform for data warehousing, analysis, and reporting, and offers powerful and intuitive tools that end users can use to access and analyze business information.

By comparison, IBM's Business Intelligence solution consists of products from its Websphere range, technology acquired from Cognos, and several other partners; none of which are tightly integrated into the DB2 database product. Instead IBM offers each component in their BI solution stack as an add-on that must be purchased separately. This lack of integration can make the deployment of an IBM BI solution a resource intensive process.

At the core of the Microsoft Business Intelligence end-to-end offering is Microsoft SQL Server 2008, a complete data services platform that is designed to enable:

- Unification of storage and access for all data across the enterprise.
- Building and management sophisticated BI solutions.
- Increasing the reach of BI solutions to empower all employees.

The specific technologies of SQL Server 2008 that form the basis of this powerful Business Intelligence offering are described in the following table:

Component	Description
SQL Server Database Engine	Provides a scalable, high-performance data storage engine for extremely large volumes of data. This makes it an ideal choice for consolidating business data from across the enterprise into a central data warehouse for analysis and reporting.
SQL Server Integration Services	A comprehensive platform for ETL operations, that enables populating and synchronization of data warehouses with data from disparate data sources that are used by business applications throughout an organization.
SQL Server Analysis Services	Provides an analytical engine for Online Analytical Processing (OLAP) solutions, including business measure aggregation over multiple dimensions and key performance indicators (KPIs). Ideal for data mining tasks that use specialized algorithms to identify patterns, trends, and associations in business data.
SQL Server Reporting Services	An extensive reporting solution that makes it easy to create, publish, and distribute detailed business reports both within the enterprise and outside the enterprise.

A Leader in BI Solutions

Gartner has recognized Microsoft as a leader among business intelligence platform vendors. With SQL Server 2008 the customer gets BI "out of the box", it is available with the database. In contrast, IBM's BI solution consists of several different tools, each of which must be acquired at an additional cost.

Seamless interoperability with the Office productivity suite
As part of Microsoft's vision of ubiquitous BI, SQL Server 2008 provides new Word rendering that enables users to consume reports directly from within Microsoft Office Word. In addition, the existing Excel renderer has been greatly enhanced to accommodate the support of features like nested data regions, sub-reports as well as merged cell improvements. This lets users maintain layout fidelity and improves the overall consumption of reports from Microsoft Office applications. Because IBM has acquired most of the BI capabilities, currently the database, BI, ETL and analysis tools are separate non-integrated products, requiring different development skills/tools, and purchasing many different SKUs.

The benefit for business is better decision making at a lower cost
SQL Server 2008 continues its tradition of leadership in business intelligence (BI), including in its basic license and price, Analysis Services for online analytical processing (OLAP) and data mining, Reporting Services, Integration Services and data warehousing functionality. IBM sells these components separately, imposing significant costs for packaged components, external extract, transform, and load (ETL) and data-cleansing tools, OLAP Server and all Data Warehouse capabilities.

Microsoft offers tailored BI solutions uniquely suited to the specific needs of industry and business through partnerships with SQL Server 2008 certified BI partners.

Advanced Technology for BI Applications

SQL Server 2008 offers technical advancements such as: Rich data visualization tools; report authoring, report management, report delivery, role based report security through SSRS (SQL Server Reporting Services); integrated full text search. Other features of SQL Server 2008 are:

- **Enterprise Reporting Engine:** Reports can easily be delivered throughout the organization both internally and externally with simplified deployment and configuration. This enables users to easily create and share reports of any size and complexity. Build flexible and effective reports with the new Tablix data structure and rich formatting capabilities
- **Report Builder Enhancements:** Easily build ad-hoc and author reports with any structure through Report Designer. Implement more responsive Reporting Services solutions through enhancements to on-demand processing and instance based rendering
- **Report Server Application Embedding:** Report Server application embedding enables the URLs in reports and subscriptions to point back to frontend applications.
- **Internet Report Deployment:** Customers and suppliers can effortless be reached by deploying reports over the internet.

- **Manage Reporting Infrastructure:** Increase supportability and the ability to control server behavior with memory management, infrastructure consolidation, and easier configuration through a centralized store and API for all configuration settings.
- **Built-in Forms Authentication:** Built-in forms authentication enables users to easily switch between Windows and Forms.
- Create high-performance Analysis Services solutions with improved cube designers, subspace computation, and MOLAP enabled write-back capabilities.

More Resources: *Learning more*	
SSAS	*SQL Server Analysis Services*
SSIS	*SQL Server Integration Services*
SSRS	*SQL Server Reporting Services*
Data Mining	*Learn more about Data Mining with SQL Server*

Data Warehousing

Data warehousing is a fast growing database workload, as enterprises of all sizes seek to maximize the business benefits associated with extracting key insights from their customer data.

In this section we present an overview of new data warehousing features of Microsoft SQL Server 2008 and compare them to the capabilities of IBM DB2.

SQL Server 2008 makes a major advance in scalability for data warehousing. It meets the data warehouse needs of the largest enterprises more easily than ever. SQL Server 2008 provides a range of integrated products that enable customers to build their data warehouse, and query and analyze its data. These include the SQL Server relational database system, Analysis Services, Integration Services, and Reporting Services.

SQL Server: A Data Warehouse Platform Leader

Gartner has acknowledged Microsoft as being a leader among data warehouse platform vendors. In earlier chapters have shown that SQL Server is the fastest growing Database and Business Intelligence vendor and the use of SQL Server for data warehousing is accelerating, especially for databases up to 5TB or 6TB in size. Further, IDC has acknowledged that SQL Server ships more units than Oracle and IBM combined. All of these achievements place SQL Server 2008 in a position of leadership in the area of data platform technologies for data warehousing.

Microsoft has significantly enhanced SQL Server 2008 as a platform for Data Warehousing. Significant feature improvements have been implemented such as resource governing, partitioning, and star join query optimizations *(more details below)*. SQL Server leads in terms of ETL performance which is a critical component of any data warehouse platform.

SQL Server 2008 offers an improved core engine and new features around DW scalability, performance, and interoperability. Key data warehousing features of SQL Server 2008 are: Backup Compression, Partitioned Table Parallelism, Star Join Query Optimizations, Grouping Sets, Change Data Capture, MERGE SQL Statement, SQL Server Integration Services (SSIS) Pipeline Improvements, and SQL Server Integration Services (SSIS) Persistent Lookups

With SQL Server 2008, there is no need to purchase additional SKUs. Microsoft offers high value on investment. SQL Server Enterprise Edition includes SQL Server Analysis Server (SSAS), SQL Server Reporting Services (SSRS) and SQL Server Integration Services (SSIS), which means OLAP, reporting and data integration for ETL are included in the low starting price. For the customer, this means they can utilize the powerful features of the number 1 OLAP Server on the market at no additional cost.

Microsoft offers excellent support infrastructure. Worldwide support from Microsoft is extensive (including partners, value-added resellers, third-party software

and tools, and the wide availability of the SQL Server skill base), and with the recent purchase of companies such as ProClarity, it is increasing its focus on BI as a core enterprise application.

New Data Warehousing Features Map

The following table shows the new scalability features in SQL Server 2008, and where they help with the activities that surround data warehouses (DW).

<table>
<tr><th></th><th>Build</th><th>Manage</th><th>Deliver Insight</th></tr>
<tr><td rowspan="2">SQL Server Relational DBMS</td><td rowspan="2">MERGE statement
Change data capture (CDC)
Minimally logged INSERT</td><td>Backup compression</td><td>Star join performance
Faster parallel query on partitioned tables
GROUPING SETS</td></tr>
<tr><td colspan="2">Resource governor</td></tr>
<tr><td></td><td colspan="3">Data compression
Partition-aligned indexed views</td></tr>
<tr><td>Integration Services</td><td>Lookup performance
Pipeline performance</td><td></td><td></td></tr>
<tr><td rowspan="2">Analysis Services</td><td></td><td>Backup</td><td>MDX Query Performance: Block Computation
Query and Write back Performance</td></tr>
<tr><td colspan="3">Scalable Shared Database</td></tr>
<tr><td>Reporting Services</td><td></td><td colspan="2">Reporting scalability
Server scalability</td></tr>
</table>

These improvements have facilitated increased deployments of SQL Server by customers:

Case Studies: SQL Server Data Warehousing	
First Premier Bank	*12-Terabyte Mission Critical BI Solution on SQL Server*
Energizer	*The Power of Microsoft Business Intelligence with Microsoft Office PerformancePoint Server*
TDC	*Slashes costs with 6-Terabyte Data Warehouse on SQL Server*
Barnes & Noble	*Gains business insights across sales channels with SQL Server Data Warehouse*
SAS	*New data warehouse replaces IBM DB2 mainframe solution*

Database Platform for OLTP

In this chapter, we compare the OLTP capabilities of SQL Server 2008 and IBM DB2.

SQL Server 2008 focuses on four key areas for OLTP database requirements:

- **Scale and Performance**. SQL Server 2008 enables companies to build a database solution with the performance and scalability capabilities that are required by today's applications.
- **High Availability**. SQL Server 2008 provides a database application with "always-on" capabilities, while minimizing the management and performance overhead of high-availability solutions.
- **Security**. SQL Server 2008 provides an enhanced highly secure data platform by encrypting valuable data, auditing changes to data and metadata, incorporating external cryptographic keys, and encrypting and signing data in backup files.
- **Manageability**. SQL Server 2008 helps organizations reduce the time and cost of managing data infrastructure by providing innovative and automated policy-based administration and improved tools for performance monitoring, troubleshooting, and tuning.

SQL Server: Ready for Mission-critical OLTP

SQL Server 2008 provides a scalable, high-performance database engine for mission-critical applications that require high levels of availability and security, while reducing the total cost of ownership through enhanced enterprise-class manageability.

First Vendor to publish TPC-E benchmark results
Microsoft is the first database vendor to publish TPC-E benchmark results. TPC-E is an On-Line Transaction Processing workload developed by the Transaction Processing Performance Council and is the successor to the TPC-C benchmark; TPC-E models an OLTP environment that is broadly representative of modern systems. SQL Server holds leadership in the TPC-E (performance and price/performance benchmarks); IBM DB2 has no benchmark results in this category

SQL Server: New Features for Improved OLTP

- Take control of workload resource utilization with Resource Governor
- Store all kinds of business data with native support for relational data, XML, file-streams, and spatial data
- Reduce storage requirements and improve performance with data compression and sparse columns
- Optimize database mirroring performance and eliminate downtime with automatic recovery of suspect pages
- Implement peer-to-peer replication quickly with the new visual designer, and add nodes to a peer-to-peer replication configuration without stopping system activity
- Audit all actions across the enterprise and consolidate audit reporting
- Help protect sensitive data with automatic, transparent data encryption
- Use Performance Data Collection to troubleshoot, tune, and monitor SQL Server 2008 instances across the enterprise
- Use Policy-Based Management to manage one or more instances of SQL Server 2008

Better Support for Mainframe Migration

Mainframe Migration is now more accessible, and easier to manage. Customers are now empowered to undertake mainframe modernization projects to transition legacy systems to Microsoft Windows Server. Mainframe modernization results in improved agility of applications, enhanced scope for uniform technical support, and increased cost savings.

Migration of the current mainframe can be performed by: re-hosting, porting, replacement, or rewriting of existing applications. Customers can utilize Microsoft's powerful consulting and support services to create solutions best suited to their unique requirements.

Case Studies: SQL Server selected over IBM DB2	
State of Alaska Dept of Revenue	*7 Terabyte Data Warehouse for the State of Alaska*

More Resources: Mainframe Migration	
Whitepapers	Mainframe modernization, and more whitepapers
Resources	Services for Mainframe Migration

More Resources: SQL Server OLTP	
Data Sheet	*OLTP Datasheet*
Whitepaper	*Online Transaction Processing in SQL Server 2008*

SAP Enterprise Application Integration

Microsoft SQL Server is the most widely deployed database for SAP deployments worldwide, according to SAP.Reliability, scalability, security and ease of deployment have been the strengths that have made SAP customers select SQL Server over all other databases.

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In this chapter we discuss the technology alliance between SAP and Microsoft that has resulted in SQL Server becoming the most popular SAP implementation, and how this benefits the enterprise customer.

SQL Server: Tight Integration with SAP

The close, long-term working relationship between Microsoft and SAP AG helps ensure that the Microsoft platform and SAP solutions are fully compatible. SQL Server delivers the features and capabilities needed to deploy SAP applications in key areas. SQL Server 2008 helps deliver competitive levels of security that meet SAP stringent security requirements.

SQL Server 2008, optimized price-performance platform for SAP A study covering 68 SAP/ERP customers Wipro Technologies, has found "Microsoft SQL Server migration pays big dividends for SAP/ERP customers." The study shows that migrating a SAP/ERP environment to SQL Server can reduce unplanned downtime by over 20%, cut IT labor costs by nearly 25%, and minimize ongoing software support costs up to 85%.

High adoption rates for SQL Server 2008 as the preferred solution for SAP customers. In the last 9 months more than 1/3 of all new SAP customers have chosen SQL Server as their data platform solution and there is a strong demand in platform migrations to SQL Server platform.

Strong ties between SAP and Microsoft. SAP has assured customers of greater integration with Microsoft products and support coverage through their services and consulting infrastructure. Further, SAP will support SQL Server 2008 for: All Netweaver 7.00 based products; Windows Server 2003 SP2; and Windows Server 2008

Rich feature set for SQL Server supported by the Microsoft/SAP Alliance. There are dedicated teams of Microsoft and SAP engineers and developers working towards the goal of ensuring SAP supports SQL Server features better than any other platform. Improvements SAP customers shall benefit from in Microsoft SQL Server 2008 include compression, minimal logging, parallelism improvements, and query handling enhancements. Customers can now utilize the new database mirroring and online indexing features in Microsoft SQL Server 2008 to dramatically increase the availability of SAP R/3. Additionally, by using the 64-bit version of SQL Server 2008 with commodity 64-bit hardware, customers can lower the total cost of ownership (TCO) while increasing performance, scalability, and reliability in the SAP R/3 landscape.

In SQL Server 2008, the following features have been optimized for interoperability with SAP systems:

- The vardecimal data type reduces disk space allocation for "sparse" fact tables leading to significant savings in storage requirements. The feature helps to save disk space for all tables that use decimal columns. Since the benefit depends on the proportion of numeric values stored in the columns, we cannot give general guidelines on the space saving you can expect. SAP Netweaver BI customers who have tested the feature have reported space savings of 30 - 40% for InfoCube fact tables.
- Automatic repair of corrupt pages when synchronized with consistent pages from a database mirror
- Compression of network traffic in database mirroring has reduced infrastructure requirements for the database
- Query handling has been optimized for Star Join queries resulting in more efficient query plans for typical SAP aggregation queries or ad-hoc queries touching fact tables
- Parallelism has been improved for operations on partitioned tables resulting in faster building of aggregates in SAP BI
- Encryption of SQL Server data files is now transparent to SAP leading to faster read-write efficiency.
- SAP is able to leverage the base infrastructure to extract complete performance data not only from SQL Server but also from the operating system as well

World-Record Scale Set by SQL Server 2008

A SAP-SD certified benchmark supported 93,000 concurrent users[4], equivalent to more than 10 times the largest SAP customer in the world. Further, Microsoft SQL Server has set a world-Record Scale on four-socket industry standard blade servers in the SAP SD 3-Tier Standard Application Benchmark Test with 34,000 SAP SD Standard application benchmark users[5].

This latest benchmark demonstrates an increase of throughput of nearly a factor of three over the past four years with industry-standard hardware. With the demonstrated throughput by SQL Server 2008 x64 and Windows Server 2008 x64 running on industry-standard hardware is expected to cover scalability needs of at least 97 percent of all SAP deployments worldwide.

That is why more than 42% of new customers are choosing SQL Server over DB2 for SAP:

Case Studies: SQL Server and SAP Integration	
China Light and Power	*Investment recouped in just 20 months. Availability is at 99.98%*
Danfoss	*Moved SAP R/3 system to SQL Server---cut costs by 50%, increased processing speed by 40%*
Fujifilm	*Achieved increased stability and improved response.*

[4] Benchmark done on Nov 7, 2005, with 93,000 concurrent users. Benchmark SAP-SD three-tier, SAP ECC release 5.0, HP Integrity Superdome, 64 processors/64 cores, Windows Server 2003, SQL Server 2005 Enterprise Edition

[5] Certification Number 2008003: SAP SD standard SAP ERP 6.0 (2005) application benchmark in 3-Tier configuration certified on 02/26/08 34,000 concurrent users, running Windows Server 2008 Enterprise Edition (64-Bit) and SQL Server 2008 (64-bit) on RDBMS database server. Hardware configuration of RDBMS server: HP ProLiant BL680c G5, 4 processor/16 core/16 thread Quad-Core Intel Xeon E7340 / 2.40GHz, 64GB RAM

Klosterfrau	*Migrated 800 Gb of data, cut administration effort by 30%*
Koehler	*100% uptime.*

More Resources: *Useful SQL Server resources for SAP customers*	
SQL Server and SAP	*Best-practices white papers, training, customer cases, and the most recent SAP benchmarks*
Microsoft SAP Customer Information Center	*Provides resources to better understand how Microsoft technologies integrate with SAP*
SAP and SQL Server Datasheet	Detailed information on SAP specific features in SQL Server and the strategic advantages they offer

Conclusion

SQL Server 2008 has significantly raised the bar in terms of performance, scalability, and security of the SQL Server database platform, enabling it to handle the most demanding data warehouse and business intelligence applications, at a lower total cost of ownership than IBM DB2 9.5. When coupled with Microsoft's global partner eco-system, which provides a broad range of solutions, services, and support; the new capabilities have helped SQL Server achieve market success.

Market Momentum: According to IDC Microsoft is the fastest growing database vendor and Gartner now ranks Microsoft among the top three database vendors.

Performance and Scalability: SQL Server has been shown to be the fastest database on Windows; it is also the fastest database on Intel Itanium processors in a non-clustered environment. SQL Server is a strong performer in high end benchmarks, notably in the 1TB and 3TB range, and benchmark testing by SAP SD has shown that SQL Server can successfully handle up to 93,000 concurrent users. SQL Server also holds the world record for ETL performance, processing 1Terabyte of TPC-H data in less than 30 minutes.

High Availability: The following features have significantly strengthened the high availability offerings in SQL Server 2008: Database snapshot (point-in-time views of the database), and snapshot Isolation (viewing transitionally consistent data); Enhanced database mirroring including automatic page repair, improved performance, and enhanced supportability; Automatic Recovery of Data, and Log Stream Compression.

Security: SQL Server is a leader in terms of database platform security, according to the National Vulnerability Database. SQL Server 2008 provides rich security architecture to help protect data and network resources. Out of the box, SQL Server 2008 is more secure than IBM DB2, with its more secure by default configuration and tight interoperability with the Windows authentication services.

Manageability: Microsoft SQL Server 2008 builds upon the ease of use and management tools that help organizations save on database administration costs.

Developer Productivity: Tight integration with the Microsoft Visual Studio development environment improves developer productivity and reduces database application development cycles. Unlike IBM DB2, SQL Server includes sophisticated business intelligence and data warehousing capabilities as part of the core database platform.

TCO: SQL Server 2008 offers lower cost than IBM DB2 in each of the major areas that contribute to total cost of ownership (TCO). Licensing fees are lower for SQL Server than for IBM DB2; SQL Server also has lower hardware costs when compared to mainframe deployments. In addition, SQL Server 2008 automates, streamlines, or eliminates many routine database management tasks, reducing the costs associated with database administration.

For more information, please visit the following:

- More on SQL Server 2008
  - General product information
  - Technical Features
  - Whitepapers
  - Benchmarks
  - Information for developers
  - Information for IT Professionals and Administrators