

Microsoft* SQL Server* 2008 and Intel® Xeon® Processors: Better Together

How the joint platform of Microsoft* SQL Server* 2008, powered by the latest Intel® Xeon® processors, meets today's database reliability, availability, and serviceability needs in a cost-effective, high performance package

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Abstract

Data management needs have evolved and grown more complex, so today's databases must be built on a combined hardware and software platform that affords the flexibility to take advantage of new development features without sacrificing performance, security, or scalability. In a challenging economy, organizations are looking to reduce operating expenses through energy efficiency, consolidation, decreased management overhead, and optimal price/performance ratios. Regardless of whether your organization is facing the need for data consolidation, seeking to implement a business intelligence (BI) solution, or replatforming from a UNIX or legacy Microsoft* environment, the combination of Microsoft* SQL Server* 2008 running on Intel® Microarchitecture-based Xeon® processors can meet the demands of today's most sophisticated databases.



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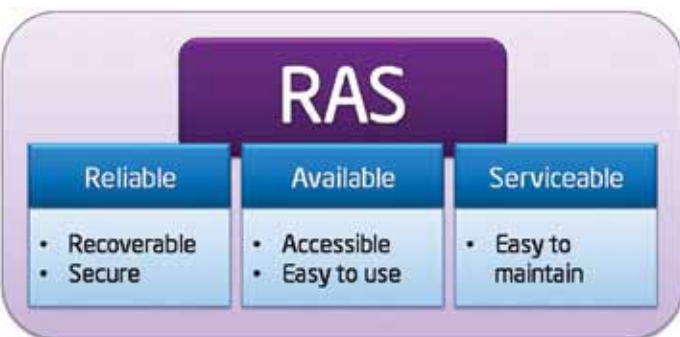
Microsoft* SQL Server* 2008 and Intel® Xeon®: Better Together

Moore's Law¹, which originated with Intel co-founder Gordon Moore, continues to hold true, as hardware capabilities increase every year. However, for advances in hardware to really matter, software applications must be designed to take advantage of the increased processing power and enhanced feature sets. In today's information-overloaded business world, it's all about the data. Storing that data in a manner that makes it easy to organize, protect, sort, and selectively retrieve requires a sophisticated database management system. Organizations want high performance, security, and advanced functionality in a cost-effective package. The solution lies in a joint platform of Microsoft SQL Server 2008 powered by the latest Intel Xeon processor-based servers.

The Evolution of Data Management

The structure of databases has grown more complex as data management needs have evolved, from simple flat models with data stored in one place, to table-based relational models that can be designed as distributed databases. Storage innovations and the ever-decreasing cost of disk capacity have led to an explosion in the amount of data that organizations must manage. The data management model is changing not only because of the increase in the sheer volume of data, but also due to such "game changers" as:

- New types of data, such as geospatial data, that don't easily fit into the old management models
- The need to access data from different locations using many different types of devices, and the need to store local copies that can be synchronized between client and server
- Industry and governmental regulatory compliance requirements that mandate more comprehensive reporting
- The need to analyze part of this data for business insight



Key requirements include reliability, availability and serviceability (RAS). The RAS concept of design² and engineering applies to both hardware and software.

Today's databases must be extensible to meet each organization's unique needs, and must provide a way to query across relational and non-relational data. In a global business environment, databases must also support location-aware applications. All of this must be done quickly so that results are delivered to users in a timely manner, even as the amounts of data and the number of users grows larger and larger. Databases need to be bigger, faster, and more accessible than ever before.

The Solution: SQL Server 2008 Plus Intel Xeon to Meet Today's Database Needs

New features and functionalities of SQL Server 2008, combined with the new capabilities and power of the new Intel Microarchitecture-based Xeon processors³ create a database solution that is much more than the sum of the parts. Performance technologies built into the new Intel Microarchitecture, such as Quick Path Interconnect (QPI), Turbo Boost Technology, and multi-level shared cache compliment performance features embedded in SQL Server 2008, including data compression, Resource Governor, and Performance Studio. Xeon's processing power to spare enables the use of SQL Server 2008's strong encryption technologies. Both hardware and software scalability give you the best of both worlds as your organization and your database needs grow.

SQL Server 2008 New Features and Functionality

New features and functionalities in SQL Server 2008 that utilize new Xeon processor features can be broken into several broad categories, including:

- Performance and Reliability
- Security
- Development
- "Beyond Relational"

Performance and Reliability

Performance and reliability are the cornerstone requirements of a data management system, and SQL Server 2008, running on Xeon processors, delivers both. The high-performance query processing engine with dynamic caching and read-ahead scanning⁴ reduces query time by decreasing the amount of physical disk access, which is often

a performance bottleneck. Data compression⁵ can reduce the number of data pages that must be read, which also increases performance on input/output (I/O)-dependent workloads. Partitioned data can also be parallelized to enhance performance.

Multiple workloads on a server may compete for system resources, adversely affecting performance for high-priority workloads. Resource Governor is a new feature in SQL Server 2008 that makes it easy for administrators to set limits and assign priorities to workloads, based on such factors as users, applications, and databases, optimizing the performance of mission-critical processes.

Performance Studio provides end-to-end performance monitoring with low overhead, making it easier to collect and analyze performance information for database systems. To take full advantage of these performance enhancements, the underlying hardware must be optimized as well, and Intel Xeon processors were designed with performance foremost in mind.

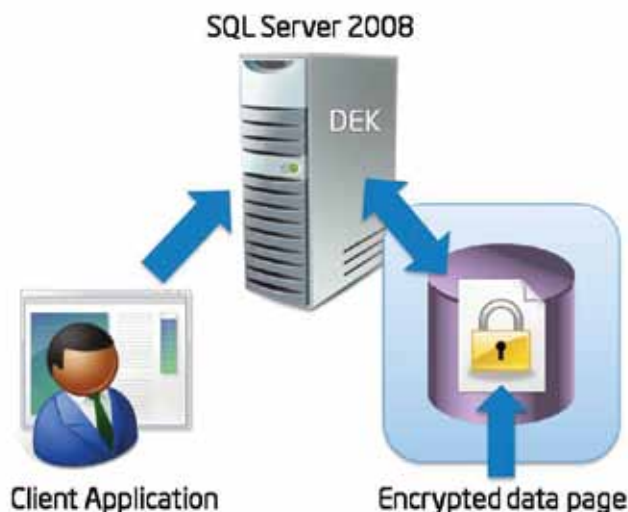
Security

Databases contain valuable and sometimes confidential information, and security is mandated in many industries by law. Organizations that handle health care information, personal financial data, credit card payments, or any other type of personally identifiable information (PII) are subject to government and/or industry compliance regulations, and must be able to document the measures they take to protect that data. Even in unregulated industries, security is essential to protect the organization's information assets and defend its brand equity.

In addition to the granular cell-level encryption that came with SQL Server 2005, SQL Server 2008 introduces Transparent Data Encryption (TDE), which encrypts the entire database without requiring modification to applications like traditional database encryption mechanisms, and is transparent to the user. The data is encrypted as it's written to disk, and decrypted as it is read. Backups, in the past a common security hole, are encrypted by TDE as well. TDE also results in less performance degradation than previous encryption methods (average 3-5% with TDE vs. average 20% with cell-level encryption).⁶

Another new security feature in SQL Server 2008 is extensible key management (EKM), which allows for part of the cryptographic key hierarchy to be managed by a cryptographic provider such as a Hardware Security Module (HSM), for a higher level of key protection.⁷ SQL Server Audit is an important new feature that helps DBAs meet regulatory compliance obligations with fine-grained auditing, by which audits can be targeted to specific actions against particular objects.⁸

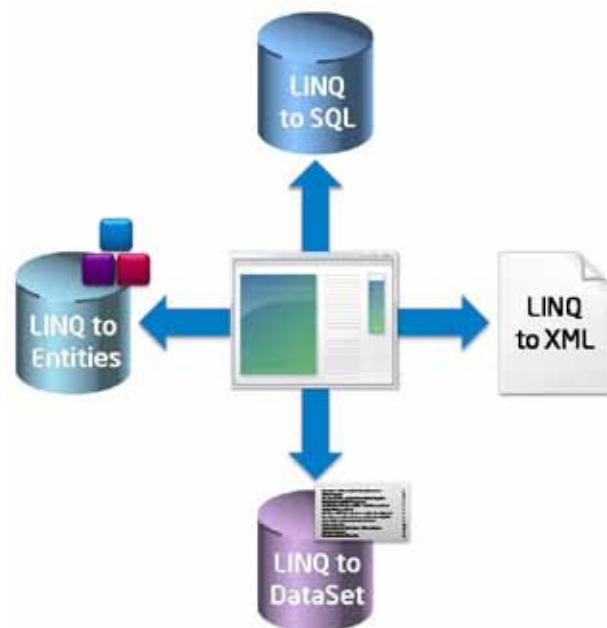
The problem with security mechanisms is that they require extra system resources. Strong encryption algorithms use processing cycles and can cause performance degradation on low-powered systems. The latest Xeon processors from Intel are powerful enough to handle security algorithms without impacting database performance.



Development

SQL Server 2008 supports the Microsoft* Visual Studio* 2008 Language Integrated Query (LINQ) framework. This means that Microsoft* Visual Basic* .NET and C# developers don't have to be database gurus; they can work with objects instead of tables and columns.

Data-centric applications can be built based on the Entity Data Model (EDM) and, using the Microsoft* ADO.NET Entity Framework, developers can focus on business solutions instead of worrying about how the data is organized in the database.



"Beyond Relational"

SQL Server 2008 goes beyond relational, enabling you to work with unstructured or semi-structured data of different types than traditional data types, including files that are stored on the file system, rather than inside a table. Supported data types include

relational data, XML documents, file streams, and geospatial data. SQL Server 2008 is a feature-rich, enterprise-level application that delivers on today's business requirements and integrates tightly with other Microsoft applications and technologies.

Handling such sophisticated software functions while maintaining the highest level of performance and reliability requires a next-generation hardware platform that's up to the task. That's where the latest Intel Xeon processors, built on Intel Microarchitecture, come in. Intel has completely redesigned the architecture, doing away with the aging front-side bus. Simply stated, this isn't your father's Xeon. The combination of SQL Server 2008 and the new Xeon technologies creates both evolutionary and revolutionary enhancements to the computing environment.

Intel Xeon Processors New Features and Functionality

Following the "tick tock" model,⁹ next-generation Xeon processors exemplify the new Intel Microarchitecture based on 45nm¹⁰ Hi-K metal gate silicon technology with hafnium circuitry.¹¹

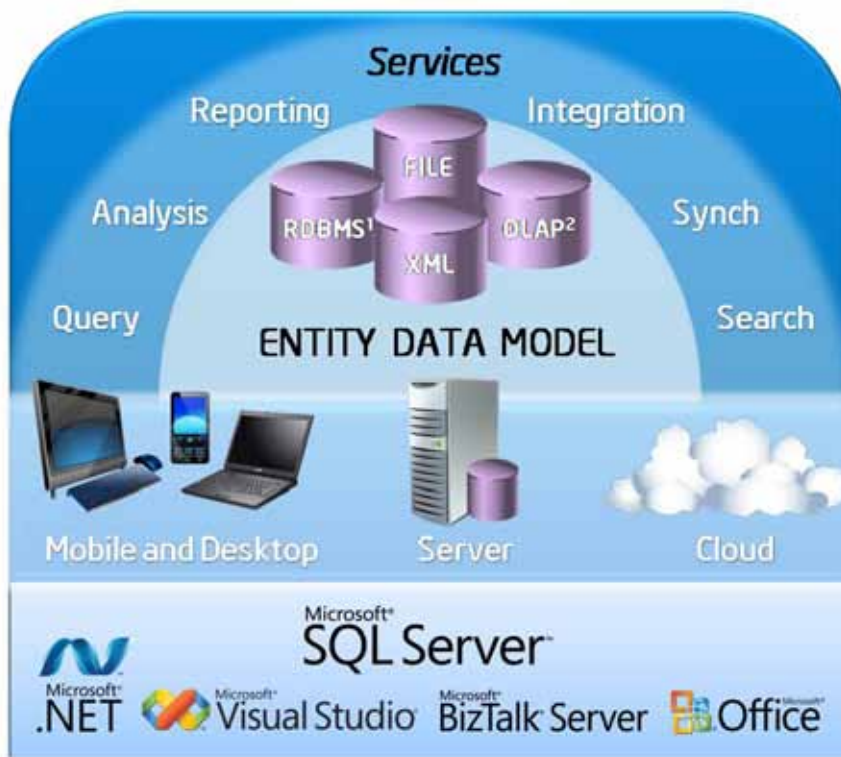
By increasing processor power and performance, this provides the perfect hardware platform for the modern Windows Server* operating systems on which SQL Server 2008 runs. For the heaviest online transaction processing (OLTP) workloads, the Xeon X5550 processor

with eight cores and hyperthreading capabilities has been shown in tests to handle over 140,000 orders per minute. The design focus is on performance and scalability, built on a foundation of rock-solid reliability. An added bonus is the cost savings made possible by the reduction in energy usage.

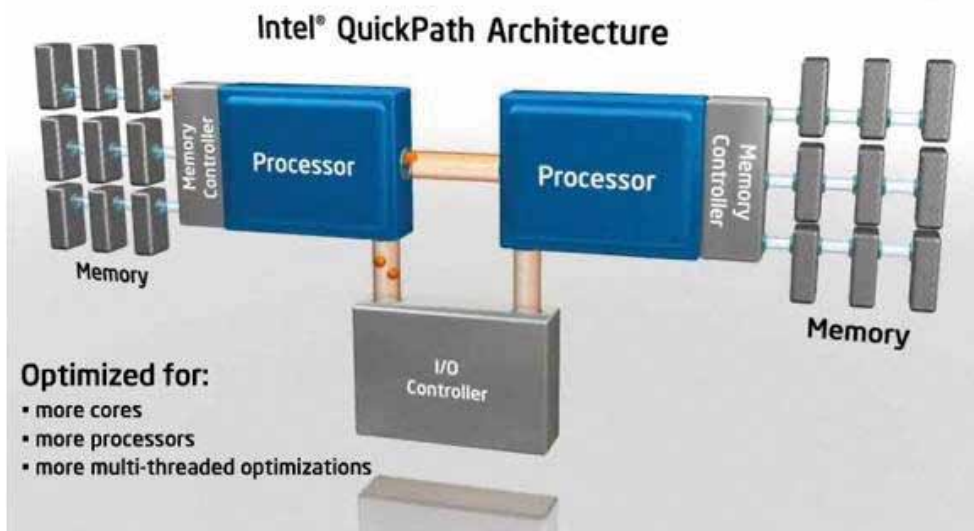
Performance and Scalability Features

In today's fast-paced world, it's all about performance. Database users are busy people, and they need results delivered as quickly as possible. Executives want reports and analyses, and they want them right now. Sales people need customer data today, not tomorrow. The need for speed extends to DBAs, who have to perform a large number of administrative tasks in a timely manner. Xeon processors are at the heart of a high-performance SQL Server 2008 data management system that can keep up with even the most demanding environment.

Database users are tired of waiting for the bus. The new Intel Microarchitecture replaces the front-side bus with QPI. Intel QuickPath Architecture¹² maximizes data transfer performance for multi-processor and/or multi-core platforms with two-way interconnects between processors that can reach up to a blazing 25.6 GB per-second. Separate data paths for I/O and memory access make memory access faster, because the CPU no longer has to communicate first with an external controller.



1. Relational database management systems
 2. Online Analytical Processing



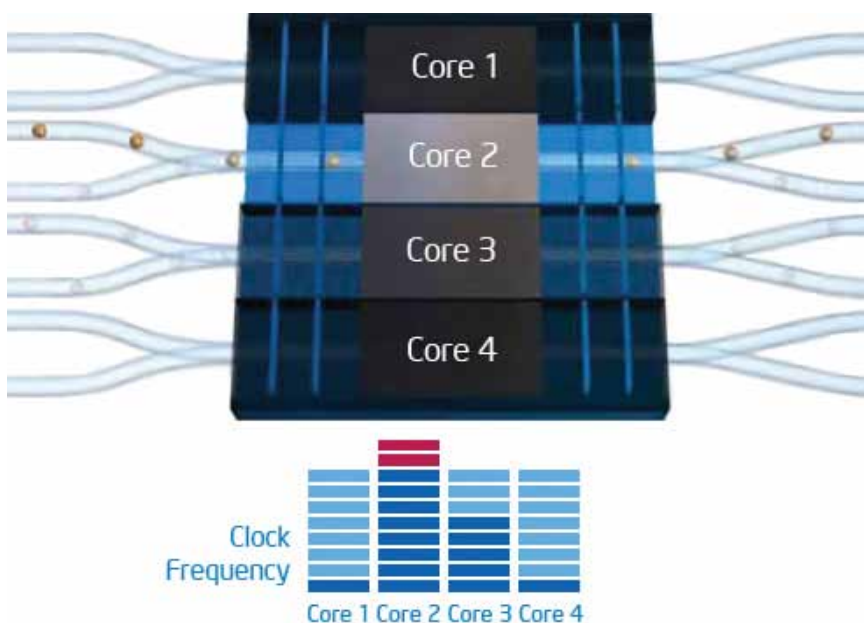
The Intel Turbo Boost technology¹³ provides “performance on demand,” allowing cores to run faster than base operating frequency when below specified power, current, and temperature thresholds. When a processor detects that it is below these limits, it increases its clock frequency to boost the performance of the active cores. This gives you extra performance when and where it’s needed, a dynamically scalable solution for database demands.

Additional performance improving features include:

- **More instructions per cycle**, are enabled by more efficient algorithms and greater parallelism
- **Enhanced branch predictions** allows processors to fetch and execute instructions without waiting for a branch to be resolved
- **Simultaneous multi-threading** delivers enhanced Hyper-Threading (HT) technology¹⁴ that allows each core to process two threads at once, doubling the number of threads that can be processed by each processor
- **Multi-level shared cache (Smart Cache)** adds an inclusive L3 (last-level) cache that is shared across all cores, which reduces latency and snoop traffic between cores
- **New Application Targeted Accelerators** provide new string and text processing instructions to parse XML strings and text at much higher speed

Energy Efficiency Features

Intel Microarchitecture was designed to meet strict power/performance efficiency guidelines, so that new features deliver more than a one percent performance gain vs. one percent power gain for a less than three percent power cost. The hafnium-insulated transistor design decreases resistance and reduces the amount of energy wasted, reducing power consumption. Simultaneous multi-threading provides a performance increase up to 30% with only a slight increase in power consumption. Different cores can run at different clock rates to save energy, and the embedded power controller can shut down or “park” idle cores.



In the first review of the dual-socket server version of the new Intel Microarchitecture-based Xeon, Techradar.com called the processor “so fast it’s almost silly.”¹⁵

SQL Server 2008 and Xeon: Benefits Overview

There are many business and technical benefits to deploying SQL Server 2008 on Intel Xeon-based servers, whether you are upgrading a legacy SQL Server deployment, moving from another database platform, or building a new database system from scratch.

Business Benefits

A Forrester study commissioned in September 2008 showed that upgrading to SQL Server 2008 from SQL Server 2000 or 2005 delivered an anticipated return on investment (ROI) of between 162% and 181% when taking into account the total economic impact. According to this study, a healthcare company with approximately 12,000 employees and over two million patient records, resulting in approximately 500,000 database queries per day, showed net savings of almost \$1.9 million by upgrading to SQL Server 2008.¹⁶ The Gartner Group's Magic Quadrant for Data Warehouse Database Management Systems names Microsoft as a leader in the field, and cites SQL Server 2008 as "giving high value with a low total cost of ownership (TCO). The SAP TCO Study shows customers lowered DBA costs by 55% and total TCO by 37% with SQL Server as compared to other databases.¹⁷

Industry-standard benchmark results show that SQL Server 2008 delivers excellent performance even when running some of the world's largest workloads for large companies such as Citi¹⁸, Barclays Capital¹⁹, and Siemens²⁰. To achieve optimum performance however, the underlying hardware must be capable of handling the load. Xeon processors' performance features do the job, making employees who work with database information more productive. At the same time, energy efficiency features save your organization real dollars on an ongoing basis by ameliorating the high cost of power in today's energy-hungry world. When you invest in energy-saving technologies, you *spend smart*—a concept that is more important than ever in today's economic climate.

Technical Benefits

The SQL Server 2008/Intel Xeon combination leverages the technical features and specifications of each component to make your database system faster, more reliable, more scalable, easier to manage, and more secure. The table below maps technical benefits to features:

Technical Benefits	SQL Server 2008 Features	Intel Xeon Features
Performance	Dynamic caching, read-ahead scanning, data compression, parallelized partitioned data, Resource Governor, Performance Studio, multi-threaded partition access, filtered indexes	Quick Path Interconnect, Intel Turbo Boost, more efficient algorithms, greater parallelism, enhanced branch predictions, simultaneous multi-threading, Smart Cache, Application Targeted Accelerators
Reliability	Resource Governor, policy-based management, database mirroring	Proven Xeon reliability, multi-processor redundancy, return stack buffer
Scalability	64 bit support, hot-add memory and CPUs	Multiple core, multiple processor support; multi-socket design
Manageability	Server Group Management, SQL Server PowerShell, enterprise reporting engine, integration with Microsoft System Center	Power management microcontroller
Security	Module signing w/certificates, transparent data encryption, Extensible Key Management, Audit object, HSM support	Processing power to support software encryption with minimal performance degradation

SQL Server 2008 and Intel Xeon: Business Scenarios

While the list of new features in both SQL Server 2008 and the new Intel Microarchitecture are impressive, the real test comes in the real world: How can those features be put to use in order to speed performance, enhance productivity, save money, and make the lives of end-users, DBAs, and business managers easier? In the next sections, we discuss three common business scenarios that can benefit dramatically from the deployment of SQL Server 2008 on the new Intel Xeon platform.

Data Consolidation Scenarios

Consolidation is the name of the game, from the server rooms of small/midsize businesses to enterprise data warehouses. Consolidation of data services offers a number of immediate practical and technical advantages:

- Consolidation of multiple databases makes it easier for end users to find the information they need, and provides consistency in the format of query results
- Consolidation of physical servers saves money by lowering initial capital expenditures, and more important, by reducing operating costs
- Consolidation provides centralized management of data and of the physical machines
- Consolidation increases reliability by making it easier to back up and restore data in the event of a hardware failure or disaster
- Consolidation enhances security by providing a centralized repository that can be more easily secured than multiple, dispersed databases
- Consolidation allows you to standardize hardware and reduce hardware diversity that leads to significant costs

Consolidation enables you to *do more with less*.

Reducing SQL Server “Sprawl”

A Web search for the term “SQL Server Sprawl” turns up almost 19,000 hits, indicating that this is a well-known phenomenon in the IT world. It refers to large numbers of SQL servers that may have accumulated on a large organization’s network due to different departments using it for their own small applications. In an enterprise environment, dozens of these separate “ad hoc” SQL Server computers may be spread throughout the company, each doing its own thing. They may be running different versions or editions, and they may or may not have the latest security updates applied. This rampant proliferation of SQL servers is a testament to the software’s popularity, but it comes at the cost of:

- **Data Reliability:** These individual machines may not be backed up regularly and/or backups may not be tested, so if a failure occurs, recovery may be difficult or impossible

- **Server Security:** Unpatched machines can put the entire network at risk
- **Hardware Cost-effectiveness:** These machines often run only one or two applications, and may run on a hodge-podge of hardware that can be over- or under-powered for the job
- **Liability:** Because these departmental servers are often administered locally, a lack of standardization exists that can negatively impact regulatory compliance

By consolidating this myriad of databases onto fewer, more powerful machines, organizations can more easily monitor, secure, back up, and enforce standard policies consistently for all SQL Server instances, and at a lower overall cost. Moving the databases off existing hardware and onto a smaller number of high-powered Intel Xeon-based servers provides increased performance, and standardizing on SQL Server 2008 for all of the databases provides for a consistent user, DBA, and developer experience, along with other benefits we discuss below.

Consolidation can be accomplished in three different ways:

- You can install multiple database instances running on the same operating system on a single physical machine
- You can combine schemas into a single physical database
- You can use virtualization technologies to install multiple operating systems in virtual machines on a single physical machine (not recommended for every type of workload)

The table below shows some advantages and disadvantages of traditional physical consolidation methods compared to virtualized consolidation.

Physical Consolidation	Virtualized Consolidation
Only one operating system license is required	An OS license is required for each virtual machine
If the OS fails, all instances of SQL Server are out of commission	If one VM fails, the others can still continue running
There is only one machine on the network to manage, patch, etc.	Each machine operates and appears to the network as a separate computer; each VM must be separately patched and managed
A larger workload can be run on the same hardware without performance degradation	Some performance degradation may occur, due to VM overhead and resources shared by OS instances

We discuss virtualization challenges and solutions later in this paper.

Hardware and Other Cost Offsets

Whether you use a traditional consolidation strategy or choose to use virtualization, fewer physical machines mean reduced hardware costs. Although the initial capital outlay for a more powerful server is higher, you need fewer of them. Most important, many of the hidden costs of operating the hardware are reduced:

- **Energy cost savings:** Many older servers are notorious energy-wasters. Modern Xeon-based servers with hafnium insulators can significantly reduce the amount of energy required to power your machines. Supporting datacenter costs for power, cooling, humidity control, and rack management can be significantly reduced.
- **Administrative overhead:** The purchase price of a new server only accounts for around 30% of TCO. Up to 70% of TCO for the typical data center goes for administration and support. Server consolidation reduces this overhead, especially when servers that are physically spread across the organization are consolidated into a central location.

Hardware resources can be utilized in a consolidation scenario in the most efficient and cost effective manner, thanks to the Xeon Turbo Boost technology that can allocate processor performance where and when it's needed.

Management and Maintenance

Consolidating multiple SQL Server servers onto a more manageable number of SQL Server 2008 instances running on Xeon processors makes it easier to perform routine maintenance tasks such as timely application of critical updates, which in turn increases overall system and network security and reduces liability. You can use SQL Server Management Studio²¹ to provide a single, consistent management interface for multiple SQL Server instances.

Backup and Recovery

When multiple databases are consolidated on a few servers in a centralized location, backup of data can be more easily controlled and automated. It is easier to provide physical protection for the servers. The "single point of failure" issue can be addressed by creating an appropriate disaster recovery plan and by employing redundancy (failover) for critical systems.

Compliance Issues

Information stored in databases may be subject to various government or industry regulations, including, in the United States, the Sarbanes-Oxley Act (SOX) for public companies, the Gramm-Leach-Bliley (GLB) Act for companies that handle personal financial information, the Payment Card Industry Data Security Standards (PCI DSS) for companies that process credit and debit card transactions,



the Health Insurance Portability and Accountability Act (HIPAA) for organizations that handle healthcare information. Businesses with a global presence must navigate an even more complex set of national and international regulations.

Database consolidation doesn't change the requirements, but it does make it easier to track compliance issues. The encryption, auditing, and key management features in SQL Server 2008 can help organizations achieve compliance, and its reporting feature helps document that compliance. All of this imposes extra processing overhead, but Intel Xeon-based servers are designed to handle the extra load.

The Microsoft SQL Server 2008/Intel Xeon Consolidation Platform

The benefits of consolidation are many, but running multiple SQL Server instances and/or multiple operating systems puts a heavy load on the hardware. To ensure the best performance, you need processors that can reliably deliver the speed you need. When you consolidate databases and have a single point of failure, reliability becomes more important than ever before. The new Intel Xeon processors provide the hardware platform that your mission-critical consolidated databases require.

Business Intelligence (BI) Scenarios

Business intelligence (BI) is a concept that was defined in 1989 by Gartner Group analyst Howard Dresner as "concepts and methods to improve business decision making by using fact-based support systems." Even though BI has been around for two decades, Gartner predicted this year that through 2012, more than 35% of the top 5000 global companies will regularly fail to make insightful decisions because they do not have the information, processes, and tools needed to do so.²²

BI applications usually draw information from data warehouses, but BI goes far beyond merely warehousing and retrieving data. BI tools must be able to analyze the data in such a way as to answer such questions as:

- What has happened in the past?
- What is happening now?
- What will happen in the future?
- Why?

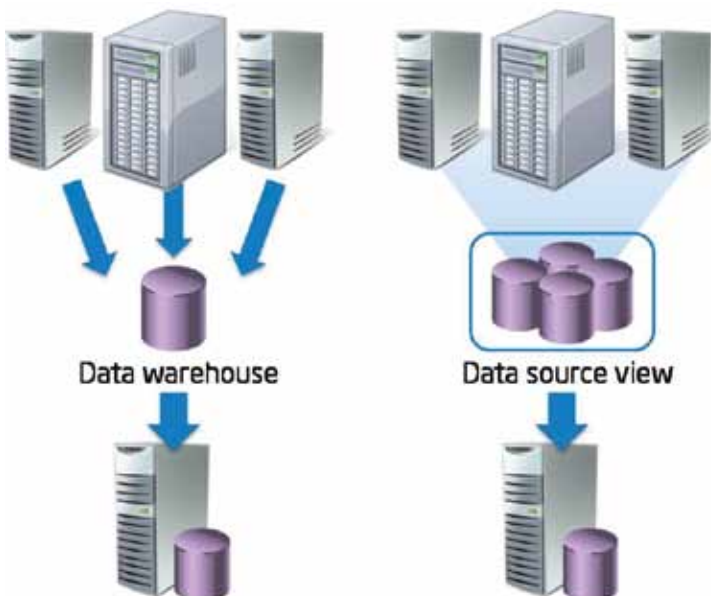
With its powerful “beyond relational” database, its SQL Server Analysis Services and SQL Server Reporting Services, and its data mining capabilities, SQL Server 2008 provides a platform that can help organizations gain deeper insight and facilitate better decision-making to align with organizations’ mission and goals.

Unified Access Across the Enterprise

The high performance database engine that serves as the foundation for SQL Server 2008 can handle extremely large amounts of data and consolidate business data across the enterprise into a central warehouse. When an organization has multiple data stores, there must be a way to create a single source of data for reporting and analysis in order to create a true BI solution. SQL Server 2008 can do this via creation of a centralized data warehouse or via data source abstraction that creates a single view of data across multiple data sources.²³

Data Extraction and Synchronization

SQL Server 2008 Integration Services enables you to synchronize data from multiple, disparate data sources used by various applications across the enterprise, and to extract the data relevant to your operation.



Analysis and Reporting

SQL Server Analysis Services in SQL Server 2008 provides an analytical engine for Online Analytical Processing (OLAP) solutions. It also enables data mining methods that can use specialized algorithms to identify patterns, trends, and associations.

Reporting is an important part of BI. SQL Server Reporting Services eases the task of creating detailed business reports, and data from multiple sources can be incorporated into a single report. A new layout structure allows you to combine table and matrix data regions (Tablix) so developers can generate reports that combine fixed and dynamic rows.

Integration with the 2007 Microsoft Office System

For BI to accomplish its purpose as a valuable source of information for users at all levels of the organization, you need a delivery system with which end-users are comfortable. The SQL Server 2008 BI platform reaches workers through the familiar interfaces of the 2007 Microsoft* Office system applications:

- **Microsoft* Office Excel*:** Can be used as an interface for OLAP analysis; users can access data stored in OLAP cubes in Analysis Services and create dynamic views to view the data in different ways. Data mining add-ins allow users to perform complex analysis directly in Excel and deliver reports formatted to render in Excel.
- **Microsoft* Office Word:** The report renderer for Word enables users to render SQL Server 2008 Reporting Services in the familiar Word format.
- **Microsoft* Office Visio*:** Users can use Visio 2007 to annotate, enhance, and present graphical views of data mining information, including decision trees, regression trees, cluster diagrams, and dependency nets. The Visio diagrams can then be embedded in other Office documents, or published to the Web.
- **Microsoft* Office SharePoint* Server 2007:** SQL Server 2008 Reporting Services integrates with SharePoint Server 2007 to enable users to view and interact with BI content, track versions, and manage reports through a consistent user interface.
- **Microsoft* Office PerformancePoint* Server:** Users can monitor, analyze, and plan business activities based on analytical information provided by SQL Server 2008.

The Microsoft SQL Server 2008/Intel Xeon Business Intelligence Platform

Microsoft SQL Server 2008 was designed to do more than warehouse data—it was designed to serve as the backbone of a comprehensive BI platform that integrates seamlessly with Microsoft Office applications for the most user-friendly BI solution. However, intelligent analysis is more resource-intensive than mere “dumb” data retrieval, so it makes sense to build your BI system on top of the most powerful processing plant: the new Intel Xeon multi-core, multi-processor servers.

Replatforming Scenarios

Moving a large database or multiple databases from one platform to another can be a complex undertaking, but many organizations' cost/benefits analyses have indicated that a move to SQL Server 2008 is worth the trouble. Whether you're "moving over" from a UNIX- or Linux-based database solution, migrating from a mainframe-based database, or "moving up" from a legacy SQL Server deployment, there are steps you can take and tools you can use to make the transition easier.

"Moving Over" from a UNIX/Linux to Windows Infrastructure

The decision to move your databases from IBM DB2, Oracle, Sybase ASE, or other database software running on a UNIX platform is a big one, but it can pay off handsomely in terms of better usability, easier manageability, cost and performance gains, and a higher level of security.²⁴ Organizations are finding that migrating from a commercial UNIX-based database to SQL Server 2008 running on Windows Server can save them money, because Microsoft doesn't charge extra for OLAP, data mining, data compression, partitioning, encryption, and other features that add to the price tag for competing enterprise database management systems. They are also finding that SQL Server 2008 is easier to install and manage.²⁵

The migration is a multi-step process that begins at the bottom (the physical layer) and involves obtaining the proper hardware, installing the new operating system, installing the new database software, and migrating the data. Careful planning is essential at each step.

Microsoft provides, free of charge, the SQL Server Migration Assistant (SSMA) 2008 for Oracle that dramatically reduces the cost, effort, and risks of migrating your databases from Oracle to SQL Server. The tools automate the process. Microsoft also provides guidance and resources on their Web site that help you plan and execute a migration.

Other organizations, particularly those that have grown, may be migrating from an open source database on Linux, such as MySQL. Enterprises, on the other hand, are finding cost savings in migrating

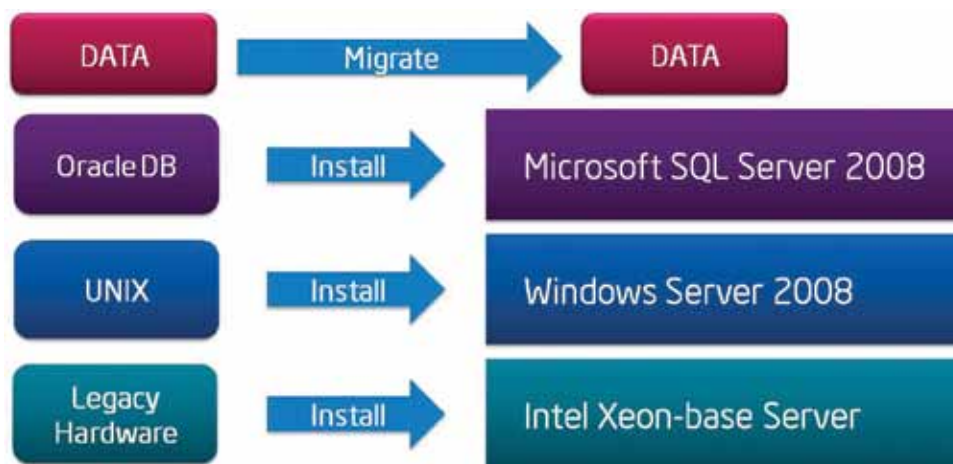
their SAP/ERP applications to SQL Server 2008. Over 25,000 SAP installations are running on SQL Server, making Windows the leading platform for SAP deployments, and Microsoft provides SQL Server technical resources for SAP on their Web site.

The decision to replatform may come about because your current database solution is out of date and no longer capable of handling the needs of your organization. It may be that you've decided to move to an "all Windows" shop to simplify administration. Regardless of your particular migration scenario, an important part of the migration planning process involves assessing hardware needs. A major platform migration affords the perfect opportunity to lay the foundation for a database solution that scales to serve your organization's needs today and in the future. By deploying SQL Server 2008 on the new Intel Xeon processors, you can enjoy the performance and manageability advantages without worrying about whether your hardware will be a bottleneck.

Migrating from a Mainframe Database

Many companies in the past relied on "big iron" when their database needs required the highest levels of performance and scalability. As performance benchmarks show that SQL Server 2008 can handle the largest workloads, many companies are migrating their databases from mainframes to SQL Server 2008. Some organizations that have moved from IBM mainframe solutions to SQL Server include Scandinavian Airlines, Copper Rubber & Tire, and Savings Bank of Russia. Citi Group runs the Lava market montage solution on SQL Server with more than 200,000 updates per second, Xerox uses SQL Server to manage 7 million transactions per day with 99.999% uptime, and Nasdaq handles 5,000 transactions per second with SQL Server.²⁶

The TPC-C benchmark shows that SQL Server 2008 can exceed 1 million transactions per minute,²⁷ and a SAP-SD certified benchmark supports 93,000 concurrent users on SQL Server 2008 (ten times larger than the largest SAP customers).



Initial acquisition costs for SQL Server running on Intel Xeon processors are lower than for the typical mainframe deployment, and because routine database management tasks are automated, streamlined or eliminated, database administration costs are lower. In addition, the most popular mainframe database solution can be 5 to 6 times as expensive to license.

Mainframe migration is now easier with re-hosting, porting, replacement, or rewriting of existing applications.

“Moving Up” from a Legacy Windows Infrastructure

A less disruptive but potentially equally beneficial replatforming scenario occurs when you decide to upgrade from a legacy SQL Server data management system (SQL Server 2000 or SQL Server 2005) to SQL Server 2008 in order to take advantage of its improved performance and reliability, new security features, richer development environment, and support for new data types.

An upgrade presents more options, but with some of those options come potential pitfalls. You may be tempted to do an “in-place” upgrade to replace the existing instance of SQL Server with SQL Server 2008, keeping the existing operating system and hardware. Fewer steps are involved, and the process is faster and appears to be simpler. An in-place upgrade on legacy hardware can prove to be a disappointment, however. It’s likely you won’t reap all the performance benefits of the new database software, because the old hardware will create a bottleneck. The in-place upgrade is also riskier; if something goes wrong, you may have to start from scratch anyway. Meanwhile, your database is out of commission.

A side-by-side upgrade has many benefits. You have the opportunity to install the new instance of SQL Server 2008 on a clean installation of Windows Server 2008, which provides important performance and security benefits. Unlike an in-place upgrade, the side-by-side

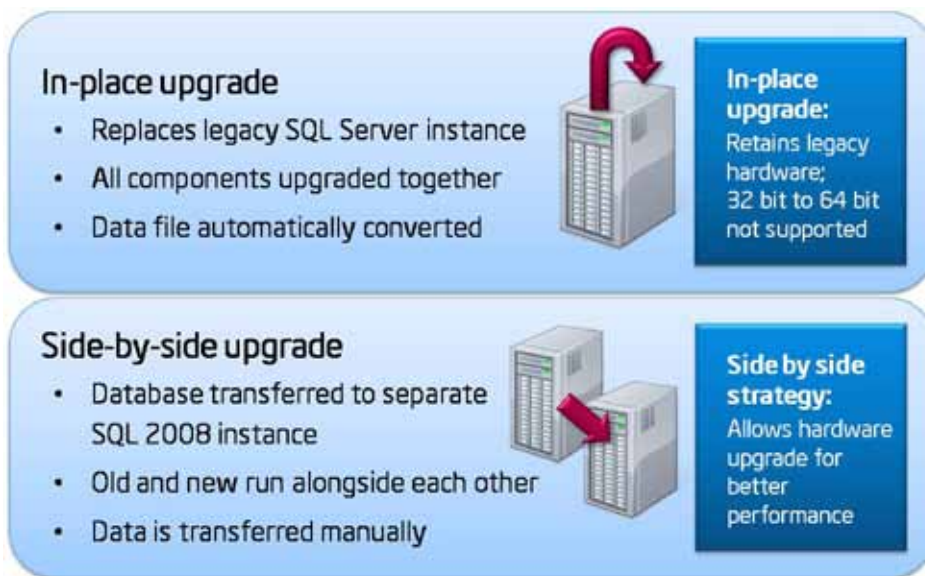
upgrade gives you the option to switch from a 32- to 64-bit operating system to take advantage of greater memory capacity that’s often needed for optimum database performance. Because the old and new machines can run side by side, database downtime is minimized. Most important, with a side-by-side upgrade you can replace the outdated hardware with a new Xeon-based server for highest performance. Be aware that with a side-by-side upgrade, you have to manually transfer data files, database objects, configuration, and security settings and other objects. The extra time required up front, however, is worth the ongoing performance gains and energy cost savings.

The Microsoft SQL Server 2008/Intel Xeon Replatforming Strategy

When your database no longer meets the needs of your growing organization, when it can’t provide the business intelligence that you need to make crucial decisions, or when it’s costing your company money due to reduced productivity and high administrative overhead, it’s time for replatforming. A popular old truism says that “it’s better to do it right than to do it over.” A half-way solution that puts a shiny new database on tired old legacy hardware ends up costing more in the long run, and you lose out on performance in the meantime. The solution is to replatform from the ground up, starting with new Intel Xeon-based servers, and building on that by installing Windows Server 2008 and Microsoft SQL Server 2008.

Issues that Span Key Scenarios

Several issues span all three of the above scenarios, and you should take them into consideration when planning a database consolidation, Business Intelligence deployment, or replatforming move. These are additional areas where the SQL Server 2008/Intel Xeon combination offers unique advantages.



XML Functionality

XML is becoming increasingly popular as a means for sharing structured data, so it's important for modern databases to support XML as well as relational data. Microsoft introduced XML capabilities in SQL Server 2000, and has expanded them with each subsequent version. SQL Server 2008 has a number of XML-handling enhancements that allow you to build powerful databases that combine relational data and XML. However, performance can be an issue with queries against large XML documents.

The new Intel Microarchitecture has added four new streaming instructions to SSE4 (SSE4.2) that are designed specifically for accelerating workloads such as XML and other pattern-related string-based and text-based tasks. These new instructions make XML parsing more efficient, by parsing entire strings (16 bytes) instead of each individual character as traditional architectures do.

Virtualization

Virtualization has moved, in the last several years, from IT buzzword to mainstream IT technology. Both operating system virtualization and application virtualization are commonplace in today's business workplace. As discussed earlier, virtualization can be a cost-effective way to accomplish SQL Server consolidation, but it often comes with performance overhead.

The new Intel Microarchitecture includes features that are designed to improve performance in virtualized environments.

Replacement of the front-side bus with QPI brings significant benefits for virtualization, as do other general performance enhancements. In fact, virtualization performance can see a significant improvement on round-trip virtualization latency compared to 65 nm processors.

Security

Security is often looked upon as purely a software issue. Yet one reason today's operating systems and applications require more system resources than ever before is the additional processing overhead for implementing security mechanisms such as authentication, encryption/decryption, biometric comparisons, and other security protocols. Database servers, which often hold sensitive information, are a prime target for attack, and must be protected with strong security measures. If the processors in the server don't have sufficient power to handle the increased load, processor queues can develop and performance suffers.

That's why hardware planning must take into account the extra processing power required for security processes. Running your SQL Server 2008 databases on Intel Xeon-based processors ensures that you won't have to sacrifice performance for security; instead, you can have both.

Xeon Platform Selection

Once an organization decides to deploy SQL Server 2008 on a Xeon-based server, the next decision concerns which Xeon platform will best serve the company's needs. A comparison of currently available 7400-series and 5500-series Xeon processor features is useful in determining which will best serve in a given business scenario.

7400 Series

The Xeon 7400 series is the last of the Intel® Penryn generation of processors. They use the 45nm manufacturing method and feature four or six cores, from 8 to 16 MB of L3 cache, and a 1066 MBx front-side bus. The 7400 series processors support DDR2-1066 RAM and vary in speed from 2.13 GHz to 2.66 GHz.

The 7400 series platform set four-socket and eight-socket world records on the TPC-C benchmark, which measures database performance in an online transaction processing environment. It is extremely scalable, with up to six cores per processor, enabling servers with 16 sockets to utilize an amazing 96 processing cores that will handle the heaviest database loads. Its advanced virtualization technology also makes it an appropriate choice for virtualized server consolidation. With its high I/O capabilities, the 7400 series is well suited for highest-use, highest-scale environments.

5500 Series

The Xeon 5500 series is based on the new Intel Microarchitecture. The same 45 nm manufacturing process is used, but QPI replaces the front-side bus, and the integrated memory controller supports either dual- or triple-channel DDR3 SDRAM or four FB-DIMM channels. All but one model are quad core, and speeds vary from 1.86 to 3.20 GHz, with QPI speed ranging from 4.8 to 6.4 GT/s. Turbo Boost and hyperthreading are supported by most models.

The 5500 series platform set new two-socket records, and provides the latest and greatest technologies for performance and scalability, including support for the highest-speed memory and the advantage of QPI over the legacy FSB. These features, along with higher-top clock speeds, make it an appropriate choice for organizations that need excellent performance and scalability in most database environments.

For processor-intensive OLTP with SQL Server 2008, selecting the 2.66 GHz X5550 can provide a significant advantage over the 2.53 GHz E5540. Testing shows 13.6 percent higher performance on otherwise identical hardware running the same workload.

Conclusion

Sometimes the synergy between two components generates a combination that is much more than the sum of the parts. Microsoft SQL Server 2008 provides significant features and functionality benefits over both its predecessors and its competitors, allowing us to greatly expand the way we think about database content to brand new data types and new ways of using that data to gain intelligent insight into all aspects of our business. The new Intel Microarchitecture-based Xeon processors make us completely rethink how processors work and interact with system memory and other server components, and showcase a new design that is, according to one reviewer, "so fast it's almost silly."

When you put the two together, you get a perfect marriage of hardware and software that works together seamlessly as the foundation upon which you can consolidate databases for greater efficiency, build a comprehensive and integrated Business Intelligence system, or replatform your old databases for higher performance, more reliability and better security. The future of databases is about flexibility, and the Microsoft SQL Server 2008/Intel Xeon platform gives you the proper tools to take you there.

Related Links, Resources, and Citations

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Intel® VT-x supports both 32-bit and 64-bit Intel® Xeon® processor-based solutions (Intel® 64 and IA-32).

Intel® VT-x is included in Intel® Xeon® processors.

Intel® Active Management Technology requires the platform to have an Intel® AMT-enabled chipset, network hardware and software. The platform must also be connected to a power source and an active LAN port.

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