More Capability and Higher Value for Mission-Critical Databases

Microsoft SQL Server* 2012 and the Intel® Xeon® processor E7-8800/4800/2800 product families offer a powerful, cost-effective platform for mission-critical databases with rich, built-in support for:

- Enterprise-wide analytics
- Big data integration
- Hybrid cloud extensibility

This white paper discusses the key capabilities SQL Server 2012 and the Intel Xeon processor E7 family bring to enterprise computing. It offers useful information for any IT decision-maker looking for ways to manage and use information more effectively to grow their business and improve profitability.
## Executive Summary

Information is the fuel that drives success in today's business world. When the right information is available at the right time, core business processes run more efficiently and employees make better, faster decisions. Some of the world's most successful companies are using innovative new database and analytics solutions to help ensure the right information is available at the right time more consistently throughout their businesses.

Intel and Microsoft can help you stay at the forefront of this revolution by taking advantage of advanced analytics capabilities that are tightly integrated into a complete information platform for mission-critical enterprise computing. Microsoft SQL Server® 2012 and the Intel® Xeon® processor E7 family deliver world-class performance and reliability for tier-1 transactional workloads across native, virtualized, and cloud computing deployment models. The combined platform also provides integrated support for advanced data analytics and big data integration, with no need for costly add-ons.

From client systems to public clouds, Intel and Microsoft provide a unified infrastructure, management, and security framework that helps IT organizations manage cost and risk more effectively as they continue to expand their information infrastructure and add new functionality. Advanced performance, reliability, and security features are built into the hardware and software platform at all levels, enabling business users to access data and insights more quickly and securely using some of their most familiar tools, such as Microsoft Excel® and Microsoft SharePoint®.

“SQL Server 2012 offers breakthrough capabilities, including integration with big data. With Windows Server 2012 Hyper-V and the Intel Xeon processor E7 family, you gain a game-changing software and hardware platform for mission-critical enterprise computing that can help you virtualize and consolidate SQL Server workloads with confidence.”

– Herain Oberoi, director, Server and Tools Marketing, Microsoft

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Data-Driven Business: The Race is On

Enterprise data has been the lifeblood of enterprise transactional systems for many years, and still is. Fast, uninterrupted access to data remains essential to support core, revenue-generating business functions. Yet today’s businesses need more from their databases than scalable performance and high availability. They also need to be able to analyze their data quickly and effectively, and they need to do so across rapidly growing and increasingly diverse data sets.

According to Gartner, total worldwide data volumes are growing at 59 percent per year¹ and up to 85 percent of that data is unstructured content, such as documents, e-mails, videos, logs, social networking posts, and networked sensor data. Properly analyzed, this data offers unprecedented insight into the minds of customers and the operations of the business.

New business intelligence (BI) and data analytics solutions have arisen to enable near-real-time analysis across all these data types. At the same time, cloud computing is emerging as a viable adjunct to traditional data center computing models. As data volumes and analytics requirements continue to grow, the elastic scalability and superior cost models of cloud computing offer new options for storing and analyzing massive data sets without breaking IT budgets.

Taking advantage of these emerging capabilities is increasingly important to build and sustain competitive advantage. SQL Server 2012 running on servers based on the Intel Xeon processor E7 family offers a uniquely powerful and cost-effective solution for the most demanding enterprise requirements (Figure 1). The combined platform provides world-class performance, scalability, and reliability for mission-critical transactional applications, along with built-in, fully integrated analytics capabilities to address the enormous challenges—and the even more enormous opportunities—presented by the ongoing explosion of enterprise data. Just as importantly, these capabilities are provided with cost models that are much more favorable than traditional database solutions, so IT organizations can deliver higher value to the business at lower total cost.

Figure 1. Powerful and cost-effective support for the full range of enterprise database requirements

A Rock-Solid Foundation for Mission-Critical Databases

SQL Server and Intel Xeon processor-based servers have been supporting mission-critical enterprise deployments for many years and in some of the world's most demanding business environments, including financial services, the telecommunications industry, and many others. Customers have successfully achieved five-nines, six-nines, and higher availability on the combined platform. SQL Server 2012 and the Intel Xeon processor E7 family offer an even more attractive platform for mission-critical computing, with better Reliability, Availability, and Serviceability (RAS) capability than previous product generations, and with tighter integration and simpler implementation.

Highly Available Servers

The Intel Xeon processor E7 family is engineered specifically for scalable performance and high availability. Errors occur in all server platforms and are among the most common causes of downtime and data corruption. Hardened circuits and rigorous testing and validation help to prevent errors throughout server platforms based on the Intel Xeon processor E7 family. When errors do occur, automated error correcting technologies help to resolve them transparently so they don’t impact systems and applications.

The Intel Xeon processor E7 family also includes Machine Check Architecture (MCA) Recovery, which enables automatic system recovery from many uncorrectable errors that would be fatal in other server platforms (Figure 2). MCA Recovery is fully supported in Windows Server* 2012, Hyper-V*, and SQL Server 2012. This comprehensive support delivers integrated error management throughout the software stack to provide higher levels of data integrity and system uptime.

Driving Real-World Business Success—Telecommunications

Scaling Redknee TCB to handle 250 million subscribers

Telecommunications providers are transforming their operations and business models in order to deliver new services to their subscribers faster and at lower cost. Redknee Turnkey Converged Billing (TCB) is a pivotal component of this transformation for many providers, delivering centralized business intelligence, a personalized subscriber experience, and a full suite of billing and customer care capabilities.

A recent 250 million-subscriber performance test by Redknee and Microsoft verified that SQL Server* 2012 running on an eight-socket server based on the Intel® Xeon® processor E7 family could support record-breaking performance. At peak performance, the system processed an average of 1,249 invoices per second and mediated an average of 113,402 Call Detail Records per second. The combined platform exceeded performance objectives and clearly demonstrated it could support peak workloads for a tier-1 telecommunications provider.

For more information, read the complete report.

Figure 2 The Intel® Xeon® processor E7 family includes Machine Check Architecture (MCA) Recovery, which is supported in SQL Server* 2012, Windows Server* 2012, and Hyper-V* to enable higher availability through sophisticated error recovery.
Servers based on the Intel Xeon processor E7 family provide many additional features for optimizing server uptime. Examples include:

- **Self-healing communication channels** within the server platform to enable continued operation in the event of I/O or memory link failures.

- **Electronically isolated hardware partitioning** to protect critical workloads more effectively in consolidated environments. This capability also allows IT organizations to perform physical server maintenance without bringing down an entire server.

- **Full and partial memory mirroring** to provide complete data redundancy for the most sensitive applications.

- **Online component replacement** so hardware repairs can be performed without downtime. In combination with predictive failure analysis (supported in Windows Server 2012) IT staff can identify and replace failing components proactively before they can impact applications.

**Fast, Automated Failover**

Microsoft SQL Server extends the inherent resilience of the hardware platform by providing complete software support for high availability and disaster recovery. AlwaysOn Availability Groups is a new integrated solution for providing data and hardware redundancy within and across data centers to increase the availability of mission-critical applications.

Database administrators can deploy up to four secondary, or replica, databases to provide multiple levels of redundancy. Up to two of the secondary databases can be replicated synchronously so they stay in lockstep with the primary production database to enable almost instant failover with no data loss. Additional secondaries can be replicated asynchronously and combined with log shipping to provide complete recovery capabilities to a remote data center for disaster recovery (Figure 3).

Failover to a synchronous replica can be fully automated to avoid the delays of manual solutions. SQL Server 2012 also introduces a new capability called Failover Clustering Dynamic Quorum, which simplifies setup by as much as 80 percent compared with previous-generation solutions and helps to ensure uptime down to the last standing replica. In addition, secondary databases are now active. They can be used for data backups, queries, and other read-only workloads to reduce the load on the primary database and to improve overall resource utilization.

SQL Server 2012 provides a number of additional advanced RAS features to further increase database uptime.

- **Faster patching and more effective testing.** SQL Server 2012 supports the Windows Server Core role, which can reduce the need for patching by as much as 50-60 percent. When patching is required, Cluster-Aware Updating (CAU) speeds updates across clustered environments. Administrators can also reduce the likelihood of problems following software updates by using Distributed Replay to provide realistic simulations of complex, production workloads for more effective testing.

- **Simpler failover and recovery.** Hyper-V Replica provides a complementary option for disaster recovery. Implemented at the virtual machine level, it provides simple support for asynchronous replication and disaster recovery across wide area networks. Administrators can also take advantage of Recovery Advisor to provide simpler and more accurate point-in-time backup and recovery, as well as snapshots to the Windows Azure platform to scale backups more economically.
Scalable Performance for Tier-1 Workloads

Maintaining performance levels in the face of growing data volumes can be a tough challenge. SQL Server 2012 has demonstrated world-record transactional performance for tier-1 workloads running on Intel Xeon processor E7 family-based servers. Both the hardware platform and the software stack can scale to support today’s most demanding requirements, not only in native environments, but also in virtualized servers and cloud infrastructures.

An eight-socket server based on the Intel Xeon processor E7 family provides massive resources for heavy workloads, with up to 80 cores, 160 threads, and support for up to four terabytes of memory. Each processor includes up to 30 MB of cache and a scalable, high-speed I/O subsystem to support network- and storage-intensive database workloads. Intel® Turbo Boost Technology automatically increases core frequencies past rated values for peak workloads when thermals allow, and Intel® Hyper-Threading Technology allows each core to process two simultaneous software threads, which improves computing efficiency when processing multiple simultaneous data requests.

Microsoft SQL Server 2012 and Windows Server 2012 scale to take full advantage of all the hardware resources in these servers—and in even larger future server generations—with support for up to 256 logical processors (threads) and four terabytes of memory per instance. A number of additional capabilities in the Intel and Microsoft database platform help to deliver higher scalability for business data at lower total cost, including:

- **Quick, simple cloud extensibility.** Businesses can scale their databases into the cloud to meet truly massive requirements. SQL Azure Federation provides “click and split” support for database scaling in hybrid cloud scenarios, and built-in connection points for Windows Azure make it easy to extend or migrate workloads from one environment to another.

- **Powerful compression.** Compression ratios of up to 90 percent can be realized for some data types and ratios of 20-60 percent are typical. These high compression ratios not only help to reduce storage requirements, but also drive higher performance by enabling more data to be held in main memory, where it can be accessed orders of magnitude faster than from disk storage. The large and efficient memory and cache subsystems of the Intel Xeon processor E7 family help IT organization make the most of these in-memory capabilities, reducing the need for performance-sapping data transfers between memory and storage.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Transactions</td>
<td>3,347 transactions per second</td>
<td>11,592 transactions per second</td>
</tr>
<tr>
<td>Batch Processing</td>
<td>1 hour 20 minutes</td>
<td>41 minutes 38 seconds</td>
</tr>
<tr>
<td>Processor Utilization</td>
<td>No more than 70%</td>
<td>No more than 75%</td>
</tr>
<tr>
<td>Scalability</td>
<td>95%</td>
<td>95%</td>
</tr>
</tbody>
</table>

Record-breaking banking performance for Temenos T24

Temenos is the market-leading provider of banking software systems worldwide, serving more than 1,500 customers in 125 countries. In a recent high-water benchmark, Temenos and Microsoft engineers tested the performance and scalability of the Temenos T24 core banking application using an Intel and Microsoft solution stack, including SQL Server* 2012 running on a server based on the Intel® Xeon® processor E7 family.

At peak performance, the system processed 11,592 transactions per second, more than tripling the performance of Temenos T24 running on a previous-generation Microsoft and Intel database platform. It also reduced end-of-day batch processing times by almost 50 percent. These record-breaking performance results provide a compelling demonstration that SQL Server 2012 and the Intel Xeon processor E7 family can readily handle mission-critical workloads for even the largest banks.

• Guaranteed resources. Enterprise databases have multiple applications vying for resources, so it’s essential to ensure critical applications get the resources they need. With Resource Governor in SQL Server 2012, administrators can create up to 64 isolated resource pools, place hard caps on CPU resource usage, and establish workload affinity to schedulers and non-uniform memory access (NUMA) nodes to provide better support for service-level agreements.

• Affordable, high-end storage. With Server Message Block (SMB), Windows Server 2012 allows IT organizations to support demanding storage requirements using remote shared folders on affordable file servers. Features such as SMB Direct and SMB Multichannel enable fast, scalable, and highly available storage connectivity to support SQL Server and other demanding applications. Intelligent storage arrays based on Intel Xeon processors add to these advantages by providing advanced storage capabilities, such as on-demand scaling, data compression, data deduplication, and thin provisioning. Many also support automated storage tiering, which, when combined with Intel® Solid-State Drives, can enable dramatic performance gains at relatively low cost.

Pervasive Insight – Built-in Analytics and Big Data Integration

All the capabilities discussed so far are about doing business as usual, only faster, more reliably, and more affordably. Today’s revolution in data analytics is about growing the business by empowering business users to identify opportunities and risks and act on them more quickly. With advanced analytics, users across the business can make better, faster decisions based on comprehensive and credible data.

Intel and Microsoft are uniquely positioned to help businesses grow their analytics capability. SQL Server 2012, combined with Microsoft business intelligence (BI) tools and Intel® processor-based servers, laptops, and tablets, provides a flexible and affordable foundation for extending advanced analytics throughout the business (Figure 4).
Self-Service Analytics with Integrated Security and Control

With Microsoft SQL Server 2012, business users can take advantage of familiar tools, such as Microsoft Excel* and Microsoft SharePoint*, to access and analyze massive volumes of data and share their insights with other users across the business. There is no need for specialized expertise in data analysis and recent innovations, such as PowerPivot and Power View, enable speed-of-thought analytics and interactive data presentations, which provide users with a simpler and more immersive experience.\(^{11}\)

Intel processor-based PCs, laptops, and tablets provide the performance needed to make the most of these tools. They also offer advanced security technologies, such as hardware-accelerated encryption, two-factor authentication, and automatic lock-downs for lost or stolen laptops. When combined with the access controls built into Windows Server 2012, these security enhancements empower IT to deliver wider access to business-critical data and insights—with less risk and improved compliance. SQL Server 2012 provides additional support for access controls, combining high levels of granularity with centralized management based on Active Directory* and SharePoint security models.

SQL Server 2012 also provides user-defined server roles for enhanced administrative security. Authorized IT administrators can use dashboards and familiar tools to monitor end-user activity, data source usage, and server metrics. This allows them to regulate the analytics environment as needed to ensure security, compliance, performance, and reliability, without disrupting the end-user experience.

Integrated Analytics across the Enterprise

SQL Server and Intel® architecture provide a common information platform that can be extended across the enterprise and configured flexibly at each point to match specific workload requirements—all the way from core transactional systems, to enterprise-scale data warehouses, to departmental data marts and end-user access points. The consistency of the platform offers important benefits, enabling centralized staff to maintain unified management, security and compliance models so they can deliver greater capability with less risk and reduced costs (see the sidebar, Higher Value through Tight Integration).

Driving Real-World Business Success: Insurance

Scaling Accenture Duck Creek to support nearly 70,000 transactions per day

Accenture, Microsoft, and Intel worked together to test the performance and scalability of Accenture Duck Creek insurance policy-administration software for Commercial Package Policies (CPPs) running on Microsoft SQL Server* and servers based on the Intel® Xeon® processor E7 family and the Intel® Xeon® processor E5 family. At peak production, the joint solution was able to process approximately $142 million in premium per hour for a simulated user community of 20,000, with policy-page response times of less than 2 seconds for average-size and large-size policies.

The system also demonstrated tremendous scalability, with new business premium tripling from $8.55 million per hour to $25.19 million per hour when the workload and number of processing servers was tripled. With this level of performance and scalability, the combined solution can clearly meet the requirements of very large tier-1 insurance carriers.


SQL Server 2012 also provides a common BI Semantic Model across all enterprise analytics requirements. Self-service analytics based on new tabular data models can be integrated with more advanced capabilities based on traditional multidimensional data models. With this integration, data analysts and IT professionals can extend end-user analyses to deliver corporate-grade reports using more sophisticated tools. They can also amplify traditional insights with integrated support for social networking concepts, text analytics, spatial data, and streaming data analytics.
Flexible Data Warehouse Solutions

A flexible and scalable data warehouse provides the foundation for high-quality analytics by enabling diverse data sets across the enterprise to be cleansed, integrated, and stored in a scalable repository specifically optimized for queries. SQL Server 2012 and servers based on Intel Xeon processors provide complete support for data warehousing, with no costly add-ons and with advanced features for managing data and accelerating query performance.

• Fast analytics across massive data sets. The In-Memory ColumnStore Index in SQL Server 2012 improves analytics performance by as much as 10x to 100x by allowing columnar tables, which are far more efficient for many queries, to be built on top of traditional row-based tables. By building these columnar tables in memory, data can be accessed much faster than from disk. The large and efficient cache and memory subsystems of the Intel Xeon processor E7 family are ideal for this in-memory processing strategy, enabling large and complex datasets to be processed more quickly.

• Built-in support for all data types. SQL Server 2012 lets database administrators store and manage complex data types in a variety of ways. Binary large objects (BLOBs) can be stored within the database or they can be stored on remote file systems and managed as if they were in the database. This flexibility makes it easier to build rich and innovative applications without paying premiums for alternative database solutions or high-end storage systems. All data types are treated as first-class citizens. They can even be protected by AlwaysOn Availability Groups to provide mission-critical service levels.

• Integration with Apache Hadoop.* Businesses are implementing Apache Hadoop to store and analyze up to petabytes of data in near real time through massively parallel processing across large numbers of low-cost servers. Microsoft will offer HDInsight*, a 100 percent Apache-compatible Hadoop distribution that is highly optimized for Intel Xeon processor-based servers. Licensed users of SQL Server 2012 can also download bi-directional Apache Hadoop connectors at no cost. With integrated support for Microsoft management and security tools and frameworks, HDInsight provides significant advantages in comparison with many alternative big data solutions. IT organizations can also take advantage of the Microsoft BI Platform to provide a simpler, more immersive, and more interactive user experience.

Higher Value through Tight Integration

Adding new functionality to a highly complex IT environment can be both complex and costly, especially when it requires patching together diverse hardware and software solutions from multiple vendors. Gaps in capability and interoperability must be identified and remediated to ensure the new solution will perform reliably, securely, and as expected.

Microsoft and Intel offer a high-value alternative. SQL Server* 2012, Windows Server* 2012, and System Center* 2012 provide a tightly integrated foundation for enterprise computing, and all are highly optimized for performance, energy-efficiency, manageability, and security on Intel* processor-based servers and clients. The combined platform enables IT to seamlessly build, deploy, and manage applications across multiple sites and all deployment models—including physical, virtual, and cloud—with policy-based monitoring and deep insight into application performance and health.


Fast, Low-Risk Deployment Models

Designing and deploying a data warehouse from the ground up can be a complex process entailing high upfront costs, long timelines, and considerable risk. Validated data warehouse reference architectures based on SQL Server 2012 and Intel Xeon processor-based servers provide complete hardware and software templates to simplify and speed deployment, while delivering higher and more predictable performance. IT organizations can build their own systems using these reference architectures or they can take advantage of production-ready appliances from third-party vendors.
Options include departmental-sized data warehouse based on the SQL Server 2012 Fast Track Reference Architecture and massive, enterprise-class data warehouses based on the Microsoft Parallel Data Warehouse Reference Architecture. Using these reference architectures, businesses can establish a hub-and-spoke environment that allows them to maximize overall business agility, while simultaneously maintaining a consistent enterprise analytics platform to control data quality and establish a single view of the truth.

Cloud-Ready for Elastic Scalability

The elastic scalability and inherent resilience of cloud computing are particularly valuable for supporting mission-critical databases. A cloud architecture provides a more agile and efficient foundation for scaling workloads and data volumes. Yet databases have, until recently, been among the most difficult applications to virtualize and migrate into a private or public cloud infrastructure.

Scalable Virtualization for Tier-1 Workloads

Windows Server 2012, SQL Server 2012, and Intel Xeon processor-based servers simplify the move toward virtualization and cloud computing for all workloads, including large databases with demanding storage and networking requirements. Windows Server 2012 Hyper-V is optimized for Intel® Virtualization Technology, which provides hardware-assists for core virtualization functions throughout the server platform. This newer version of Hyper-V also provides dramatic improvements in scalability versus the prior generation, with support for up to 64 virtual CPUs and 1 TB of RAM per virtual machine (Table 1).

Enterprise Strategy Group (ESG) ran a series of tests to verify performance and scalability for SQL Server running in virtual machines on physical servers based on the Intel Xeon processor E7 family. The results showed a 6x performance improvement versus the previous version of Hyper-V for a tier-1 online transaction processing (OLTP) workload, with a 5x improvement in average transaction response time (Figure 5). Performance scaled linearly up to 64 vCPUs, at which point the platform was able to support 797 transactions per second with an average response time of 0.10 seconds.

Table 1. Windows Server* 2012 Hyper-V* provides dramatic increases in physical and virtual scalability.

<table>
<thead>
<tr>
<th>System</th>
<th>Resource</th>
<th>Logical processors</th>
<th>Physical memory</th>
<th>Virtual processors</th>
<th>Memory</th>
<th>Active VMs</th>
<th>Virtual disk size</th>
<th>Nodes</th>
<th>VMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Host</td>
<td>SQL Server* 2008 R2 Windows Server* 2008 R2</td>
<td>64</td>
<td>1 TB</td>
<td>512</td>
<td>64 GB</td>
<td>384</td>
<td>2 TB</td>
<td>16</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>SQL Server* 2012 Windows Server* 2012</td>
<td>320</td>
<td>4 TB</td>
<td>1,024</td>
<td>1 TB</td>
<td>1,024</td>
<td>64 TB</td>
<td>64</td>
<td>8,000</td>
</tr>
</tbody>
</table>

Driving Real-World Business Success: Product Lifecycle Management

Scaling Siemens Teamcenter* to support 10,000 users

Teamcenter provides a comprehensive portfolio of end-to-end product lifecycle management (PLM) solutions used by companies around the globe to deliver world-class products more quickly and efficiently. To validate performance and scalability, Intel, Microsoft, and Siemens PLM Software performed benchmark tests for Teamcenter 8.3 using SQL Server* 2012 running on a server based on the Intel® Xeon® processor E7 family.

The platform scaled easily to support 10,000 concurrent users, with linear growth in resource usage and a weighted average response time on par with some of the fastest results ever measured in the Siemens Automated Performance Analysis facility.

Advanced Automation for Higher Value

With the addition of Windows Server 2012 and Microsoft System Center 2012 SP1, SQL Server 2012 and servers based on the Intel Xeon processor E7 family provide the foundation for hosting mission-critical database applications in private cloud environments, with support for secure resource sharing and comprehensive infrastructure, application, and traffic monitoring. System Center provides a consistent and unified set of tools for deploying and managing applications, workloads, and infrastructure across multiple sites and across physical, virtual, and cloud computing models. In combination with mainstream servers based on the Intel Xeon processor E5 family, this optimized cloud platform can be extended across your data center to improve agility and cost models, and to help solve some of your toughest data center challenges (see the sidebar, Tough Challenges, Extraordinary Opportunities).

Figure 5. Independent tests by Enterprise Strategy Group demonstrated linear scalability up to 64 vCPUs for SQL Server* 2012 on Intel® Xeon® processor-based servers, with average transaction response times as low as 0.10 seconds for a tier-1 OLTP workload.

Tough Challenges, Extraordinary Opportunities

Transform Your Data Center—One Server at a Time

Pressures are mounting for IT organizations. Workloads and data sets continue to grow rapidly and new functionality must be integrated almost continuously to keep pace with new business demands. Microsoft Windows Server* 2012 and servers based on the Intel® Xeon® processor E5 family provide extensive new capabilities for addressing these fast-growing IT requirements.

The combined platform can help you expand at lower cost by transitioning to unified 10 GB networking and to new storage technologies that let you address high-end requirements using cost-effective file servers. It can also help you consolidate more workloads onto fewer and more energy-efficient servers. Most importantly, it provides a foundation for moving incrementally and non-disruptively toward next-generation cloud functionality that can fundamentally improve the efficiency and agility of your IT infrastructure.

Looking Ahead: End-to-End Data Integration

Database and analytics technologies are evolving rapidly to accommodate the ongoing explosion in the volume, variety, and velocity of business data. However, integrating new capabilities can be complex, requiring specialized software and hardware, as well as new development, management, and security strategies.

Intel and Microsoft are delivering advanced capabilities in a fully-integrated software environment optimized to run on affordable, industry-standard servers based on Intel Xeon processors. There is no need for separate software components or specialized appliances that have to be integrated into existing environments—and IT organizations can take advantage of existing development, management, and security tools and skills. It’s a simpler, faster, and less risky way to implement transformative new capabilities. Some of the most important near-term advances are described below.

Major Performance Gains for Transactional Databases

As already discussed, Microsoft SQL Server 2012 delivers 10x to 100x faster performance for many analytics queries through its In-Memory ColumnStore Index. The next major release of SQL Server will include in-memory OLTP processing, which will provide comparable performance gains for transactional applications.

Integrated Analytics for All Data Types

Microsoft has announced the release of the Microsoft SQL Server Parallel Data Warehouse v2 (PDW v2) for the first half of 2013. This new release will provide full support for SQL Server 2012, so it will incorporate the advanced analytics capabilities already discussed in this paper. It will also include a new feature called PolyBase, which will enable federated querying against both SQL Server 2012 and HDInsight Server.

Using PolyBase, customers will be able to perform queries that operate simultaneously across their relational and non-relational data. This ground-breaking capability will help IT organizations unify analytics across all data types, without the complexity, delays, and administrative overhead of moving and integrating data.

A More Productive End-User Experience

A key benefit of the Intel and Microsoft information platform is the ease with which end-users can access, analyze, and share information using their most familiar tools. In the upcoming release of Microsoft Office 2013, PowerPivot and Power View will be included as fully-integrated features in Excel. This integration will simplify implementation and management for IT. End-users will enjoy simpler access to powerful data exploration and visualization tools—directly from the Excel ribbon menu. In combination with the advanced performance, visualization, and security technologies of Intel processor-based laptops and PCs, every user will be able to access, analyze, and share enterprise information with greater ease and flexibility and with reduced risk.

Conclusion

The race to harness the rising flood of enterprise data and turn it into a sustainable competitive advantage is well underway. Microsoft SQL Server 2012 running on Intel Xeon processor-based servers provides a uniquely powerful, flexible, and affordable platform for addressing the full range of enterprise needs—without costly add-ons and with a consistent and integrated hardware and software architecture across the enterprise information infrastructure.

The combined platform offers world-class performance for tier-1 transactional workloads, along with advanced reliability and security features for maintaining compliant, always-on operation in mission-critical environments. Just as importantly, it includes integrated support for analytics, big data integration, and cloud extensibility, so IT organizations have better and simpler options for managing the growing flood of business data and turning it into a competitive advantage.
Additional Resources

Product Information

• Intel® Xeon® processor E7-8800/4800/2800 product families:
  www.intel.com/content/www/us/en-processors/xeon/
  xeon-processor-e7-family.html

• SQL Server 2012: www.microsoft.com/sqlserver

Mission-critical computing

• SQL Server 2012: www.microsoft.com/en-us/sqlserver/
  solutions-technologies/mission-critical-operations.aspx

• Intel Xeon processor-based servers and solutions:
  www.intel.com/content/www/us/en/mission-critical/mission-critical-
  meeting-todays-it-challenges.html

Data Analytics

• Intel IT Center—Big Data: www.intel.com/content/www/us/en/
  big-data/big-data-analytics-turning-big-data-into-intelligence.html

• Microsoft BI and Analytics Solutions: www.microsoft.com/en-us/
  sqlserver/solutions-technologies/business-intelligence/big-data.aspx

Technical Information

• Intel IT Center: Modernize Your Mission Critical Data Center:
  www.intel.com/content/www/us/en/mission-critical/mission-critical-
  meeting-todays-it-challenges.html

• Official Microsoft SQL Server Blog: blogs.technet.com/b/
  dataplatforminsider/

• Microsoft Technet Blog: technet.microsoft.com/en-us/sqlserver/
  bb265254
Appendix: Technologies at a Glance

SQL Server 2012 and the Intel Xeon processor E7 family include many new features and enhancements versus previous-generation solutions, and only some of them are discussed in this white paper. Tables A1 and A2 provide more comprehensive lists. Table A3 (on page 15) provides guidance for choosing between servers based on the Intel Xeon processor E7 family and the Intel Xeon processor E5 family.


Table A1. Overview of Microsoft SQL Server* 2012 capabilities

<table>
<thead>
<tr>
<th>High Availability (HA)</th>
<th>Scalability and Performance</th>
<th>Security and Manageability</th>
<th>Business Intelligence</th>
<th>Beyond Relational</th>
<th>Web and Breadth, and EIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• HA for Microsoft StreamInsight*</td>
<td>• Up to 15K partitions per table</td>
<td>• Contained Database Authentication</td>
<td>• BI semantic model</td>
<td>• SQL Server Data Tools</td>
<td>• PHP driver</td>
</tr>
<tr>
<td>• Reliable integrated failover detection</td>
<td>• xVelocity in-memory columnstore index</td>
<td>• User-defined server roles</td>
<td>• Power View</td>
<td>• FileTable</td>
<td>• LocalDB runtime</td>
</tr>
<tr>
<td>• Application-centric failover</td>
<td>• Fast FILESTREAM</td>
<td>• Distributed replay</td>
<td>• xVelocity in-memory compression algorithms</td>
<td>• Statistical semantic search</td>
<td>• UTF-16</td>
</tr>
<tr>
<td>• Multiple, readable secondaries</td>
<td>• Fast full-text search</td>
<td>• Audit enhancements</td>
<td>• Alerting</td>
<td>• DAC enhancements</td>
<td>• Paging results sets</td>
</tr>
<tr>
<td>• Online operations</td>
<td>• Fast spatial performance</td>
<td>• Management Pack for System Center</td>
<td>• PowerPivot enhancements</td>
<td>• ODBC for Linux*</td>
<td>• JDBC 4.0 driver</td>
</tr>
<tr>
<td>• Microsoft SQL Server* AlwaysOn</td>
<td>• DBC and PDW appliances</td>
<td>• Backup secondaries</td>
<td>• ODBC for Linux*</td>
<td></td>
<td>• MDS add-in for Excel*</td>
</tr>
<tr>
<td>• Windows Server* core support</td>
<td>• Resource Governor enhancements</td>
<td>• Default schema for Windows* group</td>
<td></td>
<td></td>
<td>• Data quality services</td>
</tr>
</tbody>
</table>

Table A2. Overview of advanced Intel® server technologies in the Intel® Xeon® processor E7 family

<table>
<thead>
<tr>
<th>Technology</th>
<th>Description</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel® Turbo Boost Technology*</td>
<td>Increases processor frequencies beyond rated values to take advantage of power and thermal headroom</td>
<td>Delivers peak performance for heavy workloads without increasing power consumption for lighter workloads</td>
</tr>
<tr>
<td>Intel® Intelligent Power Technology17</td>
<td>Dynamically conserves power and enables advanced power management at the rack, group, and data center levels</td>
<td>Helps to reduce operating costs and improve system reliability through dynamic power optimization and policy-based power management</td>
</tr>
<tr>
<td>Intel® Hyper-Threading Technology8</td>
<td>Doubles the number of execution threads that can be supported by each processor core</td>
<td>Increases processing efficiency for multi-threaded applications and for multiple simultaneous tasks</td>
</tr>
</tbody>
</table>

Advanced Reliability, Availability, and Serviceability (RAS)

| Machine Check Architecture (MCA) Recovery | Enables operating systems and applications to participate in correcting and recovering from system errors | Provides the foundation for robust, mission-critical error management to sustain higher levels of data integrity and system uptime |

Hardware-Enhanced Security

| Intel® Advanced Standard New Instructions (Intel® AES-NI)18 | Seven new instructions help to accelerate compute-intensive steps of the AES encryption and decryption algorithms | Improves performance and reduces overhead, so encryption can be implemented pervasively to protect data and transactions |
### Table A3. High-level criteria for choosing the Intel® Xeon® processor E7 family

<table>
<thead>
<tr>
<th>IT Requirement</th>
<th>Intel® Xeon® Processor E5 Family</th>
<th>Intel® Xeon® Processor E7 Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability, Data Security</td>
<td>Good</td>
<td>Better</td>
</tr>
<tr>
<td>Performance, Memory, and I/O Scalability</td>
<td>• 1-4 sockets</td>
<td>• 2-256 sockets</td>
</tr>
<tr>
<td></td>
<td>• 768 GB memory (2 sockets)</td>
<td>• 2 TB memory (4 sockets)</td>
</tr>
<tr>
<td></td>
<td>• 1.5 TB memory (4 sockets)</td>
<td>• 4 TB memory (8 sockets)</td>
</tr>
<tr>
<td>(for larger systems, check with the vendor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Targeted Deployment Models</td>
<td>Scale OUT: Rapid, incremental addition of servers to meet business growth demands. Pedestal, Rack, Blade</td>
<td>Scale UP: Fewer, more powerful servers with headroom for demanding applications, heavier peak periods, and business growth. Rack and Blade</td>
</tr>
</tbody>
</table>
Windows Server 2012 running on the Intel Xeon processor E7 family holds the top score for online transaction processing (OLTP) based on the TPC-E® brokerage firm benchmark. An NEC Express5800/A1080a-E server with eight Intel® Xeon® processors E7-8870 (Westmere-EP) scored a top-resulted output of 44.74 tspc @ 5401.18 US$ as of May 18, 2012. TPC, TPC-E, and tspc are trademarks of the Transaction Processing Performance Council. For more information, please visit http://www.tpc.org/tpc/default.asp.

1 Requires a system with Intel® Turbo Boost Technology capability. Consult your PC manufacturer. Performance varies depending on hardware, software and system configuration. For more information, visit http://www.intel.com/technology/turboboost.

2 Hyper-Threading Technology requires a computer system with an Intel® processor supporting Hyper-Threading Technology and an HT Technology enabled chipset, BIOS and operating system. Performance will vary depending on the specific hardware and software you use. See http://www.intel.com/info/hyperthreading for more information including details on how processors support HT Technology.


4 Depending on the vendor and server configuration, certain key hardware components, including I/O hubs, fans, and power supplies, can be replaced without bringing down the system and without disruption to running applications.


6 SQL Server 2012 differs from previous releases in that it is the first version of SQL Server that natively supports 64-bit architecture, offering increased scalability and reliability.


8 Another reason IT organizations have been reluctant to virtualize high-volume databases is that the heavy I/O demands of these applications can create performance bottlenecks in traditional networking environments. Microsoft Windows Server 2012 and its Gigabit Ethernet Converged Network Adapters support resilient, high-bandwidth, low-latency networking on a unified network, with integrated support for Fiber Channel over Ethernet (FCoE), iSCSI, high-performance I/O virtualization, network adapter teaming, multipathing, and auto-failover to provide scalable, resilient network and storage connectivity appropriate for mission-critical workloads. For more information, see http://www.intel.com/go/virtualization.


10 For more information about these technologies, see the InformationWeek article, “Microsoft In-Memory Move Challenges SAP, Oracle,” by Doug Henschen, Executive Editor, InformationWeek, November 7, 2012. http://www.informationweek.com/2012/11/06/microsoft/in-memory-move-challenges-sap/article.dhtml

11 For more information about these technologies, visit http://www.intel.com/technology/turboboost.

12 Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM). Functionality, performance or other benefits will vary depending on hardware and software configurations. Software applications may not be compatible with all operating systems. More information is available at http://www.intel.com/go/virtualization. For more information, visit http://www.intel.com/technology/virtualization.

13 For more information about these technologies, visit http://www.intel.com/content/www/us/en/cloud-computing/cloud-computing-scale-out-storage-animation.html

14 PowerIP and Power View are currently available as free plug-ins for Microsoft Excel, and the capabilities these plug-ins provide are fully compatible with SQL Server 2012. In the upcoming release of Microsoft Office 2013, PowerIP and Power View will be included as fully-integrated features, providing high-powered data exploration and visualization options directly from the Excel ribbon menu. SQL Server 2012 SP1 will be required for users to take advantage of this integrated support.

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17 For more information about these technologies, visit http://www.intel.com/content/www/us/en/cloud-computing/cloud-computing-scale-out-storage-animation.html

18 Microsoft’s Windows Server 2012 running on the Intel Xeon processor E7 family holds the top score for online transaction processing (OLTP) based on the TPC-E® brokerage firm benchmark. An NEC Express5800/A1080a-E server with eight Intel® Xeon® processors E7-8870 (Westmere-EP) scored a top-resulted output of 44.74 tspc @ 5401.18 US$ as of May 18, 2012. TPC, TPC-E, and tspc are trademarks of the Transaction Processing Performance Council. For more information, please visit http://www.tpc.org/tpc/default.asp.

19 Requires a system with Intel® Turbo Boost Technology capability. Consult your PC manufacturer. Performance varies depending on hardware, software and system configuration. For more information, visit http://www.intel.com/technology/turboboost.

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26 Intel® Intelligent Power Technology requires a computer system with an enabled Intel® processor, chipset, BIOS and for some features, an operating system enabled for it. Functionality or other benefits may vary depending on hardware implementation and may require a BIOS and/or operating system update. Please consult your system vendor for details.

27 Intel® AES-NI requires a computer system with an AES-NI enabled processor, as well as non-intel software to execute the instructions in the correct sequence. AES-NI is available on select Intel® processors. For availability, consult your reseller or system manufacturer. For more information, see Intel® Advanced Encryption Standard Instructions (AES-NI) http://software.intel.com/en-us/articles/intel-advanced-encryption-standard-instructions-aes-ni/ for online versions.

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29 Other names and brands may be claimed as the property of others.