

4-way Server Fitted with Intel® Xeon® Processor 7500 Series Demonstrates More than Three Times the Online Transaction Processing Performance of Previous Model



“The superior online transaction processing performance of the Intel® Xeon® processor 7500 series was confirmed by industry-standard OLTP benchmark test.”

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Ideal Platform for High-end Server Applications

The Intel® Xeon® processor 7500 series based on the Intel® Nehalem microarchitecture features significantly improved database processing performance. In benchmark tests run jointly by Intel and Microsoft under a NUMA environment, a 4-way server fitted with the Intel® Xeon® processor 7500 series together with Microsoft* SQL Server* 2008 R2 running on Microsoft* Windows Server* 2008 R2 demonstrated online transaction processing (OLTP) performance more than three times better than previous models. Servers fitted with the Intel® Xeon® processor 7500 series that are suitable for up-scaling provide the ideal hardware platform for high-end server applications such as ERP, CRM and other business intelligence (BI) applications, data warehousing (DWH), and realtime database applications for the finance industry.

Online Transaction Processing Performance Verified by Industry-Standard Benchmark

The excellent database processing performance of the Intel® Xeon® processor 7500 series was verified in benchmark tests run jointly by Intel and Microsoft. The tests are similar to other benchmark tests commonly used to evaluate OLTP

performance which they do by simulating various types of transaction processing on a customer management system for a wholesaling company. The results of this benchmark testing are recognized as being very reliable.

Table 1 lists the hardware and software configurations for the benchmark tests.

Table 1. Hardware and Software Configurations for Benchmark Tests

Intel® Xeon® Processor X7560 / Microsoft* SQL Server* 2008 R2	
Database platform	Microsoft* SQL Server* 2008 R2 Enterprise x64 Edition
Server OS	Microsoft* Windows Server* 2008 R2 Enterprise x64 Edition
Memory	128GB
No. of sockets (cores)	4 sockets (32 cores)
Processor	Intel® Xeon® processor X7560 (operating frequency: 2.26GHz)
Intel® Xeon® Processor X7560 / Microsoft* SQL Server* 2008 SP1+CU7	
Database platform	Microsoft* SQL Server* 2008 Enterprise x64 Edition SP1+CU7
Server OS	Microsoft* Windows Server* 2008 R2 Enterprise x64 Edition
Memory	128GB
No. of sockets (cores)	4 sockets (32 cores)
Processor	Intel® Xeon® processor X7560 (operating frequency: 2.26GHz)
Intel® Xeon® Processor X5570 / Microsoft* SQL Server* 2008 SP1+CU7	
Database platform	Microsoft* SQL Server* 2008 Enterprise x64 Edition SP1+CU7
Server OS	Microsoft* Windows Server* 2008 R2 Enterprise x64 Edition
Memory	48GB
No. of sockets (cores)	2 sockets (8 cores)
Processor	Intel® Xeon® processor X5570 (operating frequency: 2.93GHz)

The hardware consisted of a 4-way server fitted with the Intel® Xeon® processor X7560 (8-core, 2.26GHz). A 2-way server fitted with the Intel® Xeon® processor X5570 (4-core, 2.93GHz) was used for comparison.

The test used the latest software which consisted of Microsoft® Windows Server® 2008 R2 Enterprise x64 Edition and Microsoft® SQL Server® 2008 R2 Enterprise x64 Edition. A comparison system used Microsoft® SQL Server® 2008 Enterprise x64 Edition SP1 (with Cumulative Update 7).

Although the memory size, storage configuration, and other hardware features were different on each system, because the data size for the benchmark test was made small enough that the entire data file could be loaded into memory and the only disk I/O that occurred during the test was writing the transaction log file, these memory size, storage configuration, and other differences did not detract from the reliability of the test results.

Getting Maximum Performance from Latest Software Configuration

Yukio Kumazawa, Technology Consultant at the Application Platform, Server Platform Business Group of Microsoft Corporation described the objectives of the benchmark tests as follows.

“The objective of the benchmark tests was to determine the benefits of up-scaling by comparing the performance of a 4-way server fitted with the Intel® Xeon® processor X7560 against that for a 2-way server fitted with the Intel® Xeon® processor X5570. Both machines ran a combination of Microsoft® Windows Server® 2008 R2 and Microsoft® SQL Server® 2008 R2. The test procedure we adopted sought to evaluate the benefits of up-scaling by first undertaking performance tuning to configure node and thread management appropriately, and then running the industry-standard OLTP load tests to determine the processors’ performance limits for database processing.”

Microsoft® Windows Server® 2008 R2 and Microsoft® SQL Server® 2008 R2 are the latest available software and are designed to take full advantage of the hardware

resources provided by Intel® QuickPath Technology which is a feature of the Intel® Xeon® processor 7500 series. The test environment correctly detected the four NUMA (non-uniform memory access) nodes with eight processors per node.

This is an important factor for obtaining the best performance from the Intel® Xeon® processor 7500 series. Older software configurations are unable to take full advantage of the superior performance of the Intel® Xeon® processor 7500 series as this requires the latest software configuration including Microsoft® Windows Server® 2008 R2 and Microsoft® SQL Server® 2008 R2 which fully support Intel® QuickPath.

Appropriate performance tuning is also required to achieve best practice for Microsoft® SQL Server® 2008 R2 (see column on p.3).

Combining the latest software configuration with performance tuning of Microsoft® SQL Server® allows the Intel® Xeon® processor 7500 series to exhibit its maximum performance. Figure 1 shows how the total of 32 cores in the 4-way server’s Intel® Xeon® processor X7560 CPUs execute parallel processing appropriately under the

software configuration selected for the benchmark test. Similarly, Figure 2 shows parallel processing being executed correctly using 64 threads when Intel® Hyper-Threading Technology¹ is enabled.

More than Three-fold Improvement in Online Transaction Processing Performance Compared to Previous System

The following section discusses the benchmark testing results.

The comparison between the 4-way server fitted with the Intel® Xeon® processor X7560 and the 2-way server fitted with the Intel® Xeon® processor X5570 shows the Intel® Xeon® processor X7560 achieving more than 3 times the OLTP performance of the Intel® Xeon® processor X5570.

The OLTP load test performed as part of benchmark testing determined the processors’ performance limits for database processing. This involved increasing the number of user connections to the database (number of executing threads) from 350 to 700 and then to 1050 to load up the processors and thereby measure the peak throughput and maximum number

Figure 1. Benchmarking with NUMA_on and SMT_off (1050 user connections)

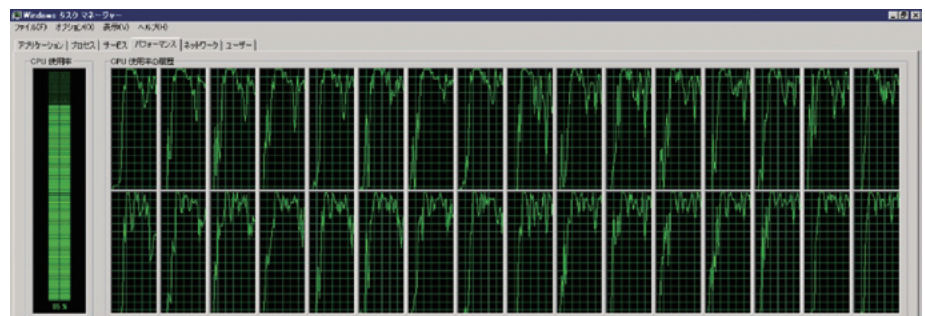


Figure 2. Benchmarking with NUMA_on and SMT_on (1050 user connections)

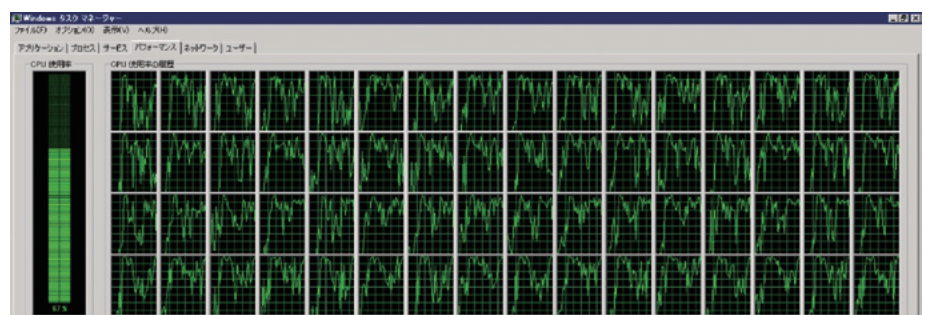
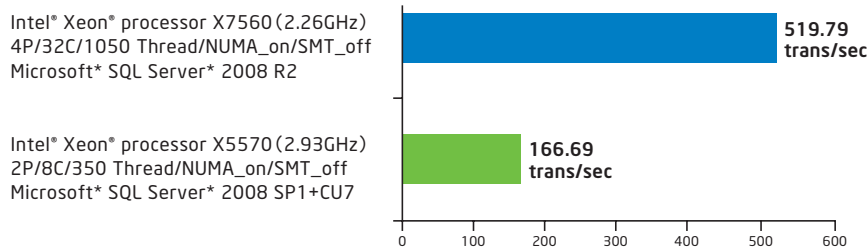


Figure 3. Peak Throughput during OLTP Load Test



The test results indicate that the OLTP performance of the 4-way server fitted with the Intel® Xeon® processor X7560 is more than 3 times that of the 2-way server fitted with the Intel® Xeon® processor X5570 (throughput improved by approximately more than 3 times).

of user connections that can be handled and determine the maximum limit for the processing performance.

The results for the 2-way server fitted with the Intel® Xeon® processor X5570 were a peak throughput of 166.69 trans/sec and the ability to handle 350 user connections. The results for the 4-way server fitted with the Intel® Xeon® processor X7560 were a peak throughput of 519.79 trans/sec and the ability to handle 1050 user connections (see Figure 3).

A simple comparison between the 4-way server fitted with the Intel® Xeon® processor X7560 and the 2-way server fitted with the Intel® Xeon® processor X5570 (double the number of processor sockets, four times the number of cores, and 0.775 times the operating frequency) would indicate an up-scaling coefficient of 3.08 (the theoretically expected benefit of up-scaling). In contrast, the above OLTP load testing found a maximum improvement in peak processor throughput of more than 3 times indicating that the actual up-scaling benefit was higher than expected.

Commenting on the results of this benchmark testing, Yukio Kumazawa said,

“this indicates that the latest software configuration combining Microsoft® Windows Server® 2008 R2 and Microsoft® SQL Server® 2008 R2 makes effective use of the hardware resources of the Intel® Xeon® processor 7500 series and that adequate up-scaling benefits can be obtained.”

Performance Improvements from Latest Database Engine

Next, a performance comparison of Microsoft® SQL Server® 2008 R2 and Microsoft® SQL Server® 2008 SP1 running on a 4-way server fitted with the Intel® Xeon® processor X7560 found that Microsoft® SQL Server® 2008 R2 can deliver up to 15.7% higher performance than Microsoft® SQL Server 2008 SP1 (see Table 2). This performance improvement is due to enhancements to the Microsoft® SQL Server® database engine.

The Intel® Turbo Boost Technology⁵ capability of the Intel® Xeon® processor X7560 was enabled during benchmark testing. The testing also indicated that the benefits of Intel® Hyper-Threading Technology are greater when the processor is heavily loaded.

Table 2. Comparison of Microsoft® SQL Server® 2008 R2 and Microsoft® SQL Server® 2008

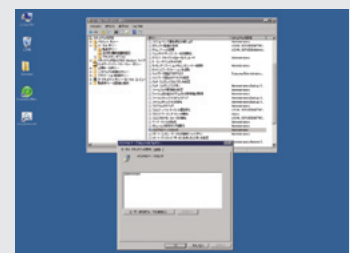
Database Platform	Microsoft® SQL Server® 2008 R2	Microsoft® SQL Server® 2008 SP1+CU7	Performance Improvement
1050 Thread/NUMA_on/SMT_off	519.79 trans/sec	475.99 trans/sec	Ratio = 1.092
1050 Thread/NUMA_on/SMT_on	540.74 trans/sec	504.34 trans/sec	Ratio = 1.072
1050 Thread/NUMA_off/SMT_on	545.66 trans/sec	471.49 trans/sec	Ratio = 1.157

Comparison on a 4-way server fitted with the Intel® Xeon® processor X7560. The server operating system was Microsoft® Windows Server® 2008 R2. Microsoft® SQL Server® 2008 R2 can deliver up to 15.7% higher performance than Microsoft® SQL Server® 2008 SP1.

Microsoft® SQL Server® Performance Tuning

To obtain the best possible performance from the combination of a 4-way server fitted with the Intel® Xeon® processor 7500 series and Microsoft® SQL Server® 2008 R2, it is necessary to tune the performance of Microsoft® SQL Server®. Performance tuning makes it possible to achieve best practice for Microsoft® SQL Server® 2008 R2. Performance tuning is performed for the following three parameters.

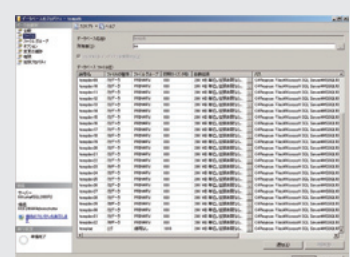
- **Lock pages in memory**
It is necessary to assign “lock pages in memory” rights to Administrator.



- **Maximum degree of parallelism (MAX DOP)**
Set the maximum degree of parallelism to one-quarter the number of server cores (= 8).



- **Split tempdb data file**
Split the tempdb data file into one file per server core (= 32).



Intel® Xeon® Processor 7500 Series and Microsoft* SQL Server* 2008 R2 Create the Ideal Server for Mission-critical Computing

A key feature of the Intel® Xeon® processor 7500 series based on the Intel® microarchitecture codename Nehalem is its support for extremely demanding high-end server applications due to its excellent performance scalability and high level of reliability. The results of this benchmark testing fully back up this assessment.

The Intel® Xeon® processor 7500 series supports up-scaling of server configurations to as many as eight processors (8-way server) without using a node controller. If a node controller is used, up-scaling to 256-way server configurations is possible.

The Intel® Xeon® processor 7500 series incorporates more than 20 new RAS functions to satisfy the extremely high levels of reliability, scalability, and ease-of-maintenance

demanded for mission-critical computing.

Reviewing the benchmark testing, Yukio Kumazawa said, "the Intel® QuickPath Technology in the Intel® Xeon® processor 7500 series is an extremely good fit with the NUMA architecture support in Microsoft* SQL Server* 2008 R2 and allows higher performance to be achieved than in the past."

Similarly, Tsuyoshi Kitagawa, Senior Product Manager at the Application Platform, Server Platform Business Group of Microsoft Corporation gave his assessment of the Intel® Xeon® processor 7500 series as follows.

"Servers with the Intel® Xeon® processor 7500 series are a very attractive proposition for up-scaling existing server systems because they are easy to install, reliably

deliver the expected performance, and have high reliability. These up-scaling servers also make good server integration platforms. Although high price was a disadvantage of previous servers designed for up-scaling, a major attraction of servers fitted with the Intel® Xeon® processor 7500 series is that they can be installed at lower cost than previous models and expectations are high for their use as replacement systems in core enterprise applications and other mission-critical roles."

Servers fitted with the Intel® Xeon® processor 7500 series feature high-end functions that are ideal for mission-critical server applications such as ERP, CRM and other business intelligence (BI) applications, data warehousing (DWH), and realtime database applications for the finance industry.

For more details about the Intel® Xeon® processor 7000 series, please visit http://www.intel.co.jp/p/ja_JP/products/server/processor/xeon7000/

For more details about Microsoft* SQL Server* 2008 R2, please visit <http://www.microsoft.com/japan/sqlserver/2008/r2/>

Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See http://www.intel.com/products/processor_number for details.

[†] Intel® Hyper-Threading Technology (Intel® HT Technology) requires a computer system with an Intel® processor supporting HT 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/products/ht/hyperthreading_more.htm for more information including details on which processors support HT Technology.

[§] Intel® Turbo Boost Technology requires a platform with a processor with Intel Turbo Boost Technology capability. Intel Turbo Boost Technology performance varies depending on hardware, software, and overall system configuration. Check with your PC manufacturer on whether your system delivers Intel Turbo Boost Technology. See www.intel.com/technology/turboboost for more information.

Source: Results of benchmark testing conducted jointly by Intel Corporation and Microsoft Corporation (July 2010)

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