

Proven Performance as a High Performance Microsoft® SQL Server® Database Solution Combining an NEC Express 5800 Scalable Enterprise Server and HGST FlashMAX II

NEC PCIe SSD Appliance for Microsoft® SQL Server® delivers a major boost to the performance of enterprise systems and large-scale BI (business intelligence) processing

In addition to high reliability and availability, enterprise mission critical applications, data centers operating 24x7, and data analysis platforms all demand powerful data processing capabilities and stability. The NEC PCIe SSD Appliance for Microsoft® SQL Server® is a best-practice reference architecture for such demanding workloads. It comprises an Express 5800 Scalable Enterprise Server Series with Intel® Xeon® processor E7 v2 family CPUs, high-performance HGST FlashMAX II PCIe server-mounted flash storage, and Microsoft® SQL Server® 2014. When compared with the previous reference architecture based on a server with the Intel® Xeon® processor E7 family CPUs, benchmark testing demonstrated a performance improvement of up to 173% in logical scan rate in a data warehouse environment. The testing also demonstrated consistently fast and stable performance in online transaction processing (OLTP) that could potentially be encountered.

Highly Reliable and High-Performance Express 5800 Scalable Enterprise Server Series with the Latest CPU and the NEC Original RAS Technology

The Intel® Xeon® processor E7 v2 family are the latest models in the Intel® Xeon® processor product line. They provide enterprise systems with high levels of availability and reliability, while also delivering the high processing performance for big data analysis. The NEC Express 5800 Scalable Enterprise Server Series are suitable as a large IT platform, featuring high levels of performance, reliability, and availability demanded by enterprise mission critical and social infrastructure systems. NEC Express 5800 Scalable Enterprise Servers are scalable with up to four of the latest Intel® Xeon® processor E7 v2 family CPUs and achieve roughly twice the performance of NEC's previous Express5800/

A1080a-S server. It is also suitable for in-memory databases that utilize the large memory size to process data at high speed. With up to 16 of the latest PCI-Express 3.0 I/O slots available, the server can be used as a platform for a real-time analysis, incorporating multiple network interface cards, storage interface cards, and flash storage.

The reliability, availability, and serviceability (RAS) technology developed by NEC also makes the server suitable for enterprise mission critical systems and social infrastructure applications. The enhanced availability of CPU and memory, which detect potential failures in advance, maximizes system level availability by de-allocating resources before potential failures which could lead to a system down and recovering system operation automatically.



All-in-One Solution for High Performance Database Processing

Working in collaboration with SCSK Corporation, the Japanese agent for HGST, NEC Corporation conducted benchmark performance testing of a Microsoft® SQL Server® 2014 database system running on a Express 5800 Scalable Enterprise Server Series with high-performance HGST FlashMAX II server-mounted PCIe flash storage. Based on the results of this benchmark testing, NEC released the NEC PCIe SSD Appliance for Microsoft® SQL Server®, a high performance database solution for Microsoft® SQL Server® database processing as a proven best practice.

The high-performance HGST FlashMAX II server-mounted PCIe flash storage, incorporating a hardware RAID mechanism optimized for flash memory, guarantees enterprise-class reliability, as well as delivering linear performance improvement in OLTP, analytics, and other processing applications.

The NEC PCIe SSD Appliance for Microsoft® SQL Server® is a reference architecture based on the Express 5800 Scalable Enterprise Server. Its main features are as features include:

- ① **All-in-one model with built-in storage:** The high-performance HGST FlashMAX II server-mounted PCIe flash storage eliminates the need for external storage and provides a high-speed architecture housed entirely in a single chassis.
- ② **Best practice configuration with no need for sizing:** Using a core-balanced architecture based on the Fast Track Data Warehouse Benchmark, Microsoft's reference architecture for data warehouses, this best practice reference architecture achieves fast throughput by balancing I/O channels and storage sequential I/O capacity against the CPU cores.
- ③ **Mirroring configuration for high availability:** Using the HGST FlashMAX II PCIe SSD in a software-mirroring configuration, high availability is secured. Furthermore, the configuration can be scaled up from one to four CPUs (Fig. 1), with balanced performance and data capacity.

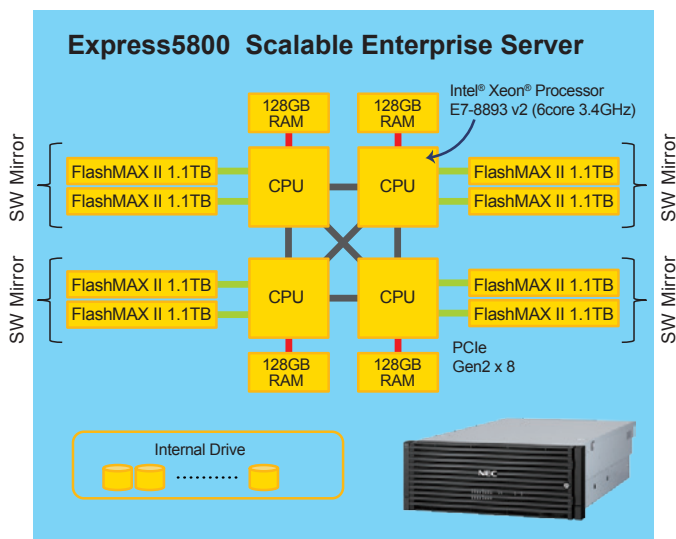


Figure 1. Block Diagram of NEC PCIe SSD Appliance for Microsoft® SQL Server®

- ④ **Rich product line-up:** With a wide variety of configurations, users can select the best fit for their own use. Choices include single-node configurations and a high-availability cluster configuration using always-on availability groups.

Thanks to these features, users can get the best configuration with performance guaranteed in advance, simply by selecting a configuration which meets their own data warehouse or database capacity requirements.

The New Solution Provides Significant Improvements in Logical Scan Rate and TCO for Data Warehouses

To test the performance of a data warehouse system hosted on an NEC PCIe SSD Appliance for Microsoft® SQL Server®, Microsoft® Fast-track Data Warehouse Benchmark was used and the performance was compared with Microsoft® SQL Server® Fast Track Data Warehouse (FTRA DWH) running on an Express5800/A1080a-S server with the earlier Intel® Xeon® processor E7 family CPUs. FTRA DWH is a data warehouse solution that provides quick deployment by using a reference architecture certified by Microsoft.

Table 1 shows the configuration of the hardware used for the benchmark tests. Express5800/A1080a-S FTRA DWH is the previous solution and NEC PCIe SSD Appliance for Microsoft® SQL Server® is the new solution using the latest Express 5800 Scalable Enterprise Server Series. While the Express5800/A1080a-S FTRA DWH was measured in a single configuration with two CPUs (20 physical cores), NEC PCIe SSD Appliance for Microsoft® SQL Server® was measured in four configurations ranging from one to four CPUs (6 to 24 physical cores). The databases used were Microsoft® SQL Server® 2012 and Microsoft® SQL Server® 2014 respectively.

Configuration for DWH performance comparison		NEC PCIe SSD Appliance for Microsoft® SQL Server®				Express5800/A1080a-S FTRA DWH
CPU		E7-8893 v2 (6C, 3.4GHz)				E7-8870 (10C, 2.4GHz)
CPU socket count		1	2	3	4	2
Total core count		6	12	18	24	20
Physical memory capacity		128GB	256GB	384GB	512GB	128GB
Storage configuration		1.1TB FlashMAX II (Max Capacity Mode) Mirrored storage pool configuration				iStorage M100 x3 (72 450GB 10krpm SAS-HDD) RAID-10 18 pair
		1set	2set	3set	4set	
Physical Storage Capacity		1.1TB	2.2TB	3.3TB	4.4TB	16.2TB
Physical Capacity per Usage	User data*	~0.5TB	~1.0TB	~1.5TB	~2.0TB	8.0TB
	Transaction log	~0.2TB	~0.4TB	~0.6TB	~0.8TB	3.5TB
	tempdb	~0.3TB	~0.6TB	~0.9TB	~1.2TB	4.5TB

Table 1. Tested Configuration for Single-Node Data Warehouse Performance Benchmarking

Figure 2 shows the test results. "Logical Scan Rate" is an indicator of user data scan throughput. While the results show a consistent improvement in performance as the hardware is scaled up through the four different configurations of NEC PCIe SSD Appliance for Microsoft® SQL Server®, they also show that the time to scan user data remains roughly the same regardless of increases in database size. Also, the 3-CPU (18 physical cores) configuration of NEC PCIe SSD Appliance for Microsoft® SQL Server® has approximately the

same performance as Express5800/A1080a-S FTRA DWH. The performance is improved by 173% in the scaled-up configuration with four CPUs (24 physical cores).

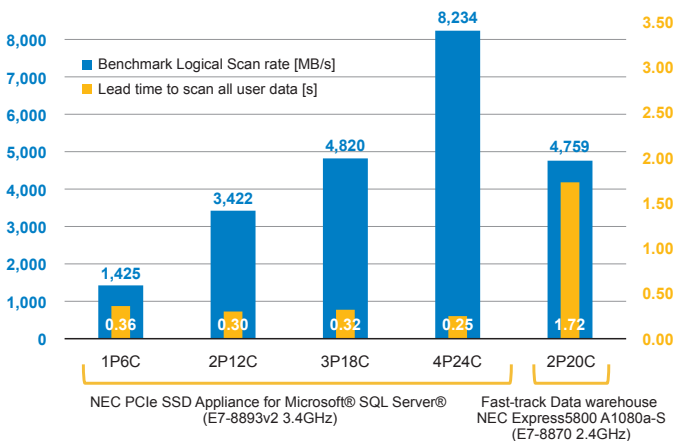


Figure 2. Results of Benchmark Tests against Previous Data Warehouse Solution

Figure 3 summarizes the benefits of the solution as a data warehouse system. As Figure 3 indicates, NEC PCIe SSD Appliance for Microsoft SQL Server not only brings a major improvement in performance but it also reduces the TCO by significantly shrinking the rack space and power requirements compared to Express5800/A1080a-S FTRA DWH.

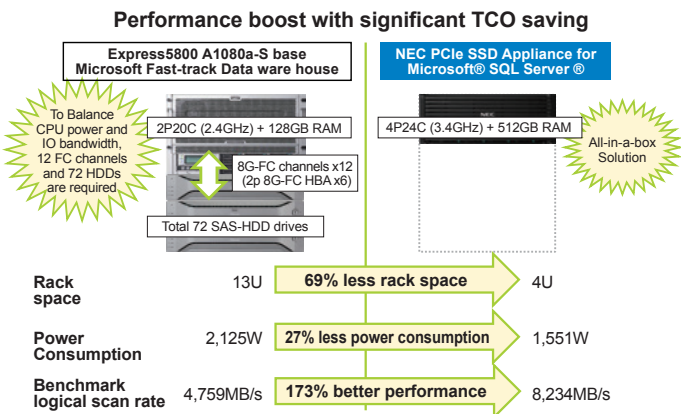


Figure 3. Advantages for Use as Data Warehouse System

Consistent High Performance for OLTP Under High Load or Non-tuned Environments

Next, the performance testing of NEC PCIe SSD Appliance for Microsoft SQL Server as an OLTP system was conducted. The HammerDB open source database load testing and performance benchmarking tool was used to make performance comparisons with a Express5800/A1080a-S server with the previous Intel Xeon processor E7 family CPUs configured with external FC storage.

In almost all cases, I/O is the bottleneck in conventional OLTP databases. To resolve this, tuning work, such as optimizing indexes to take account of database operation, is required. But this is not an easy task to achieve with accuracy. The benchmark testing demonstrated that NEC PCIe SSD Appliance for Microsoft SQL Server solves this problem.

Table 2 lists the hardware configurations used for the benchmark tests. Express5800/A1080a-S + External FC storage is the previous solution and NEC PCIe SSD Appliance for Microsoft SQL Server using the latest Express 5800 Scalable Enterprise Server Series is the new solution. The database in both cases was Microsoft SQL Server 2014.

Configuration for OLTP performance comparison		NEC PCIe SSD Appliance for Microsoft SQL Server				Express5800/A1080a-S + External FC storage
CPU		E7-8893 v2 (6C, 3.4GHz)				E7-8870 (10C, 2.4GHz)
CPU socket count		1	2	3	4	2
Total core count		6	12	18	24	20
Physical memory capacity		128GB	256GB	384GB	512GB	256GB
Storage configuration		1.1TB FlashMAX II (Max Performance Mode) Mirrored storage pool configuration				iStorage M100 x1 (24 450GB 10krpm SAS-HDD) RAID-10 6 pair
Physical Storage Capacity		0.9TB	1.7TB	2.6TB	3.4TB	5.4TB
Physical Capacity per Usage	User data	~0.5TB	~1.0TB	~1.5TB	~2.0TB	3.6TB
	Transaction log	~0.2TB	~0.4TB	~0.6TB	~0.8TB	1.0TB
	tempdb	~0.2TB	~0.3TB	~0.5TB	~0.6TB	0.8TB

Table 2. Tested Configuration for Single-Node OLTP Performance Benchmarking

Figure 4 shows the test results.

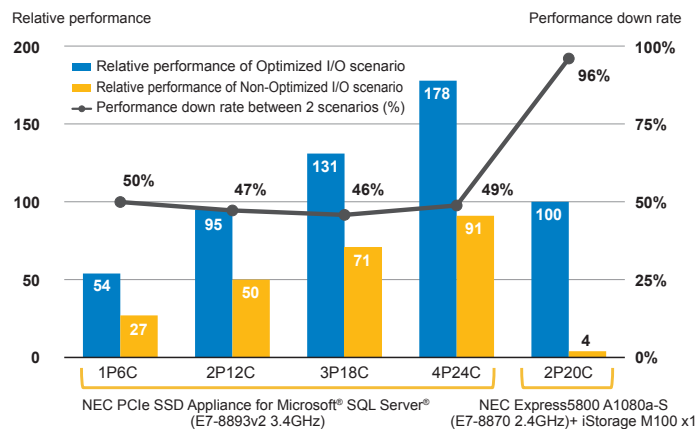


Figure 4. Results of Benchmark Testing Against Previous OLTP Solution

The test was conducted with two different scenarios. The blue bars in the graph represent the results for an optimized I/O scenario in which the server memory cache and storage cache were enabled to minimize I/O. The red bars represent a non-optimized I/O scenario in which caches were disabled to maximize I/O. The transaction performance results are indicated in relative values to the performance of the previous solution under the optimized I/O scenario (defined as 100). The right-most bars show the results for the previous solution, and the four left-hand sets of bars are for the four different data sizes used with NEC PCIe SSD Appliance for Microsoft SQL Server.

The first finding is that for all four models of NEC PCIe SSD Appliance for Microsoft SQL Server performance clearly scales up in accordance with the hardware configuration. In other words, the results demonstrate that this hardware configuration can leverage all of the potential of the server, CPUs, and database in a linear fashion.

A second point to note relates to the environment where

I/O bottlenecks occur. The previous solution caused severe performance degradation when I/O is maximized. Whereas the performance reduction of the NEC PCIe SSD Appliance for Microsoft® SQL Server® was around 50% for all four configurations, the performance fell by 96% with the previous solution. The Express 5800 Scalable Enterprise Server used in NEC PCIe SSD Appliance for Microsoft® SQL Server® adopts a new ultra-fast I/O technology. This prevents the significant performance drop off even when I/O is not optimized. Figure 5 summarizes benefits of the solution for an OLTP system.

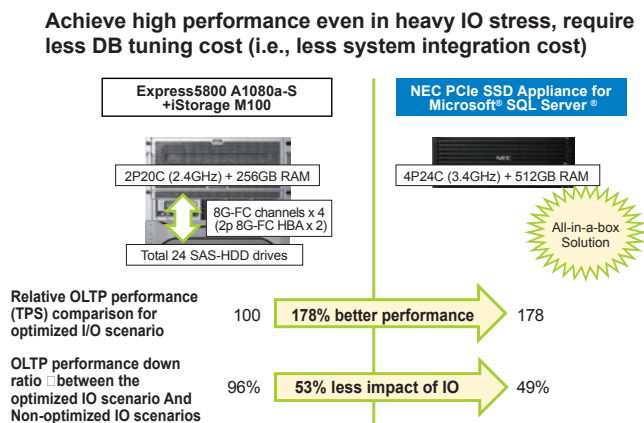


Figure 5. Consistent High Performance for Systems under High I/O Load

These results indicates that by using NEC PCIe SSD Appliance for Microsoft® SQL Server® in the situations such as physical consolidation of database servers from legacy systems, users can quickly start the operation with confidence of guaranteed performance without major application tuning. This brings not only the merits of speeding up the process of database installation or migration, but also operational benefits such as saving the cost of tuning, improving the average performance, and proactively preventing potential loss of business when any bottleneck occurs.

Applications such as business intelligence (BI) and big data analysis are a recent trend. These analytical tasks need to process input and output directly to the data workload which is changing in real-time. For such dynamic processing, it is important to secure enough performance to handle unexpected increases in workload. NEC PCIe SSD Appliance for Microsoft® SQL Server® has the ability to respond to this demand appropriately and effectively.

The Solution to Accelerate Database Processing for Enterprise Systems, Significantly Improving Logical Scan Rate and TCO for Data Warehousing and Delivering High-Speed OLTP even without Tuning

The testing described here proves that NEC PCIe SSD Appliance for Microsoft® SQL Server® delivers performance improvements consistently when scaling up hardware resources. It also shows that the maximum 4-CPU configuration (24 physical cores) showed a 173% increase in logical scan rate over the previous solution with a 2-CPU configuration (20 physical cores) while also bringing significant improvements in rack space and power consumption which contribute to TCO.

Also, benchmark testing for OLTP workload demonstrated the ability to maintain stable, high-speed processing and significantly reducing the performance degradation when I/O bottlenecks occur compared to the previous solution, regardless of whether tuning has been performed.

NEC PCIe SSD Appliance for Microsoft® SQL Server®, which consists of highly reliable, high-performance Express 5800 Scalable Enterprise Server Series with the Intel® Xeon® processor E7 v2 family, high-performance HGST FlashMAX II PCIe server-mounted flash storage and Microsoft® SQL Server® 2014, is a solution to accelerate database processing for enterprise systems, providing excellent stability and the performance required for enterprise systems, data centers, data analysis platforms and other mission-critical computing applications and the real-time processing of large data.

Joint tester

SCSK Corporation,
the Japanese agent for HGST



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