Express5800 Scalable Enterprise Server Reference Architecture

For NEC PCIe SSD Appliance for Microsoft® SQL Server®

An appliance that significantly improves performance of enterprise systems and large-scale business intelligence (BI) processing

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1. Benefits of NEC PCIe SSD Appliance for Microsoft® SQL Server®

Balancing performance with database capacity is becoming more and more difficult with data size and system complexity increasing daily. Adding more hardware will not address the problem in the long-term, yet the hardware sizing and functionality testing required to build new database servers, which would address the problem, demands large investments of time and money (Figure 1).

The new NEC PCIe SSD (Solid-State Drives) Appliance for Microsoft SQL Server was developed to address the challenges of building database servers quickly and easily in order to maintain performance affordably. Pretesting best practices enable the NEC PCIe SSD Appliance to rapidly establish balanced and predictable performance for general hardware and software – even under heavy I/O loads (Figure 2). NEC’s appliance is also easy to deploy to exacting specifications, and offers significant CAPEX and OPEX cost reductions.

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**Figure 1. Challenges of building a database server**

**Figure 2. Benefits of NEC PCIe SSD Appliance for Microsoft SQL Server**
2. Characteristics of NEC PCIe SSD Appliance for Microsoft SQL Server

The NEC PCIe SSD Appliance for Microsoft SQL Server is a reference architecture based on the new Express5800 Scalable Enterprise Server equipped with the Intel® Xeon® processor E7 v2 family. Its main features are listed below.

1) **All-in-one model with built-in storage**

   The high-performance FlashMAX® II PCIe storage-class memory (SCM) by HGST provides a high-speed architecture housed entirely in a single chassis. This device delivers vast gains in total cost of ownership (TCO) by occupying less rack space compared to conventional external storage configurations. Because fewer components are involved, the system achieves greater availability for lower failure rates, as well as reduced energy demands.

2) **Best practice configuration with no need for sizing**

   Using a core-balanced architecture adjusts the balancing of the I/O channels and storage I/O capacity to the CPU cores (Figure 3). Bottlenecks and over-spec issues for certain components are eliminated, enabling the maximum performance of every component.

![An Appropriate Configuration](image)

In this configuration, the performance of each component is balanced, enabling maximum throughput at optimum levels.

![An Inappropriate Configuration](image)

In this configuration, the performance of each component is not balanced, and maximum throughput cannot be achieved. In this example, the CPU is the bottleneck.

*Figure 3. Core-balanced architecture*

3) **Securing high reliability and high availability**

   The new Express5800 Scalable Enterprise Server uses the Intel Xeon processor E7 v2 family
of processors, which has high availability optimized for enterprise servers, to support Machine Check Architecture (MCA) recovery, memory scrubbing, DDDC (corrects data even in the event of a DRAM 2Chip failure), and memory mirroring. Furthermore, system availability is vastly improved by expunging sectors at risk for system downtime and implementing auto-recovery with NEC’s service processor and firmware technologies.

In addition, FlashMAX II comes with a hardware RAID configuration, which is equivalent to RAID5, to protect against the failure of flash memory elements. With the NEC PCIe SSD Appliance for Microsoft SQL Server, additional improvements to availability are configured with software mirroring using the storage pool feature that comes standard in Windows Server®, to handle potential failures in the FlashMAX II control chip.

4) **Rich product line-up for different uses and scopes**

There are four different sized NEC server models available based on the Core-Balanced Architecture ([Figure 4](#)). Users can quickly identify the optimal configuration by making a choice based on database size and capabilities.

![Figure 4. Four NEC server models based on Core-Balanced Architecture](image)

5) **Pretesting validation for a wide range of uses**

All of the models have been specifically tested for use with data warehouses (DWH) and online transaction processing (OLTP), and validated for a wide range of uses. The Microsoft Fast Track Data Warehouse Benchmark, a benchmark derived from TPC-H, was used for the DWH
testing (Figure 5). The open source HammerDB, a benchmark derived from TPC-C, was used for OLTP testing, (Figure 6).

When these benchmarks are compared to the results of the Express5800/A1080a-S server, which is the prior model equipped with the Intel Xeon processor E7 family, the new Express5800 Scalable Enterprise Server’s advanced capabilities are apparent.

Figure 5. Results of benchmark comparisons with conventional DWH systems

Figure 6. Results of benchmark comparisons with conventional OLTP systems

More testing information is available in Section 4: Pretesting the NEC PCIe SSD Appliance for Microsoft SQL Server.

1 The DWH and HammerDB workloads are derived from the TPC-H Benchmark and TPC-C Benchmark respectively. As such they are not comparable to published TPC-H Benchmark and TPC-C Benchmark results.
3. The NEC PCIe SSD Appliance for Microsoft SQL Server configurations

3-1. Hardware configurations

There are four models of the NEC PCIe SSD Appliance for Microsoft SQL Server hardware, as shown in Table 1 and Figure 7. More details, including other components, can be found in Appendix 1.

Table 1. Hardware configurations

<table>
<thead>
<tr>
<th>New Express5800 Scalable Enterprise Server</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intel Xeon processor E7-8893 v2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Processor</th>
<th>Socket count</th>
<th>Total core count</th>
<th>Physical memory capacity</th>
<th>PCIe SSD storage</th>
<th>Device count</th>
<th>Software mirroring count</th>
<th>600GB HDD (10,000 rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CPU</td>
<td></td>
<td>1</td>
<td>6</td>
<td>128GB</td>
<td>FlashMAX II (1.1TB)</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2 CPU</td>
<td></td>
<td>2</td>
<td>12</td>
<td>256GB</td>
<td></td>
<td>4</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3 CPU</td>
<td></td>
<td>3</td>
<td>18</td>
<td>384GB</td>
<td></td>
<td>6</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4 CPU</td>
<td></td>
<td>4</td>
<td>24</td>
<td>512GB</td>
<td></td>
<td>8</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>
New Express5800 Scalable Enterprise Server

Well-suited for large-scale IT platforms, the Express5800 Scalable Enterprise Server features high levels of performance, reliability, and availability demanded by enterprise mission critical and social infrastructure systems (Figure 8). Scalable up to four of the latest Intel Xeon processor E7 family v2, this enterprise-class server achieves roughly twice the performance of NEC’s previous Express5800/A1080a-S server. It is also ideal for in-memory databases that utilize the large memory size to process data at high speeds. With up to 16 of the latest PCI-Express 3.0 I/O slots available, the server can be used as a platform for real-time analysis, simultaneously incorporating multiple network interface cards, storage interface cards, and flash storage.

The RAS technology developed by NEC enhances the availability of CPU and memory to detect potential failures in advance. System level availability can be maximized by de-allocating resources before potential failures lead to system downtime, and recovering system operations automatically. This scalable high availability (HA) server seeks to set high standards for extensibility, availability, and reliability. Building on NEC’s years of experience.
designing supercomputers and mainframes, this Express5800 server offers businesses superior performance with simple and flexible resource scalability.

**Figure 8. New Express5800 scalable enterprise server**

**CPUs**
The Intel Xeon processor E7-8893 v2 (37.5M cache, 3.40 GHz) is used in all four models, in configurations ranging from one to four CPUs.

**Memory**
The four models range from 128GB to 512GB RAM.

**PCIe SSD Storage**
The high-performance, server embedded, PCIe flash storage from HGST, FlashMAX II (*Figure 9*), is used in all four models in configurations ranging from two to eight devices. To ensure availability, each pair of FlashMAX II devices uses software mirroring.

**Figure 9. FlashMAX II**

**3-2. Software configurations**

The software used with the NEC PCIe SSD Appliance for Microsoft SQL Server is shown in Table 2. Details, including other components, can be found in *Appendix 1. List of Configuration Parts*. 
Table 2. Software configuration

<table>
<thead>
<tr>
<th>Software</th>
<th>Version (see Note)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server</td>
<td>Windows Server 2012 R2 Standard</td>
</tr>
<tr>
<td>.NET Framework</td>
<td>.NET Framework 3.5 Service Pack 1</td>
</tr>
<tr>
<td>SQL Server</td>
<td>SQL Server 2014 Enterprise</td>
</tr>
<tr>
<td>FlashMAX II driver</td>
<td>FlashMAX II-4.1.0.68411</td>
</tr>
</tbody>
</table>

Note: Information as of August 2014. Please inquire for the latest version information.

3-3. Environment Settings

3-3-1. Windows Server

The Windows Server configuration settings are shown in Table 3.

Table 3. Windows Server settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Power option</td>
<td>High performance</td>
</tr>
<tr>
<td>2) Allocation unit size</td>
<td>OLTP: Default</td>
</tr>
<tr>
<td></td>
<td>DWH: 64KB</td>
</tr>
<tr>
<td>3) Paging file size</td>
<td>Physical memory size x 1.5</td>
</tr>
<tr>
<td>4) Page lock within memory</td>
<td>Enabled for account running SQL Server</td>
</tr>
<tr>
<td>5) Run volume maintenance tasks</td>
<td>Enabled for account running SQL Server</td>
</tr>
</tbody>
</table>
1) **Power option**
Configured to run in power-saving mode can have a harmful effect on SQL Server. In some instances, a latency of 20 to 25% may occur, so use the voltage control setting that prioritizes performance.

2) **Allocation unit size**
When placing user database files on a volume for DWH purposes, the allocation unit size is formatted in 64KB chunks. Since data is physically placed continuously for DWH normally, the larger the allocation unit size, the better the performance.

3) **Paging file size**
Sufficient disk space must be allocated for virtual RAM and paging requirements. In general, either 250GB or 1.5 times the amount of system RAM, whichever is larger, must be available as blank disk space.

4) **Page lock within memory**
Permission for the *Local Security Policy: Page Lock within Memory* must be granted to the account running the SQL Server engine service. The paging of allocated memory will be avoided by accounts with permission for *Page Lock within Memory* for running processes. As a result, the buffer pool will not page-out, and performance improves.

5) **Run volume maintenance tasks**
Permission for the *Local Security Policy: Run Volume Maintenance Tasks* is granted to the account running the SQL Server engine service. Running processes skip the zero-fill process that occurs at file initialization when the account has *Run Volume Maintenance Tasks* permission. As a result, the blocking period during the initialization of files when they are added, expanded and/or restored is shortened and performance improves.
3-3-2. SQL Server

The SQL Server configuration settings are as indicated in Table 4.

Table 4. SQL Server settings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Startup option 1 (-E)</td>
<td>-E (DWH only)</td>
</tr>
<tr>
<td>2) Startup option 2 (-T1117)</td>
<td></td>
</tr>
<tr>
<td>3) Startup option 3 (-T1118)</td>
<td></td>
</tr>
<tr>
<td>4) Max server memory</td>
<td>Sizing considering memory used other than for the SQL Server</td>
</tr>
<tr>
<td>5) Max degree of parallelism</td>
<td>OLTP: Equal to ½ the physical core count</td>
</tr>
<tr>
<td></td>
<td>DWH: Equal to the physical core count</td>
</tr>
</tbody>
</table>

1) **Startup option 1 (-E)**
   Configured for DWH: When –E is enabled, up to 64 extents can be continuously allocated to a data file within a file group. Data continuity improves, therefore, data warehouse workloads (sequential I/O) will be processed more efficiently.

2) **Startup option 2 (-T1117)**
   When -T1117 is enabled, all files within a file group will expand at once when automatic file expansion is set to occur. Data will therefore be balanced and I/O will be standardized.

3) **Startup option 3 (-T1118)**
   When -T1118 is enabled, the use of compound extents is restricted. This reduces latch contention.
4) **Max server memory**

When *max server memory* is made the default setting, memory will continue to be secured so there is more cache. The status of physical memory will be periodically checked, and when a deficiency is detected, an attempt will be made to free memory. When memory cannot be immediately freed, however, because it is in use, paging will occur and performance may suffer. For this reason, configuring for a set limit *max server memory* is recommended. To determine the value for *max server memory*, subtract the total amount of memory used by the OS and all other processes from the total amount of physical memory.

5) **Max degree of parallelism**

Parallelism is, in general, particularly valuable in environments where synchronous overhead can result in degradation of throughput, such as DWH, where simultaneous processing is high, and OLTP, where simultaneous transactions are comparatively short. Since no maximum degree of parallelism is set by default, configuring a value equivalent to \( \frac{1}{4} \) the physical core count for OLTP, and a value equivalent to the core count for DWH is recommended.

### 3-3-3. Storage

The storage configuration settings are indicated in Table 5.

**Table 5. Storage settings**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure data availability</td>
<td>Use software mirroring with the storage pool feature</td>
</tr>
<tr>
<td>2. FlashMAX II operations mode</td>
<td>OLTP: Maximum Performance</td>
</tr>
<tr>
<td></td>
<td>DWH: Maximum Capacity</td>
</tr>
</tbody>
</table>

1) **Ensure Data Availability**

FlashMAX II uses a hardware RAID mechanism, equivalent to RAID5, to guard against the failure of flash memory elements. Additionally, it can take advantage of software mirroring through the storage pool feature that comes standard with
Windows Server to both protect against failures of the FlashMAX II control chip and to improve availability. What’s more, the software mirroring pair comprises a pair of FlashMAX II units connected to the same CPU socket.

2) **FlashMAX II Operations Mode**

The FlashMAX II Operations Mode is optimized to suit specific applications. For OLTP, configure it to *Maximum Performance*. For DWH, use *Maximum Capacity*.

### 3-4. Storage configuration and arrangement of database files

Database files are arranged in the logical volumes configured by software mirroring by the storage pool feature that comes standard with Windows Server. Scaling up the number of CPUs and adding logical volume will add to the number of database files arranged. Storage configuration and the arrangement of database files are shown in *Figure 10*.

*Figure 10. Storage configuration and arrangement of database files*
4. Pretesting the NEC PCIe SSD Appliance for Microsoft SQL Server

4-1. DWH Testing

Microsoft Fast Track Data Warehouse Benchmark was used to test the performance of a data warehouse system hosted on an NEC PCIe SSD Appliance for Microsoft SQL Server against a Microsoft SQL Server Fast Track Data Warehouse (FTRA DWH) running on an Express5800/A1080a-S server with the conventional Intel Xeon processor E7 family CPUs. FTRA DWH is a data warehouse solution that deploys quickly by using a reference architecture that has undergone Microsoft-certified pretesting.

Express5800/A1080a-S FTRA DWH is the conventional solution and the NEC PCIe SSD Appliance for Microsoft SQL Server is the solution using the new Express5800 Scalable Enterprise Server. While the Express5800/A1080a-S FTRA DWH was measured in a single configuration with two CPUs (20 physical cores), the 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. Figure 11 shows the test results.

![Figure 11. Results of benchmark testing against previous data warehouse solution](image-url)
Logical Scan Rate is an indicator of user data scan throughput. While the results show clear performance improvements as the hardware is scaled up through the four different configurations of the 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 the NEC PCIe SSD Appliance for Microsoft SQL Server has approximately the same performance as the Express5800/A1080a-S FTRA DWH, however, the performance is improved by 173% in the scaled-up configuration with four CPUs (24 physical cores).

Figure 12 gives concrete numerical improvements based on the benchmark comparison results in Figure 11. The NEC PCIe SSD Appliance for Microsoft SQL Server not only delivers significant performance improvements, but it also reduces the TCO by consuming less rack space and power compared to the Express5800/A1080a-S FTRA DWH.

<table>
<thead>
<tr>
<th>Rack space</th>
<th>13U</th>
<th>69% reduction</th>
<th>4U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>2,125W</td>
<td>27% reduction</td>
<td>1,551W</td>
</tr>
<tr>
<td>Benchmark logical scan rate</td>
<td>4,759MB/s</td>
<td>173% improvement</td>
<td>8,234MB/s</td>
</tr>
</tbody>
</table>

Figure 12. Advantages of data warehouse system
4-2. OLTP Single-node configuration testing

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

In nearly all cases, I/O is the bottleneck in conventional OLTP databases. Tuning work, such as optimizing indexes to take account of database operation, is required to resolve this issue, but it is not a simple task. Benchmark testing demonstrated that the NEC PCIe SSD Appliance for Microsoft SQL Server solves this problem.

The Express5800/A1080a-S with external FC storage is the conventional solution and the NEC PCIe SSD Appliance for Microsoft SQL Server using the latest NX7700x Series is the new solution. The database used in both cases was Microsoft SQL Server 2014. Figure 13 illustrates the test results.

![Figure 13. Results of benchmark testing against previous OLTP solution](image)

The test was conducted in two different scenarios. The light 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 navy blue 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 conventional solution under the optimized I/O solution (defined as 100). The bars on the right show the results for the conventional solution, and the four bars on the left are for the four different data sizes used with the NEC PCIe SSD Appliance for Microsoft SQL Server.

The first finding is that, for all four models of the 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 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 was 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 conventional solution. The Express5800 Scalable Enterprise Server used in the NEC PCIe SSD Appliance for Microsoft SQL Server adopts a new ultra-fast I/O technology, which prevents significant performance drops even when I/O is not optimized.

*Figure 14* gives concrete numerical improvements based on the benchmark comparison results of *Figure 13.*
4-3. **Summary of testing results**

These results indicate that by using NEC PCIe SSD Appliance for Microsoft SQL Server in situations, such as the physical consolidation of database servers from legacy systems, users can quickly start operations confident of guaranteed performance without major application tuning. The merits of accelerating the process of database installation or migration are obvious, as well as the operational benefits of saving time tuning, improving the average performance, and proactively preventing potential business losses from bottlenecks.

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 a dynamic process, enough performance must be secured to handle unexpected increases in workload. The NEC PCIe SSD Appliance for Microsoft SQL Server has the ability to respond to this demand appropriately and effectively.
5. Summary

Testing proved that the 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) demonstrated a 173% increase in logical scan rate over the previous solution with a 2 CPU configuration (20 physical cores), while also offering significant improvements in rack space and power consumption contributing to TCO.

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

With these considerations, the NEC PCIe SSD Appliance for Microsoft SQL Server is poised to become a database platform for enterprise systems that provides superior stability and performance, particularly for enterprise mission-critical systems and data centers, as well as data analysis platforms in the field of real-time processing computing for mission-critical and large-scale data. As an example, it creates a low cost all-in-one big data analytic system by combining elements of the SQL Server family: SQL Server Integration Services for data extraction, processing and migration; SQL Server Analysis Services for data analysis; and SQL Server Reporting Services for data visualization with Power BI.
Enabling an All-in-One Big Data Analytic System at a Low Cost

Figure 16. Putting together an all-in-one big data analytic system at low cost
6. Appendix 1. List of Configuration Parts

The hardware and software used in this system is listed in Table 6 and Table 7.

**Table 6. Hardware**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Part Name</th>
<th>1 CPU Model</th>
<th>2 CPU Model</th>
<th>3 CPU Model</th>
<th>4 CPU Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE3300-040F, or NE3400-040F</td>
<td>NEC Express5800/A1040b, or NEC Express5800/A2040b</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE3351-100</td>
<td>Internal DVD-ROM Drive</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE3381-88</td>
<td>Power Supply Unit (1000W)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>NE3343-H001, or NE3343-H002</td>
<td>Cable Arm (70mm or 110mm)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE3301-H008F</td>
<td>Intel Xeon E7-8893v2 Processor Kit</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>NE3302-H002</td>
<td>Memory Riser Card</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>NE3302-H010F</td>
<td>16GB MEM (2 x 8GB RDIMM)</td>
<td>8</td>
<td>16</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>NE3350-304</td>
<td>600GB HDD</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>NE3303-168</td>
<td>RAID Controller (1GB, RAID 0/1/5/6/10/50/60)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>NE3304-133</td>
<td>1000BASE-T Adapter (4 port)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>NE3318-H001F</td>
<td>1.1TB PCIe SSD</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>NE3300-SV406</td>
<td>Customized Service: I/O card installation for SQL Server</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 7. Software**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Product Name</th>
<th>1 CPU Model</th>
<th>2 CPU Model</th>
<th>3 CPU Model</th>
<th>4 CPU Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>Windows Server 2012 R2 Standard</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>---</td>
<td>SQL Server 2014 Enterprise Core (2-pack Core License)</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>
7. Appendix 2. Related Information

- NEC Express5800 Series


8. Appendix 3. Inquiries

- NEC Express5800 Series

   https://contact.nec.com/http-www.nec.com_tb_009express_en_882b3f/

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