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**TPC Benchmark™ E**  
**Full Disclosure Report**

***NEC Express5800/A1080a-E***

**with Microsoft® SQL Server® 2008 R2 Datacenter Edition**  
**and**  
**Microsoft® Windows Server® 2008 R2 Datacenter x64 Edition**

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**Second Edition**  
**2-June-2010**

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Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC Benchmark™ E should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

All performance data contained in this report were obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. NEC does not warrant or represent that a user can or will achieve similar performance expressed in transactions per second (tpsE) or normalized price/performance (\$/tpsE). No warranty of system performance or price/performance is expressed or implied in this report.

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## *Abstract*

This report documents the compliance of NEC Corporation's TPC Benchmark™ E tests on the NEC Express5800/A1080a-E client/server system with version 1.9.0 of the TPC Benchmark™ E Standard Specification. Two clients (NEC Express5800/R120a-2) were used as the Tier-A clients.

The operating system and the DBMS used on the server were Microsoft® Windows Server® 2008 R2 Datacenter x64 Edition and Microsoft® SQL Server® 2008 R2 Datacenter Edition. The operating system on the clients was Microsoft® Windows Server® 2008 Standard Edition.

Two standard metrics, transaction-per-second-E(tpsE) and price per tpsE(\$/tpsE) are reported, in accordance with the TPC Benchmark™ E Standard. The independent auditor's report by Francois Raab appears at the end of this report.

### *TPC Benchmark™ E Metrics*

The standard TPC Benchmark™ E metrics, tpsE (transactions per second), price per tpsE are reported.

<b>System</b>	<b>Software</b>	<b>Total System Cost</b>	<b>tpsE</b>	<b>\$ USD /tpsE</b>	<b>Availability Date</b>
NEC Express5800 /A1080a-E	Microsoft® SQL Server® 2008 R2 Datacenter Edition Microsoft® Windows Server® 2008 R2 Datacenter x64 Edition	\$2,415,759 (USD)	3141.76	\$768.92	30-July-2010

### *Executive Summary*

The following pages contain executive summary of results for this benchmark.

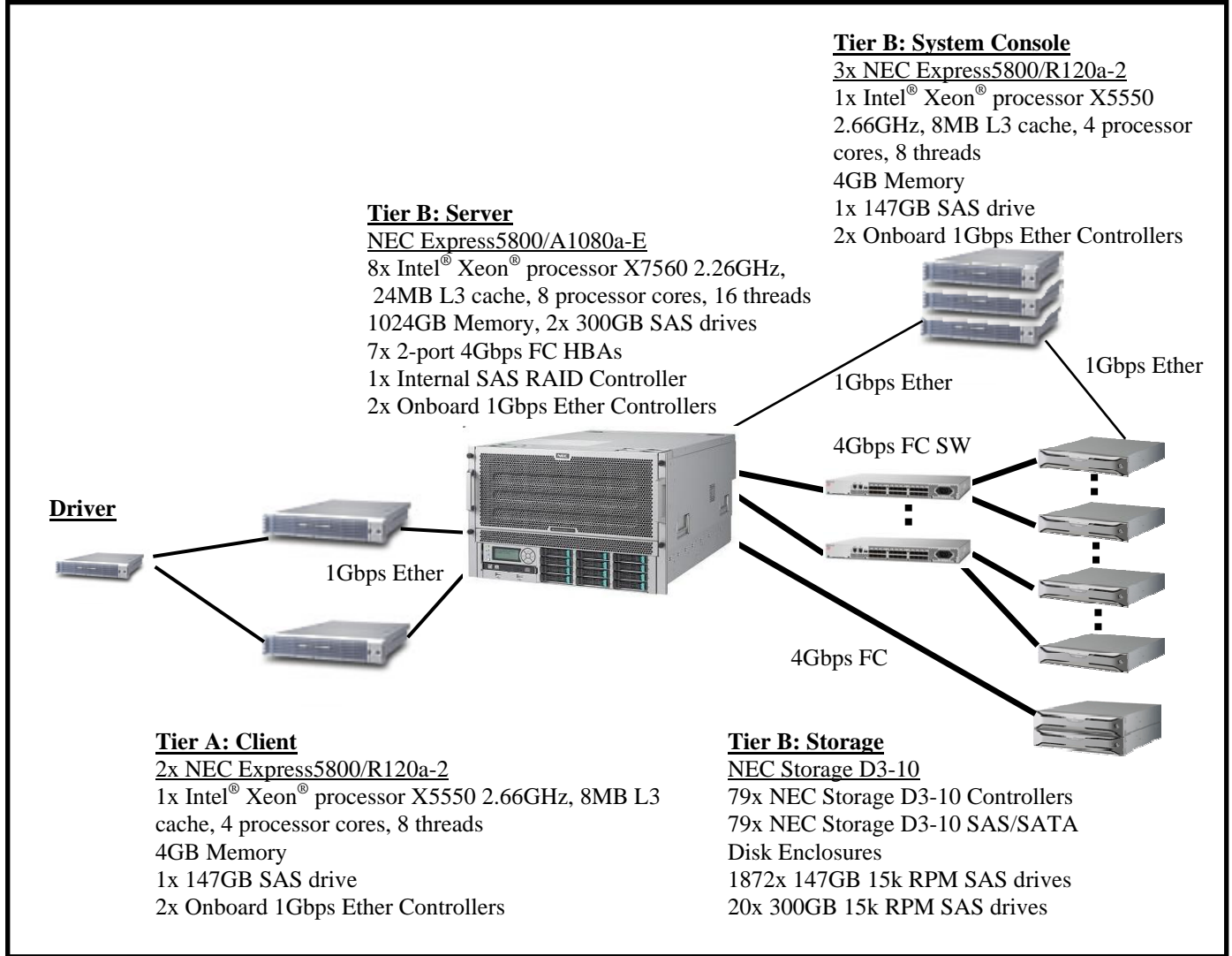
### *Auditor*

The benchmark configuration, environment and methodology were audited by Francois Raab of InfoSizing, Inc. to verify compliance with the relevant TPC specifications.

<b>NEC</b>	<b>NEC Express5800/A1080a-E</b>		<b>TPC-E 1.9.0</b> <b>TPC Pricing 1.5.0</b>
			Report Date : 30-March-2010 Revised Date : 2-June-2010
TPC-E Throughput <b>3141.76 tpsE</b>	Price/Performance <b>\$768.92</b> <b>USD per tpsE</b>	Availability Date <b>30-July-2010</b>	Total System Cost <b>\$2,415,759USD</b>

**Database Server Configuration**

Operating System <b>Microsoft® Windows Server® 2008 R2 Datacenter x64 Edition</b>	Database Manager <b>Microsoft® SQL Server® 2008 R2 Datacenter Edition</b>	Processors/Cores/Threads <b>8 /64 /128</b>	Memory <b>1024GB</b>
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Initial Database Size <b>13,391 GB</b>	Redundancy Level : 1 <b>RAID50 : Log / RAID10 : Data</b>	Storage <b>1872 x 147GB 15K</b> <b>20 x 300GB 15K</b>
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## NEC Express5800/A1080a-E

### TPC-E 1.9.0 TPC Pricing 1.5.0

Report Date : 30-March-2010  
Revised Date : 2-June-2010

Available Date  
30-July-2010

Description	Part Number	Third Party		Unit Price	Qty	Extended Price	3-yr Mnt. Price
		Brand	Pricing				
<b>Server Hardware</b>							
NEC Express5800/A1080a-E							
A1080a-E Base Unit (1x MGM card, 2x power module included)	NE3100-101H	NEC	1	12,499	1	12,499	
Processor Memory Module (PMM) X7560 All Cores Activated	NE3102-001	NEC	1	7,999	8	63,992	
16GB Memory (1067MHz 8GB DIMM x2)	NE3103-003	NEC	1	1,899	64	121,536	
6Gbps SAS RAID Controller for Embedded HDD/SSD	NE3104-001	NEC	1	499	1	499	
300GB 10krpm 6Gbps SAS HDD	NE3105-104	NEC	1	599	2	1,198	
2-port 4Gbps FC-HBA (PClex4)	NE3108-102	NEC	1	2,299	7	16,093	
Embedded DVD-ROM	NE3100-201	NEC	1	99	1	99	
Power Module	NE3100-301	NEC	1	1,499	2	2,998	
Power Cable for 200V	NE3107-001	NEC	1	69	4	276	
PDU L6-30P	NE3107-101	NEC	1	599	2	1,198	
Installation	SP-GX00-STIN001	NEC	1	5,000	1	5,000	
Microsoft Windows Server 2008 R2 Datacenter per 4p	062-03621-000	NEC	1	11,996	2	23,992	
Platinum Warranty (Yr 1,2 & 3)	UPPLT-A1080a8-3Y	NEC	1	6,799	1		6,799
NEC Express5800/R120a-2 (for System Maintenance)							
Model R120a-2 (CPU less, MEM less, DVD-ROM, 2 x 1000BaseT port, DAC(RAID0/1), Front Bezel, 3yrs Basic Warranty	N8100-1506FB	NEC	1	2,795	3	8,385	
Xeon X5550 (Nehalem-EP 2.66G)	N8101-428	NEC	1	1,955	3	5,865	
2GB (2GB x1) DDR3-1066 memory for R120a-1 and R120a-2	N8102-327	NEC	1	105	6	630	
146GB HDD 3.5" (SAS) 15KRPM, Hot-Plug	N8150-201	NEC	1	270	3	810	
3 Years of Upgraded Platinum Warranty for the Express 5800/100 Series	UPPLT-GP100-2U-3Y	NEC	1	840	3		2,520
NEC AccuSync 73VX 17" LCD Display (+2 spares)	ASLCD73VX-BK	NEC	3	117	6	702	
					<b>Subtotal</b>	<b>265,772</b>	<b>9,319</b>
<b>Disk Subsystem</b>							
NEC Storage D3-10							
NEC Storage D3-10 Base Model	850193310	NEC	1	6,834	79	539,886	
3 Years of Platinum Warranty Upgrade for D3-10 Base Model	UPPT850193310	NEC	1	1,025	79		80,975
SAS/SATA Disk Enclosure w/NEC logo	NF5021-SE60E-000	NEC	1	2,749	79	217,171	
3 Years of Platinum Warranty Upgrade for 3Gbps Disk Enclosure	UPPTNF5021SE60E	NEC	1	412	79		32,548
SAS disk drive (15k rpm/147GB) (+10% spares)	NF5021-SM624E	NEC	1	343	2060	706,580	
3 Years Platinum Warranty Upgrade SAS Disk Drive(15krpm/147GB/3Gbps)	UPPTNF5021SM624E	NEC	1	51	2060		105,060
SAS disk drive (15k rpm/300GB) (+10% spares)	NF5021-SM625E	NEC	1	485	22	10,670	
3 Years Platinum Warranty Upgrade SAS Disk Drive(15krpm/300GB/3Gbps)	UPPTNF5021SM625E	NEC	1	73	22		1,606
1 yr of Platinum SW Maintenance for Base SW	UFSD0M-310000AMAS	NEC	1	520	237		123,240
UPS 3kVA	050-02424-000	NEC	1	1,799	2	3,598	
42U Rackframe	050-02378-001	NEC	1	1,799	8	14,392	
FC Cable 10M LC-LC (+10% spares)	F2F202LL-10M	Belklin	3	40	102	4,079	
					<b>Subtotal</b>	<b>1,496,376</b>	<b>343,429</b>
<b>Server Software</b>							
Microsoft SQL Server 2008 R2 Datacenter Edition	*	Microsoft	2*	45,807	8	366,456	259
					<b>Subtotal</b>	<b>366,456</b>	<b>259</b>

*continued on the next page*



## NEC Express5800/A1080a-E

### TPC-E 1.9.0 TPC Pricing 1.5.0

Report Date : 30-March-2010  
Revised Date : 2-June-2010

Available Date  
30-July-2010

#### Client Hardware

<b>NEC Express5800/R120a-2</b>							
Model R120a-2 (CPU less, MEM less, DVD-ROM, 2 x 1000BaseT port, DAC(RAID0/1), Front Bezel, 3yrs Basic Warranty	N8100-1506FB	NEC	1	2,795	2	5,590	
Xeon X5550 (Nehalem-EP 2.66G)	N8101-428	NEC	1	1,955	2	3,910	
2GB (2GB x1) DDR3-1066 memory for R120a-1 and R120a-2	N8102-327	NEC	1	105	4	420	
146GB HDD 3.5" (SAS) 15KRPM, Hot-Plug	N8150-201	NEC	1	270	2	540	
3 Years of Upgraded Platinum Warranty for the Express 5800/100 Series	UPPLT-GP100-2U-3Y	NEC	1	840	2		1,680
NEC AccuSync 73VX 17" LCD Display (+2 spares)	ASLCD73VX-BK	NEC	3	117	4	468	
42U Rackframe	050-02378-001	NEC	1	1,799	1	1,799	
Cat5e Patch Cable 25' RJ45-RJ45 (+10% spares)	N001-025-BL	Tripp Lite	3	6	94	563	
Cat5e Crossover Cable 10' RJ45-RJ45 (+2 spares)	N010-010-GY	Tripp Lite	3	5	7	35	
<b>Subtotal</b>						<b>13,325</b>	<b>1,680</b>

#### Client Software

Windows Server 2008 Standard Edition (x86)**	P73-04165	Microsoft	2	711	5	3,555 (Included)	
<b>Subtotal</b>						<b>3,555</b>	<b>0</b>

#### Infrastructure

Brocade 300 8Gbps SAN Switch, 4GbSFPx16p	BR-340-0004-A	Brocade	1	8,500	9	76,500	
Rack Mount Kit for Brocade 300 Switch (+2 spares)	XBR-R000162	Brocade	1	1,500	9	13,500	
Brocade 300 ADV REPLMNT Service 1YR	300-SVC-ADVANCE-1	Brocade	1	450	27		12,150
24-Port 10/100/1000 Gigabit Switch (+2 spares)	SR2024C	Cisco	3	286	6	1,716	
<b>Subtotal</b>						<b>91,716</b>	<b>12,150</b>

**TOTAL** 2,237,200 366,837

NEC Large Volume Discount\*\*\* -10% -185,963 -2,315

#### Notes:

Pricing: 1-NEC Contact: 1-866-632-3226, 2-Microsoft 3-CDW

\* This component is not immediately orderable. See the FDR for more information.

\*\* Qty of Windows Server 2008 Standard Edition includes the license of the DB server's maintenance Console

\*\*\*10% discount was based on the overall value of the specific components from NEC in this single

quotation except 3-yr Mnt. Price for Disk Subsystem

Discount for similarly sized configurations will be similar to those quoted here but may vary

based on the components in quotation

**Results and methodology audited by Francois Raab of InfoSizing, Inc. (www.sizing.com)**

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflects standard pricing policies for the listed components. For complete details, see the pricing sections of the TPC benchmark specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at [pricing@tpc.org](mailto:pricing@tpc.org). Thank you.

3-Yr. Cost of Ownership: **\$2,415,759**

tpsE Throughput: **3141.76**

**\$ / tpsE \$768.92**



NEC Express5800/A1080a-E

TPC-E 1.9.0  
TPC Pricing 1.5.0

Report Date : 30-March-2010  
Revised Date : 2-June-2010

Available Date  
30-July-2010

Numerical Quantities Summary				
<b>Reported Throughput : 3141.76 tpsE</b>		<b>Configured Customers : 1,650,000</b>		
Response Times (in seconds)	Minimum	Average	90 <sup>th</sup> %tile	Maximum
Broker Volume	0.01	0.05	0.09	2.88
Customer Position	0.01	0.02	0.05	43.55
Market Feed	0.01	0.03	0.05	48.81
Market Watch	0.01	0.03	0.07	2.77
Security Detail	0.01	0.01	0.03	2.89
Trade Lookup	0.01	0.50	0.71	49.09
Trade Order	0.01	0.07	0.11	45.96
Trade Result	0.01	0.07	0.13	68.73
Trade Status	0.01	0.02	0.04	60.23
Trade Update	0.01	0.56	0.73	3.46
Data Maintenance	0.01	0.11		1.12
Transaction Mix		Transaction Count		Mix %
Broker Volume		11,084,250		4.900%
Customer Position		29,408,007		13.000%
Market Feed		2,262,086		1.000%
Market Watch		40,718,758		18.000%
Security Detail		31,670,116		14.000%
Trade Lookup		18,096,002		8.000%
Trade Order		22,847,611		10.100%
Trade Result		22,620,694		10.000%
Trade Status		42,980,977		19.000%
Trade Update		4,524,077		2.000%
Data Maintenance		120		
Test Duration and Timings				
Ramp-up Time				1:05:42
Measurement Interval				2:00:00
Business Recovery Time				1:39:28
Total Number of Transactions Completed in Measurement Interval				226,212,578

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# PREAMBLE

## *Introduction*

TPC Benchmark™ E (TPC-E) is an On-Line Transaction Processing (OLTP) workload. It is a mixture of read-only and update intensive transactions that simulate the activities found in complex OLTP application environments. The database schema, data population, transactions, and implementation rules have been designed to be broadly representative of modern OLTP systems. The benchmark exercises a breadth of system components associated with such environments, which are characterized by:

- The simultaneous execution of multiple transaction types that span a breadth of complexity;
- Moderate system and application execution time;
- A balanced mixture of disk input/output and processor usage;
- Transaction integrity (ACID properties);
- A mixture of uniform and non-uniform data access through primary and secondary keys;
- Databases consisting of many tables with a wide variety of sizes, attributes, and relationships with realistic content;
- Contention on data access and update.

The TPC-E operations are modeled as follows: The database is continuously available 24 hours a day, 7 days a week, for data processing from multiple Sessions and data modifications against all tables, except possibly during infrequent (e.g., once a month) maintenance Sessions. Due to the worldwide nature of the application modeled by the TPC-E benchmark, any of the transactions may be executed against the database at anytime, especially in relation to each other.

## *Goal of the TPC-E Benchmark*

The TPC-E benchmark simulates the OLTP workload of a brokerage firm. The focus of the benchmark is the central database that executes transactions related to the firm's customer accounts. In keeping with the goal of measuring the performance characteristics of the database system, the benchmark does not attempt to measure the complex flow of data between multiple application systems that would exist in a real environment.

The mixture and variety of transactions being executed on the benchmark system is designed to capture the characteristic components of a complex system. Different transaction types are defined to simulate the interactions of the firm with its customers as well as its business partners. Different transaction types have varying run-time requirements.

The benchmark defines:

- Two types of transactions to simulate Consumer-to-Business as well as Business-to-Business activities
- Several transactions for each transaction type
- Different execution profiles for each transaction type
- A specific run-time mix for all defined transactions

For example, the database will simultaneously execute transactions generated by systems that interact with customers along with transactions that are generated by systems that interact with financial markets as well as administrative systems. The benchmark system will interact with a set of Driver systems that simulate the various sources of transactions without requiring the benchmark to implement the complex environment.

The Performance Metric reported by TPC-E is a "business throughput" measure of the number of completed Trade-Result transactions processed per second (see Clause 6.7.1). Multiple Transactions are used to simulate the business activity of processing a trade, and each Transaction is subject to a Response Time constraint. The Performance Metric for the benchmark is expressed in transactions-per-second-E (tpsE). To be compliant with the TPC-E standard, all references to tpsE Results must include the tpsE rate, the associated price-per-tpsE, and the Availability Date of the Priced Configuration (See Clause 6.7.3 for more detail).

Although this specification defines the implementation in terms of a relational data model, the database may be implemented using any commercially available Database Management System (DBMS), Database Server, file system, or other data repository that provides a functionally equivalent implementation. The terms "table", "row", and "column" are used in this document only as examples of logical data structures.

TPC-E uses terminology and metrics that are similar to other benchmarks, originated by the TPC and others. Such similarity in terminology does not imply that TPC-E Results are comparable to other benchmarks. The only benchmark Results comparable to TPC-E are other TPC-E Results that conform to a comparable version of the TPC-E specification.

## ***Restrictions and Limitations***

Despite the fact that this benchmark offers a rich environment that represents many OLTP applications, this benchmark does not reflect the entire range of OLTP requirements. In addition, the extent to which a customer can achieve the Results reported by a vendor is highly dependent on how closely TPC-E approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.

Benchmark Results are highly dependent upon workload, specific application requirements, and systems design and implementation. Relative system performance will vary because of these and other factors. Therefore, TPC-E should not be used as a substitute for specific customer application benchmarking when critical capacity planning and/or product evaluation decisions are contemplated.

Benchmark Sponsors are permitted various possible implementation designs, insofar as they adhere to the model described and pictorially illustrated in this specification. A Full Disclosure Report (FDR) of the implementation details, as specified in Clause 9.1, must be made available along with the reported Results.

**Comment:** While separated from the main text for readability, comments are a part of the standard and must be enforced.

# Clause 1 : General Items

## Order and Titles

*The order and titles of sections in the Report and Supporting Files must correspond with the order and titles of sections from the TPC-E Standard Specification (i.e., this document). The intent is to make it as easy as possible for readers to compare and contrast material in different Reports.*

The order and titles of sections in this report correspond with that of the TPC-E standard specification.

## Executive Summary Statement

*The TPC Executive Summary Statement must be included near the beginning of the Report. An example of the Executive Summary Statement is presented in Appendix B. The latest version of the required format is available from the TPC Administrator.*

The TPC Executive Summary Statement is included at the beginning of this report.

## Benchmark Sponsor

*A statement identifying the benchmark Sponsor(s) and other participating companies must be reported in the Report.*

This benchmark test was sponsored by NEC Corporation.

## Configuration Diagrams

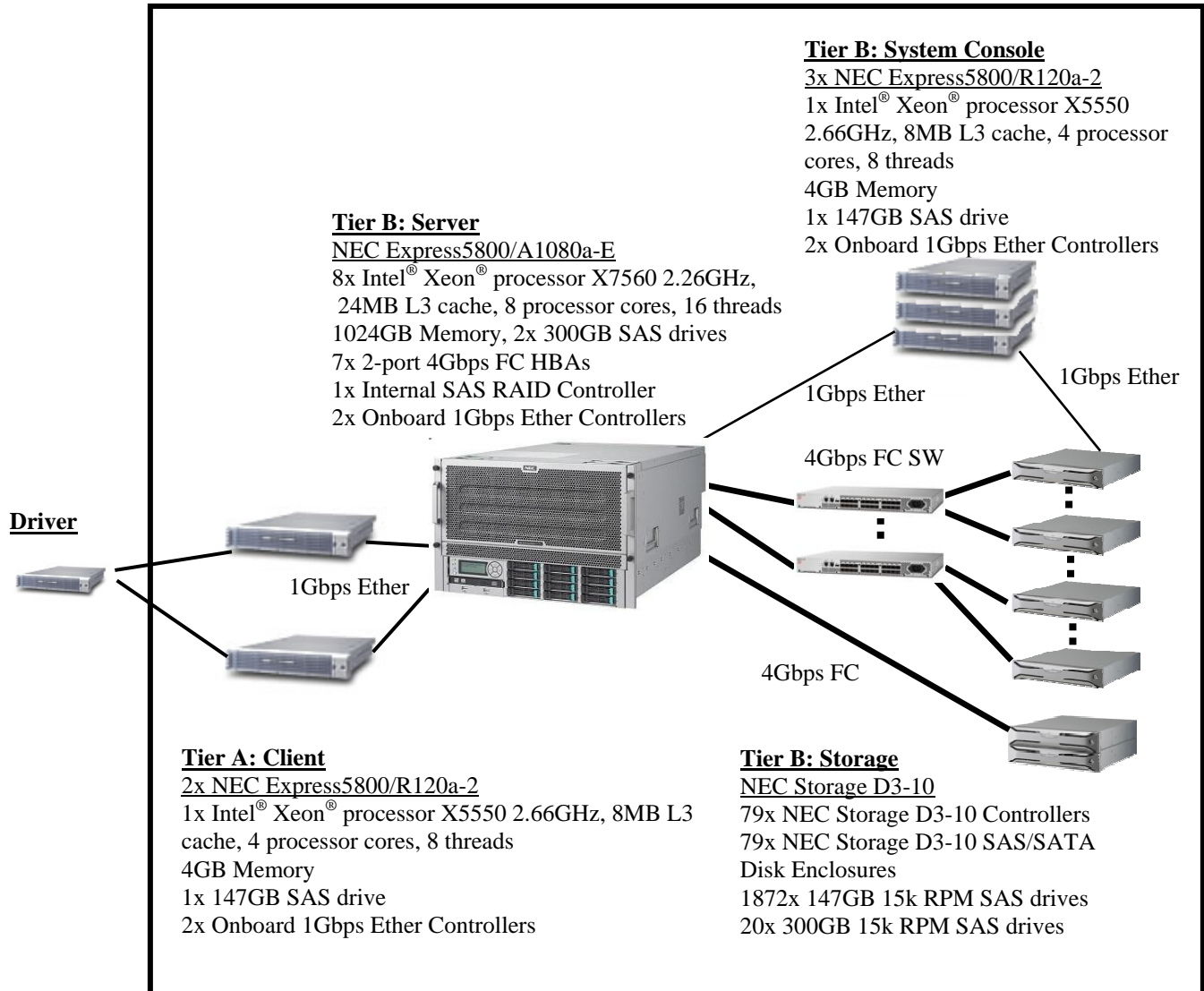
*Diagrams of both measured and Priced Configurations must be reported in the Report, accompanied by a description of the differences. This includes, but is not limited to:*

- *Number and type of processors, number of cores and number of threads.*
- *Size of allocated memory, and any specific mapping/partitioning of memory unique to the test.*
- *Number and type of disk units (and controllers, if applicable).*
- *Number of channels or bus connections to disk units, including their protocol type.*
- *Number of LAN (e.g. Ethernet) connections, including routers, workstations, etc., that were physically used in the test or incorporated into the pricing structure.*
- *Type and the run-time execution location of software components (e.g. DBMS, client, processes, transaction monitors, software drivers, etc.).*

## Measured and Priced Configuration

The following figure represents the measured and priced configuration.

**Figure1.1: NEC Express5800/A1080a-E, Measured and Priced Configuration Diagram**



## Hardware Configuration

A description of the steps taken to configure all of the hardware must be reported in the Report. Any and all configuration scripts or step by step GUI instructions are reported in the Supporting Files (see Clause 9.4.1.1). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of computer systems and the TPC-E specification could recreate the hardware environment. This includes, but is not limited to:

- A description of any firmware updates or patches to the hardware.
- A description of any GUI configuration used to configure the system hardware.
- A description of exactly how the hardware is combined to create the complete system. For example, if the SUT description lists a base chassis with 1 processor, a processor update package of 3 processors, a NIC controller and 3 disk controllers, a description of where and how the processors, NIC and disk controllers are placed within the base chassis must be reported in the Report.
- A description of how the hardware components are connected. The description can assume the reader is knowledgeable of computer systems and the TPC-E specification. For example, only a description that Controller 1 in slot A is connected to Disk Tower 5 is required. The reader is assumed to be knowledgeable enough to determine what type of cable is required based upon the component descriptions and how to plug the cable into the components.

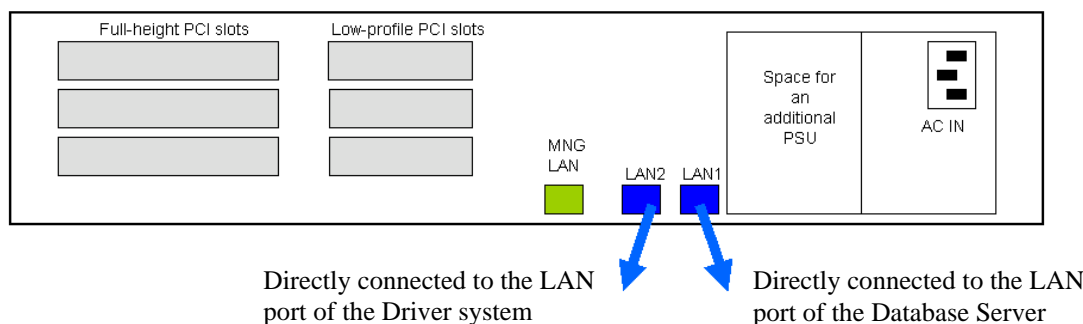
## Driver

The driver is not included in the priced configuration or SUT. In this benchmark, the NEC Express5800/R120a-2 was used. The driver machine was configured with IP addresses of 10.10.1.250 and 10.10.2.250.

## Tier-A installation / configuration

The NEC Express5800/R120a-2 has 1x Intel® Xeon® processor X5550, 4GB of Memory, 1x 147GB SAS drive. Tier-A consists of 2x NEC Express5800/R120a-2, all of which have the same hardware configuration. Each Tier-A machine is connected to the database server and to the driver system with a GbE cable respectively.

**Figure1.2: Rear view of each Client (NEC Express5800/R120a-2)**

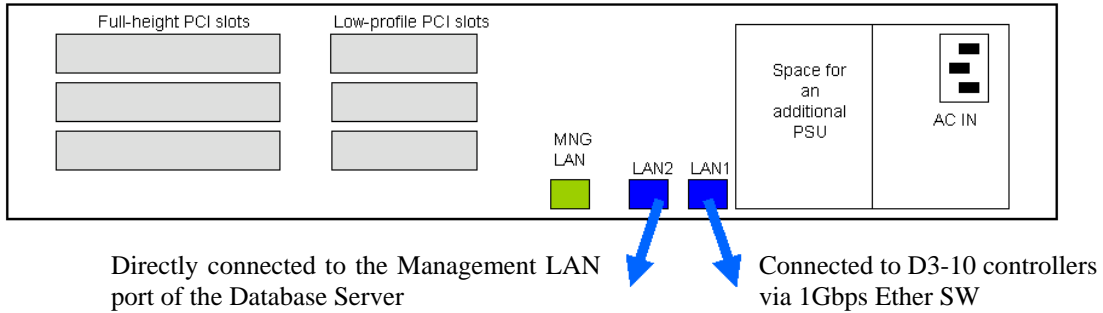


## Tier-B installation / configuration

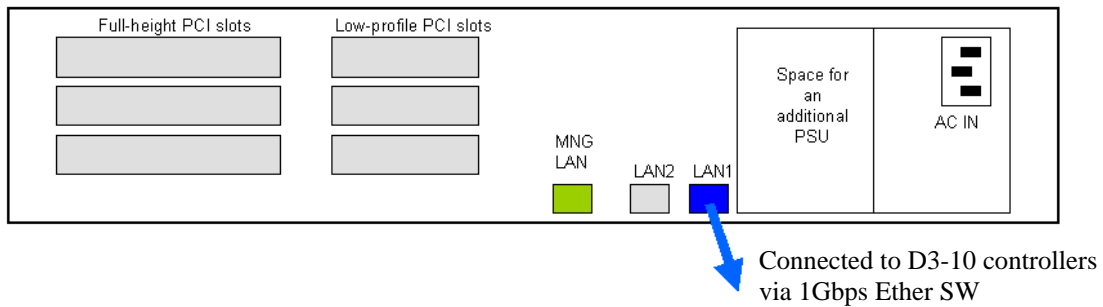
Tier-B hardware consists of one NEC Express5800/A1080a-E as the database server, seventy-nine NEC Storage D3-10 as the Database Array and three NEC Express5800/R120a-2 as the System Console of the NEC Express5800/A1080a-E and the NEC Storage D3-10.

The hardware configuration of the System Consoles (NEC Express5800/R120a-2) is same as that of a Client. The difference is the network configuration. The System Console #1 is directly connected to the Management LAN port of the Database Server, and connected to D3-10 controllers via 1Gbps Ether switch. The System Console #2 and the system Console #3 are connected to D3-10 controllers via 1Gbps Ether switch.

**Figure1.3: Rear view of the System Console #1 (NEC Express5800/R120a-2)**



**Figure1.4: Rear view of the System Console #2,3 (NEC Express5800/R120a-2)**



The NEC Express5800/A1080a-E has 8x Intel® Xeon® processor X7560 2.26GHz, 24MB L3 cache, 128x 8GB DIMMs, 2x Onboard 1Gbps Ether Controllers, one internal SAS RAID Controller and 2x 300GB SAS drive with Microsoft® Windows Server® 2008 R2 Datacenter x64 Edition.

The 7x 2-port 4Gbps FC HBAs are installed to the PCI-Express slots of the NEC Express5800/A1080a-E. The FC HBAs are connected to the Database Array via 16-port 4Gbps FC switches as follows:

Management LAN	to the system console
Onboard LAN#0	to GbE NIC of client #1
Onboard LAN#1	to GbE NIC of client #2
PCI-Express #2: 2-port 4Gbps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #5: 2-port 4Gbps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #7: 2-port 4Gbps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #8: 2-port 4Gbps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #10: 2-port 4Gbps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #12: 2-port 4Gbps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #13: 2-port 4Gbps FC HBA	#0 to D3-10 Controllers via 16-port 4Gbps FC switch, #1 to D3-10 Controller

**Figure1.5: Rear view of the Server (NEC Express5800/A1080a-E)**

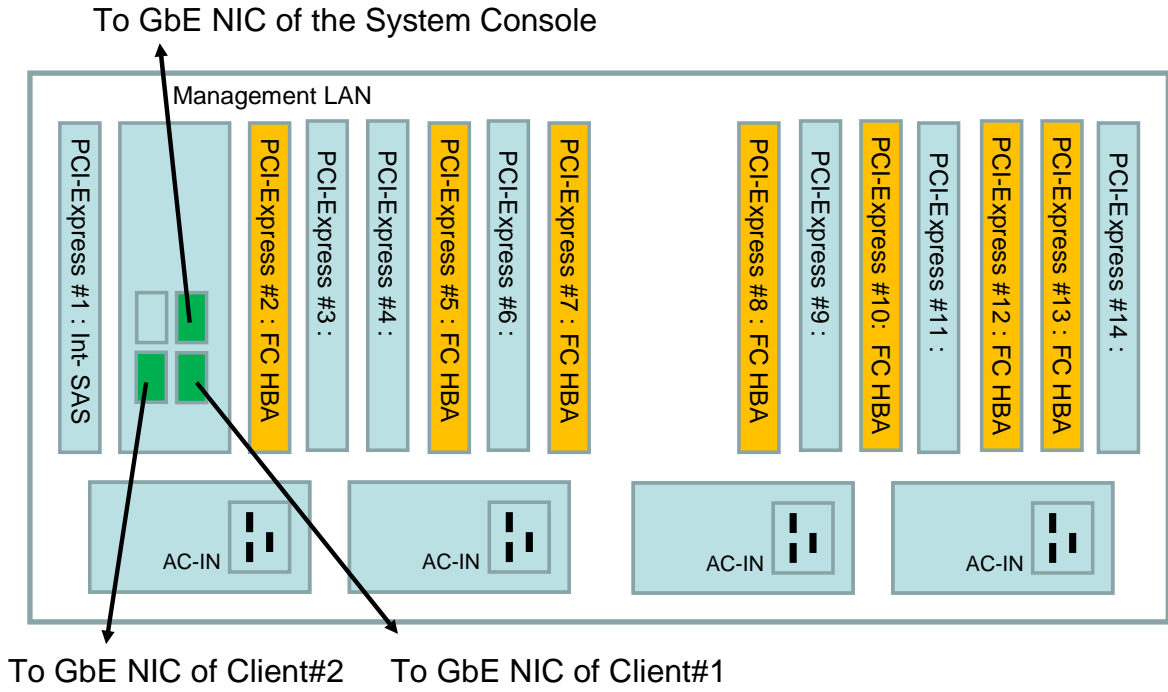
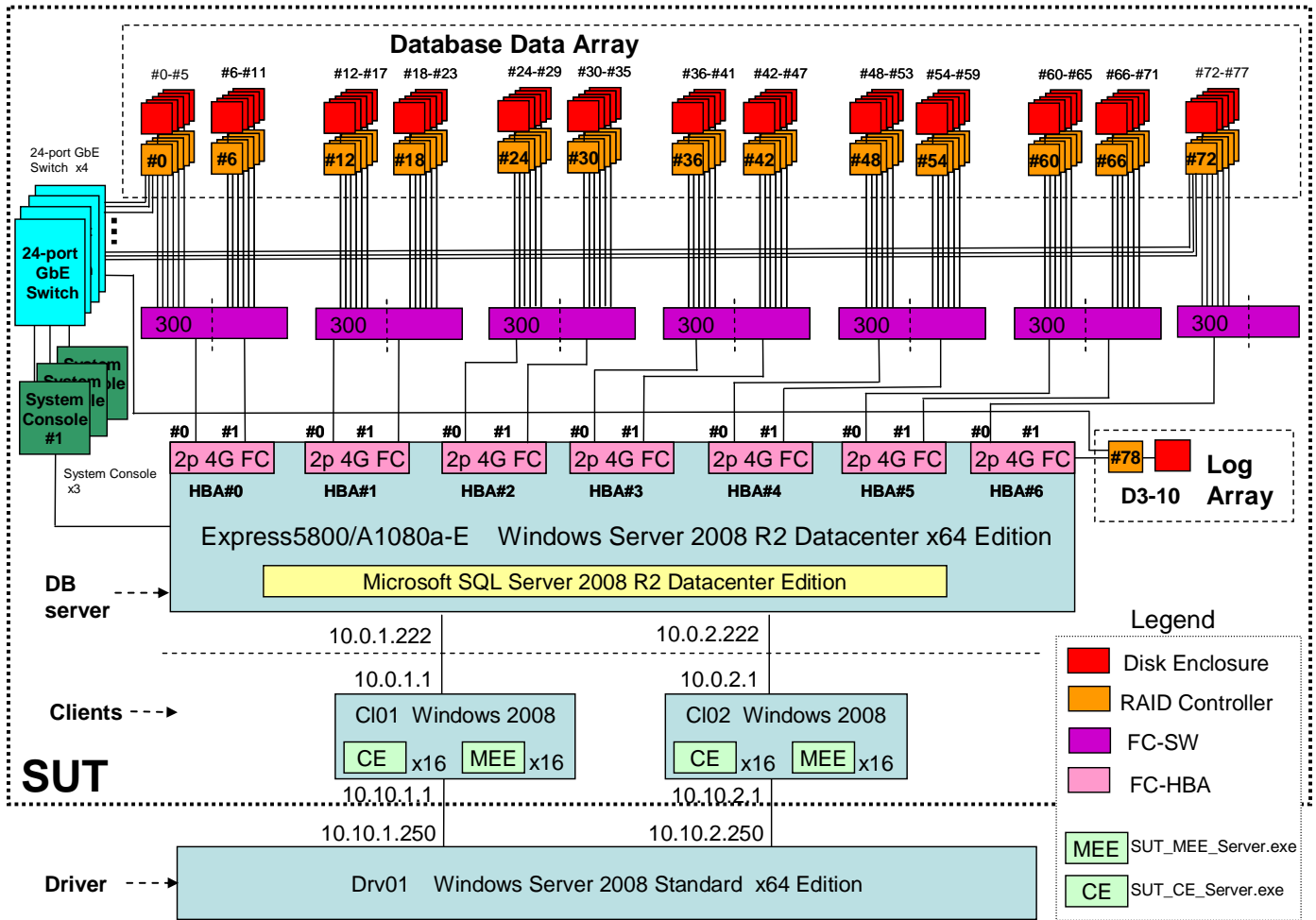




Figure1.6: Overview of the whole system connections



**Connect NEC Storage D3-10 controllers to disk enclosures**

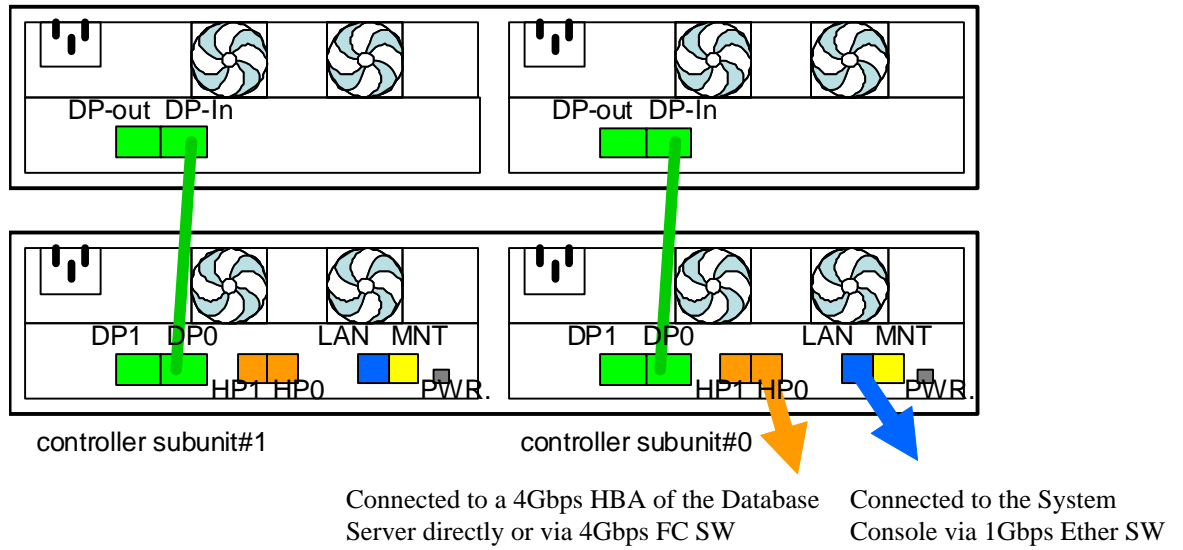
The Database Array consists of two types of disk array system. One is Database Data Array and the other is Log Array.

Database Data Array has seventy-eight NEC Storage D3-10 controllers and seventy-eight disk enclosures. Each controller is connected to a 4Gbps FC HBA of the Database Server via 16-port 4Gbps FC switch.

Log Array has one NEC Storage D3-10 controller and one disk enclosure. The controller is connected to the 4Gbps FC HBA of the Database Server.

See Figure 1.7 to check the connection diagram for the NEC Storage D3-10 controller and the disk enclosure.

**Figure1.7: Connection diagram for the NEC Storage D3-10**



## Software Configuration

A description of the steps taken to configure all software must be reported in the Report. Any and all configuration scripts or step by step GUI instructions are reported in the Supporting Files (see Clause 9.4.1.2). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of computer systems and the TPC-E specification could recreate the software environment. This includes, but is not limited to:

- A description of any updates or patches to the software.
- A description of any changes to the software.
- A description of any GUI configurations used to configure the software.

## Driver

The driver is not included in the priced configuration or SUT. In this benchmark, the driver machine runs Microsoft® Windows Server® 2008 Standard Edition. Proprietary driver was installed on the machine.

## Tier-A

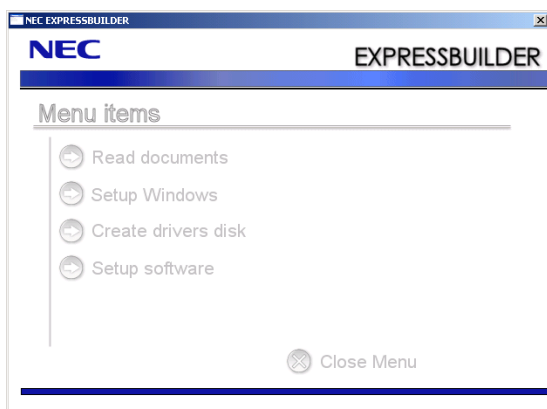
### OS Installation

**Step.1:** Install “Windows Server® 2008”

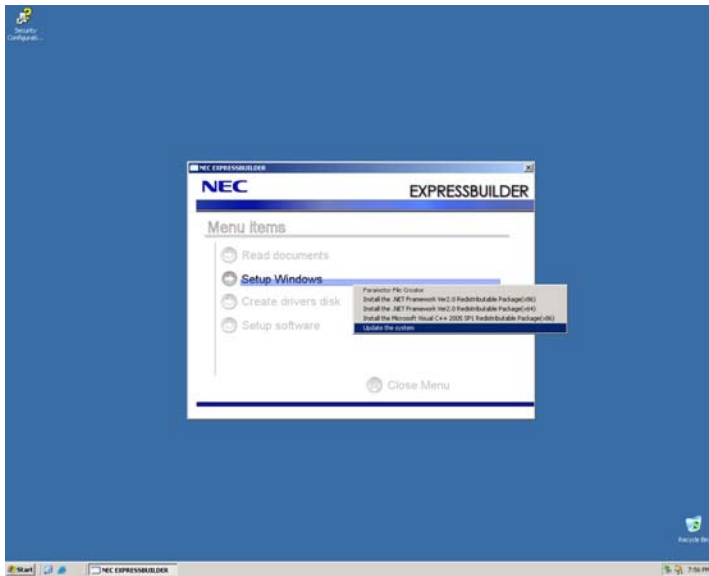
1. Put an OS install medium into the DVD drive of the NEC Express5800/R120a-2.
2. Power on the NEC Express5800/R120a-2 with a DVD Drive, then “Windows Setup” boots from the OS install medium.
3. Continue normal Windows installation.

**Step.2:** Install driver

1. After Windows installation completes, put the EXPRESSBUILDER DVD medium into the DVD drive of the NEC Express5800/R120a-2.
2. A dialog below is displayed.



3. Select “Setup Windows” -> “Update the system”.



4. When “Update the system” is finished, remove the EXPRESSBUILDER DVD medium from the DVD drive and reboot the NEC Express5800/R120a-2.

## OS Configuration

Assign IP addresses to Ethernet cards.

### Step.1: Connection to the Database server

“Local Area Connection” is used for this connection. Assign IP address “10.0.x.1”.

“x” represents the Client number.

### Step.2: Connection to the Driver system

“Local Area Connection 2” is used for this connection. Assign IP address “10.10.x.1”.

“x” represents the Client number.

## SQL Server<sup>®</sup> Installation (only client #1)

Install Microsoft<sup>®</sup> SQL Server<sup>®</sup> 2008 R2 Express. The SQL Server<sup>®</sup> installation procedure on the client #1 is the same as described in Tier-B portion of this clause.

## Benchmark module Installation

After the OS is installed, install the vc2008SP1redist\_x86.exe, SUT\_CE\_Server.exe and SUT\_MEE\_Server.exe.

## Tier-B

Tier-B hardware consists of one NEC Express5800/A1080a-E as the database server, seventy-nine NEC Storage D3-10 as the Database Array and two NEC Express5800/R120a-2 as the System Console of the NEC Express5800/A1080a-E and the NEC Storage D3-10.

## **Tier-B : The System Console**

### **OS Installation**

The OS installation procedure on the System Console, NEC Express5800/R120a-2, is the same as described in Tier-A portion of this clause.

### **OS Configuration**

Assign IP addresses to Ethernet connections.

#### **Step.1: Connection to D3-10 controllers**

“Local Area Connection” is used for this. Assign IP address “192.168.11.253”.

#### **Step.2: Connection to the Management LAN port of the Database Server**

“Local Area Connection 2” is used for this. Assign IP address “192.168.1.6”.

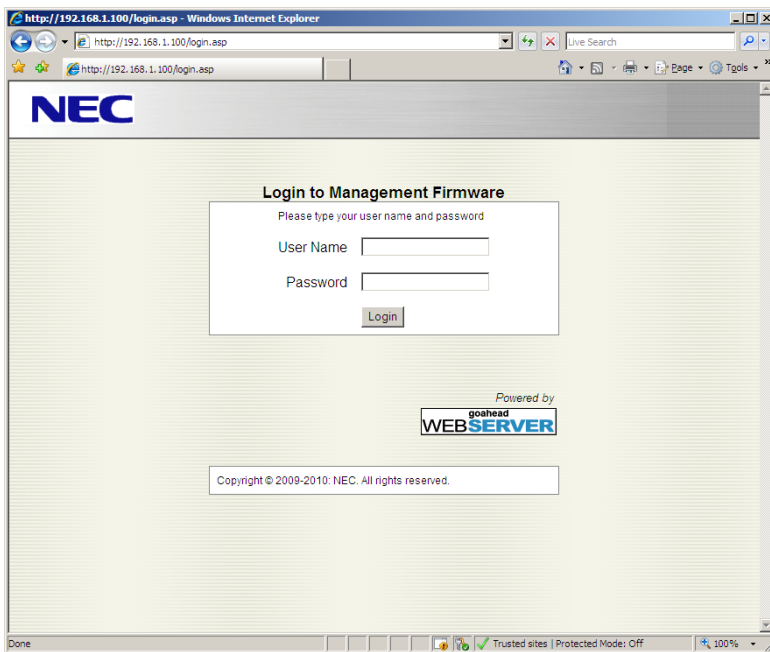
## **Tier-B : The Database Server**

### **Power up the database server, NEC Express5800/A1080a-E**

The System Console #1 is directly connected to the Management LAN port of the database server, NEC Express5800/A1080a-E. Following steps are executed on the System Console #1.

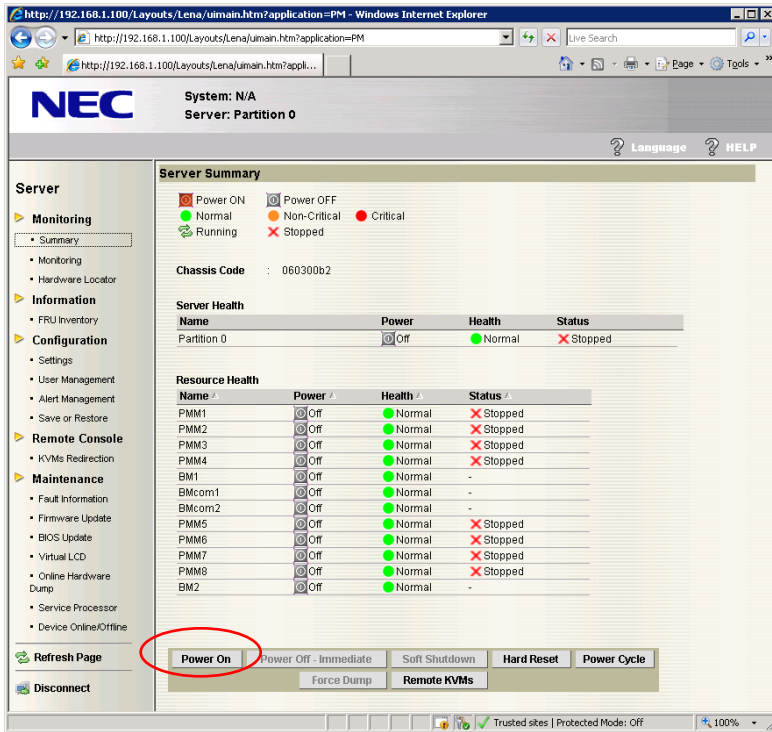
**Step.1:** Start up “Internet Explorer”.

**Step.2:** Enter “http://192.168.1.100/” as Address and log on to Management Firmware with User Name and Password.



(The IP address, User Name and Password of Management Firmware are to be provided by NEC.)

**Step.3:** Click “Power On”.



**Step.4:** Then the database server is booting up OS automatically.

## OS Installation

The database server has already had its OS, Microsoft® Windows Server® 2008 R2 Datacenter x64 Edition installed.

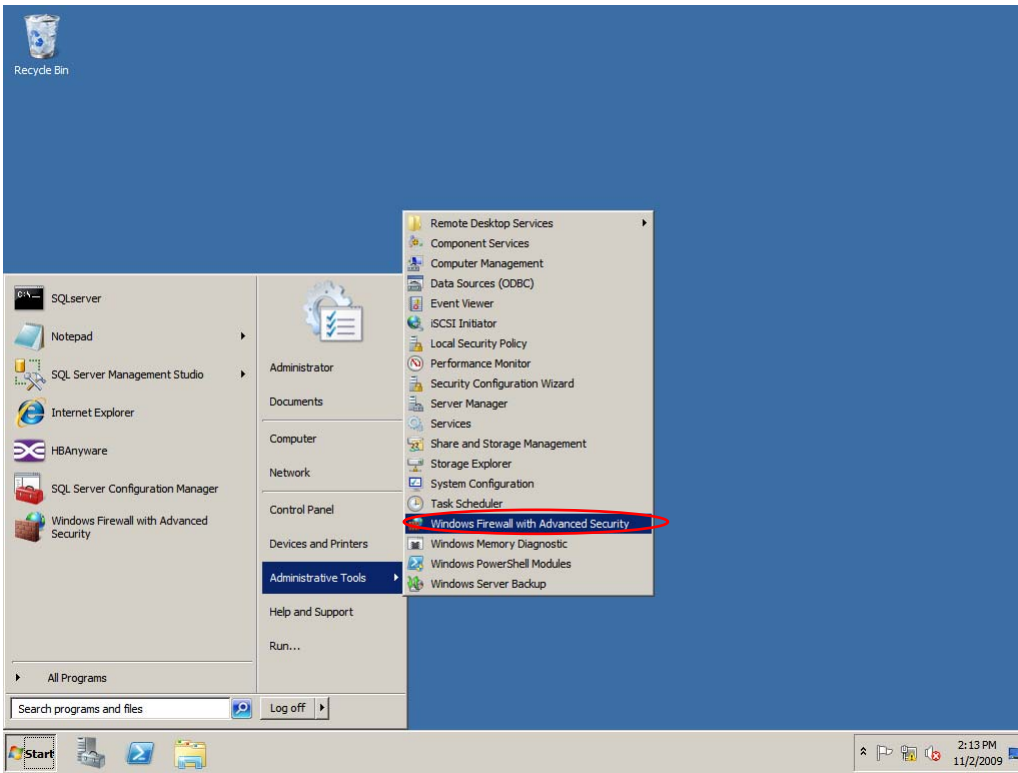
## OS Configuration

To configure the OS of the Database Server, follow the procedures below.

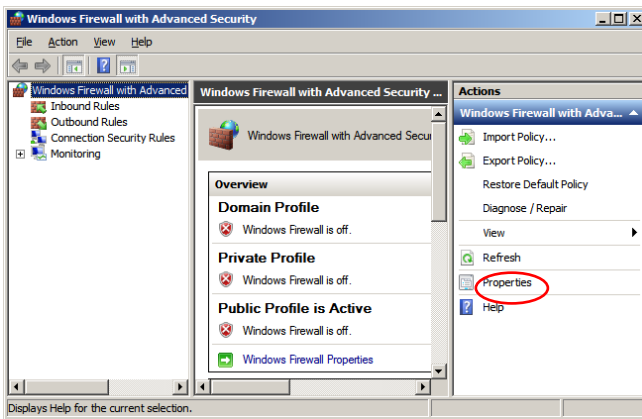
### Disable “Windows Firewall”

To connect the Database Server to the Clients, disable “Windows Firewall”.

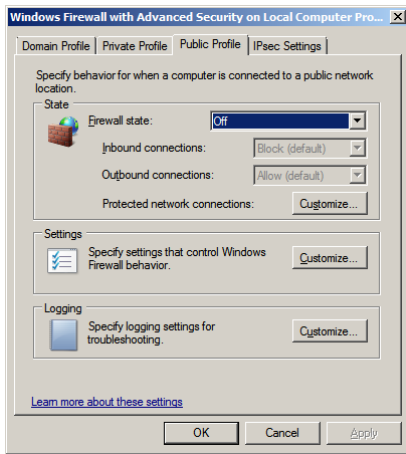
1. Launch “Administrator Tools” -> “Windows Firewall with Advanced Security”.



2. Click “Properties”.

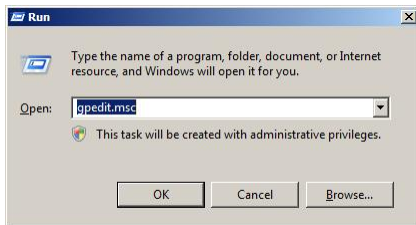


3. Change the “Firewall state” from On to Off.

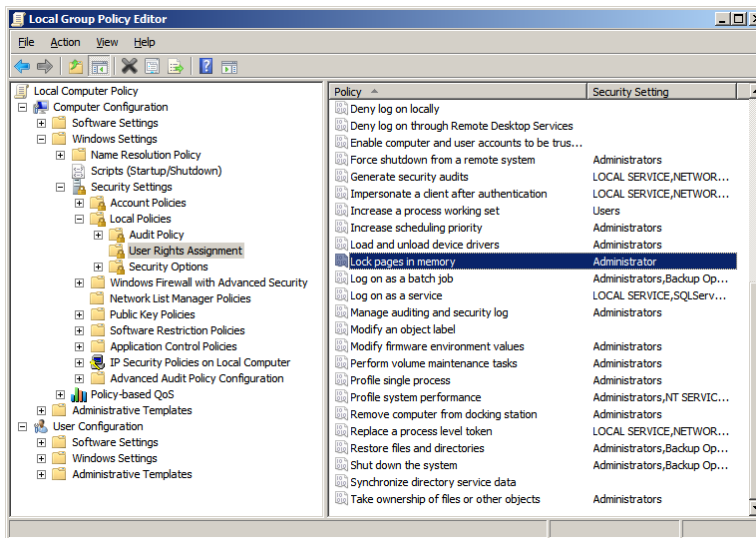


## Configure “Lock pages in memory”

1. Run configuration tool “gpedit.msc” from “Run...” of the Start menu.



2. Select “Local Computer Policy” -> “Computer configuration” -> “Windows Settings” -> “Security Settings” -> “Local Policies” -> “User Rights Assignment” in the left window.



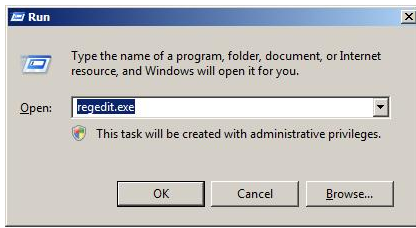
3. Double-click “Lock pages in memory” in the right window to open dialog, then add Administrator into this policy.
4. Logoff to reflect new configuration.

## Configure “Registry”

To enable “code in large page” configuration controlled by the OS, and add registry key. OS will load sqlbinary in large pages.



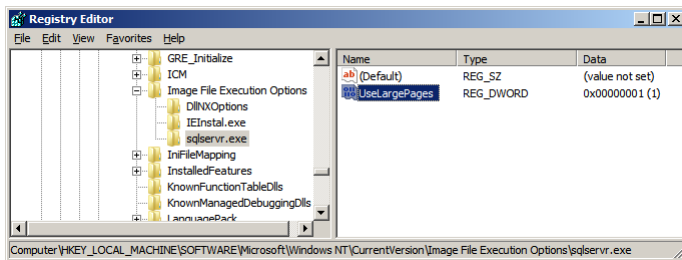
1. Start “regedit.exe” from “Run...” of the Start Menu.



2. Select “HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Image File Execution Options”
3. Add a key “sqlservr.exe” and select this key.
4. Right click it, then open menu.
5. And Select “New” -> “DWORD(32-bit) Value”.
6. Configure as follows.

Name: UseLargePages

Value: 1



7. Reboot OS to reflect new configuration.

### **Apply hotfix**

Download the hotfix at <http://support.microsoft.com/kb/975992> and apply it.

### **FC Switch Configuration for the Database Array**

Step by Step instruction is shown in SwitchSetup.doc (included in the Supporting Files).

### **RAID Configuration for the Database Array**

Step by Step instruction is shown in StorageSetup.doc (included in the Supporting Files).

### **Configure Partitions for Database Server**

#### ***Step.1: Create Partitions***

Use “Disk Management” to create partitions as shown sydiskmap\_[01..23].png (included in the Supporting Files).

#### ***Step.2: Create Junction Points***

Create junction points using mkmp.cmd (included in the Supporting Files).

### Step.3: Assign Mount Points

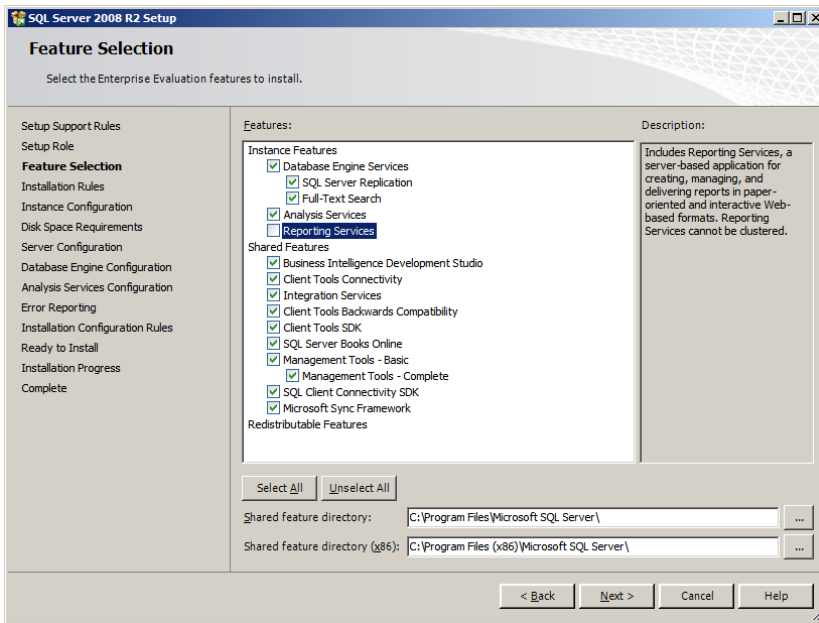
Assign mount points using diskpart command. Execute “diskpart /s mount.txt” from the command line. (the script file “mount.txt” is included in the Supporting Files).

## SQL Server® Installation

Install Microsoft® SQL Server® 2008 R2 Datacenter Edition. Here are the notes for the installation.

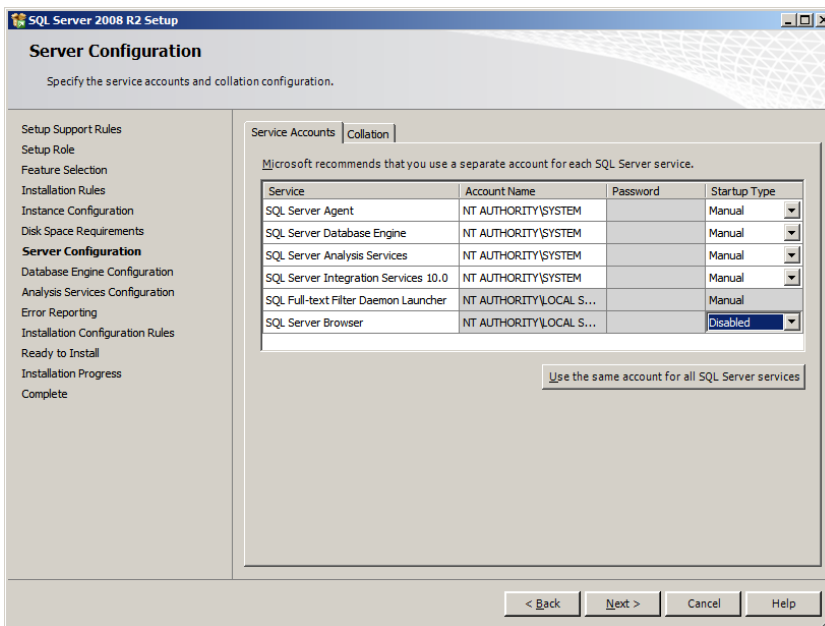
### Step.1: “Feature Selection”

Select Features as below.



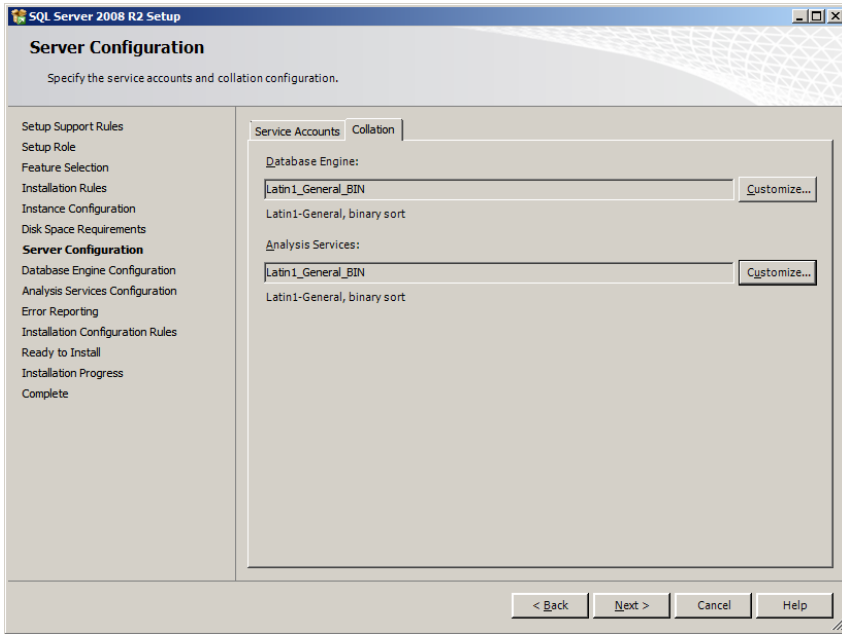
### Step.2: “Server Configuration”

Change the “Startup Type” from Automatic to Manual.



Select “Collation” tab.

Change the “Database Engine Collation” to Laten1\_General\_BIN.



## SQL Server® Configuration

### Step.1: Startup Parameter

Start Microsoft® SQL Server® 2008 R2 from the command line using startSQL.cmd (included in the Supporting Files).

### Step.2: sp\_configure

name	minimum	maximum	config_value	run_value
-----	-----	-----	-----	-----
access check cache bucket count	0	65536	0	0
access check cache quota	0	2147483647	0	0
Ad Hoc Distributed Queries	0	1	0	0
affinity I/O mask	-2147483648	2147483647	0	0
affinity mask	-2147483648	2147483647	-1	-1
affinity64 I/O mask	-2147483648	2147483647	0	0
affinity64 mask	-2147483648	2147483647	-1	-1
Agent XPs	0	1	1	1
allow updates	0	1	0	0
awe enabled	0	1	0	0
backup compression default	0	1	1	1
blocked process threshold (s)	0	86400	0	0
c2 audit mode	0	1	0	0
clr enabled	0	1	0	0
common criteria compliance enabled	0	1	0	0
cost threshold for parallelism	0	32767	5	5
cross db ownership chaining	0	1	0	0

cursor threshold	-1	2147483647	-1	-1
Database Mail XPs	0	1	0	0
default full-text language	0	2147483647	1033	1033
default language	0	9999	0	0
default trace enabled	0	1	0	0
disallow results from triggers	0	1	0	0
EKM provider enabled	0	1	0	0
filestream access level	0	2	0	0
fill factor (%)	0	100	0	0
ft crawl bandwidth (max)	0	32767	100	100
ft crawl bandwidth (min)	0	32767	0	0
ft notify bandwidth (max)	0	32767	100	100
ft notify bandwidth (min)	0	32767	0	0
in-doubt xact resolution	0	2	0	0
index create memory (KB)	704	2147483647	0	0
lightweight pooling	0	1	1	1
locks	5000	2147483647	0	0
max degree of parallelism	0	1024	1	1
max full-text crawl range	0	256	4	4
max server memory (MB)	16	2147483647	972800	972800
max text repl size (B)	-1	2147483647	65536	65536
max worker threads	128	32767	4096	4096
media retention	0	365	0	0
min memory per query (KB)	512	2147483647	1024	1024
min server memory (MB)	0	2147483647	0	16
nested triggers	0	1	1	1
network packet size (B)	512	32767	4096	4096
Ole Automation Procedures	0	1	0	0
open objects	0	2147483647	0	0
optimize for ad hoc workloads	0	1	0	0
PH timeout (s)	1	3600	60	60
precompute rank	0	1	0	0
priority boost	0	1	1	1
query governor cost limit	0	2147483647	0	0
query wait (s)	-1	2147483647	-1	-1
recovery interval (min)	0	32767	32767	32767
remote access	0	1	1	1
remote admin connections	0	1	0	0
remote login timeout (s)	0	2147483647	0	0
remote proc trans	0	1	0	0

remote query timeout (s)	0	2147483647	0	0
Replication XPs	0	1	0	0
scan for startup procs	0	1	0	0
server trigger recursion	0	1	1	1
set working set size	0	1	0	0
show advanced options	0	1	1	1
SMO and DMO XPs	0	1	1	1
SQL Mail XPs	0	1	0	0
transform noise words	0	1	0	0
two digit year cutoff	1753	9999	2049	2049
user connections	0	32767	0	0
user options	0	32767	0	0
xp_cmdshell	0	1	0	0

### **Step.3: Configure cpu affinity**

Run 128cpu-affinity.sql to configure the affinity of cpu (the sql file “128cpu-affinity.sql” is included in the Supporting Files).

### **Step.4: Configure tempdb**

Run tempdb.sql to increase the size of the temporary database (the sql file “tempdb.sql” is included in the Supporting Files).

### **Step.5: Configure softNUMA node**

1. Run “SoftNUMA-node-cpumask.reg” to add node keys and configure CPUmask for each node (the reg file “SoftNUMA-node-cpumask.reg” is included in the Supporting Files).
2. Run “SoftNUMA-ports.reg” to configure TCP/IP ports for softNUMA nodes (the reg file “SoftNUMA-ports.reg” is included in the Supporting Files).

## Clause 2 : Database Design, Scaling & Population Related Items

### Database Creation

*A description of the steps taken to create the database for the Reported Throughput must be reported in the Report. Any and all scripts or step by step GUI instructions are reported in the Supporting Files (see Clause 9.4.2). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of database software environments and the TPC-E specification could recreate the database.*

The database has been created for 1,650,000 customers. The SQL Server<sup>®</sup> scripts and setup command files are included in the Supporting Files\Clause2 folder. Three file groups are used for tables and indices. One filegroup called "growing\_fg" and one filegroup called "scaling\_fg" and the other filegroup called "fixed\_fg". "growing\_fg" uses all the Z:\Device\Growing\_\* disk partitions. "scaling\_fg" uses all the Z:\Device\Scaling\_\* disk partitions. "fixed\_fg" uses Z:\Device\Data\_01\TPCE\_Fixed.ndf. The database log uses the Z:\Device\TPCE\_Log partition.

### Table Organization

*The physical organization of tables and User-Defined Objects, within the database, must be reported in the Report.*

Physical space was allocated to Microsoft<sup>®</sup> SQL Server<sup>®</sup> 2008 R2 on the server disks as detailed in Table 2-2.

### Disclosure of Partitioning

*While few restrictions are placed upon horizontal or vertical partitioning of tables and rows in the TPC-E benchmark (see Clause 2.3.3), any such partitioning must be reported in the Report.*

Partitioning was not used on any tables in this benchmark.

### Replication of Tables

*Replication of tables, if used, must be reported in the Report (see Clause 2.3.4).*

No tables were replicated in this benchmark.

### Additional and/or Duplicated Attributes in any Table

*Additional and/or duplicated columns in any table must be reported in the Report along with a statement on the impact on performance (see Clause 2.3.5).*

No duplications or additional attributes were used in this benchmark.

### Initial Cardinality of Tables

*The cardinality (e.g. the number of rows) of each table, as it existed after database load (see Clause 2.6), must be reported in the Report.*

The TPC-E database was originally built with 1,650,000 customers.

**Table 2.1: Number of Rows for Server**

Table Name	Rows Loaded
<b>Scaling Tables</b>	
ACCOUNT PERMISSION	11,715,137
ADDRESS	2,475,004
BROKER	16,500
COMPANY	825,000

COMPANY COMPETITOR	2,475,000
CUSTOMER	1,650,000
CUSTOMER ACCOUNT	8,250,000
CUSTOMER TAXRATE	3,300,000
DAILY MARKET	1,474,976,250
FINANCIAL	16,500,000
LAST TRADE	1,130,250
NEWS ITEM	1,650,000
NEWS XREF	1,650,000
SECURITY	1,130,250
WATCH ITEM	164,968,526
WATCH LIST	1,650,000
<b>Growing Tables</b>	
CASH TRANSACTION	26,231,073,750
HOLDING	1,459,598,584
HOLDING HISTORY	38,210,947,095
HOLDING SUMMARY	82,049,088
SETTLEMENT	28,512,000,000
TRADE	28,512,000,000
TRADE HISTORY	68,428,832,164
TRADE REQUEST	0
<b>Fixed Tables</b>	
CHARGE	15
COMMISSION RATE	240
EXCHANGE	4
INDUSTRY	102
SECTOR	12
STATUS TYPE	5
TAX RATE	320
TRADE TYPE	5
ZIP CODE	14,741

## Distribution of Tables and Logs

*The distribution of tables, partitions and logs across all media must be explicitly depicted for the measured and Priced Configurations.*

Table 2.2 depicts the distribution of the database over the disks of the measured and priced system. Figure 1.1 shows the disk configuration for measured and priced system.

**Table 2.2: Data Distribution for the Measured and Priced Configuration**

Disk#	Controller #	HBA#	Drives Enclosure model RAID level	Partition Filesystem	Size	Use
0	internal	internal	2x300GB, 10K, SAS internal RAID1	System Reserve C: (NTFS)	100MB 278.78GB	OS
1	0	0-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_25\ (RAW) Z:\Device\Scaling_25\ (RAW)	190GB 10GB	Growing_25 Scaling_25
2	0		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_26\ (RAW) Z:\Device\Scaling_26\ (RAW)	190GB 10GB	Growing_26 Scaling_26
3	1		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_27\ (RAW) Z:\Device\Scaling_27\ (RAW)	190GB 10GB	Growing_27 Scaling_27
4	1		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_28\ (RAW) Z:\Device\Scaling_28\ (RAW)	190GB 10GB	Growing_28 Scaling_28
5	2		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_31\ (RAW) Z:\Device\Scaling_31\ (RAW)	190GB 10GB	Growing_31 Scaling_31
6	2		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_32\ (RAW) Z:\Device\Scaling_32\ (RAW)	190GB 10GB	Growing_32 Scaling_32
7	3		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_35\ (RAW) Z:\Device\Scaling_35\ (RAW)	190GB 10GB	Growing_35 Scaling_35
8	3		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_36\ (RAW) Z:\Device\Scaling_36\ (RAW)	190GB 10GB	Growing_36 Scaling_36
9	4		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_33\ (RAW) Z:\Device\Scaling_33\ (RAW)	190GB 10GB	Growing_33 Scaling_33
10	4		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_34\ (RAW) Z:\Device\Scaling_34\ (RAW)	190GB 10GB	Growing_34 Scaling_34
11	5		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_29\ (RAW) Z:\Device\Scaling_29\ (RAW)	190GB 10GB	Growing_29 Scaling_29
12	5		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_30\ (RAW) Z:\Device\Scaling_30\ (RAW)	190GB 10GB	Growing_30 Scaling_30



**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

13	6	0-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_11\ (RAW) Z:\Device\Scaling_11\ (RAW) Z:\Device\TPCE_TempDB\ (NTFS)	190GB 10GB 598GB	Growing_11 Scaling_11 tempdb.mdf
14	6		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_12\ (RAW) Z:\Device\Scaling_12\ (RAW)	190GB 10GB	Growing_12 Scaling_12
15	7		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_07\ (RAW) Z:\Device\Scaling_07\ (RAW)	190GB 10GB	Growing_07 Scaling_07
16	7		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_08\ (RAW) Z:\Device\Scaling_08\ (RAW)	190GB 10GB	Growing_08 Scaling_08
17	8		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_03\ (RAW) Z:\Device\Scaling_03\ (RAW)	190GB 10GB	Growing_03 Scaling_03
18	8		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_04\ (RAW) Z:\Device\Scaling_04\ (RAW)	190GB 10GB	Growing_04 Scaling_04
19	9		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_01\ (RAW) Z:\Device\Scaling_01\ (RAW) Z:\Device\Data_01\ (NTFS)	190GB 10GB 598GB	Growing_01 Scaling_01 TPCE_Misc.ndf
20	9		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_02\ (RAW) Z:\Device\Scaling_02\ (RAW)	190GB 10GB	Growing_02 Scaling_02
21	10		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_05\ (RAW) Z:\Device\Scaling_05\ (RAW)	190GB 10GB	Growing_05 Scaling_05
22	10		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_06\ (RAW) Z:\Device\Scaling_06\ (RAW)	190GB 10GB	Growing_06 Scaling_06
23	11		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_09\ (RAW) Z:\Device\Scaling_09\ (RAW)	190GB 10GB	Growing_09 Scaling_09
24	11		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_10\ (RAW) Z:\Device\Scaling_10\ (RAW)	190GB 10GB	Growing_10 Scaling_10

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

25	12	1-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_13\ (RAW) Z:\Device\Scaling_13\ (RAW)	190GB 10GB	Growing_13 Scaling_13
26	12		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_14\ (RAW) Z:\Device\Scaling_14\ (RAW)	190GB 10GB	Growing_14 Scaling_14
27	13		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_15\ (RAW) Z:\Device\Scaling_15\ (RAW)	190GB 10GB	Growing_15 Scaling_15
28	13		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_16\ (RAW) Z:\Device\Scaling_16\ (RAW)	190GB 10GB	Growing_16 Scaling_16
29	14		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_21\ (RAW) Z:\Device\Scaling_21\ (RAW) Z:\Device\TPCE_TempLog\ (NTFS)	190GB 10GB 598GB	Growing_21 Scaling_21 templog.ldf
30	14		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_22\ (RAW) Z:\Device\Scaling_22\ (RAW)	190GB 10GB	Growing_22 Scaling_22
31	15		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_19\ (RAW) Z:\Device\Scaling_19\ (RAW)	190GB 10GB	Growing_19 Scaling_19
32	15		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_20\ (RAW) Z:\Device\Scaling_20\ (RAW)	190GB 10GB	Growing_20 Scaling_20
33	16		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_23\ (RAW) Z:\Device\Scaling_23\ (RAW)	190GB 10GB	Growing_23 Scaling_23
34	16		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_24\ (RAW) Z:\Device\Scaling_24\ (RAW)	190GB 10GB	Growing_24 Scaling_24
35	17		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_17\ (RAW) Z:\Device\Scaling_17\ (RAW)	190GB 10GB	Growing_17 Scaling_17
36	17		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_18\ (RAW) Z:\Device\Scaling_18\ (RAW)	190GB 10GB	Growing_18 Scaling_18

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

37	18	1-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_67\ (RAW) Z:\Device\Scaling_67\ (RAW) Z:\Device\Backup_67\ (NTFS)	190GB 10GB 598GB	Growing_67 Scaling_67 Backup_67
38	18		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_68\ (RAW) Z:\Device\Scaling_68\ (RAW) Z:\Device\Backup_68\ (NTFS)	190GB 10GB 598GB	Growing_68 Scaling_68 Backup_68
39	19		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_65\ (RAW) Z:\Device\Scaling_65\ (RAW) Z:\Device\Backup_65\ (NTFS)	190GB 10GB 598GB	Growing_65 Scaling_65 Backup_65
40	19		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_66\ (RAW) Z:\Device\Scaling_66\ (RAW) Z:\Device\Backup_66\ (NTFS)	190GB 10GB 598GB	Growing_66 Scaling_66 Backup_66
41	20		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_57\ (RAW) Z:\Device\Scaling_57\ (RAW) Z:\Device\Backup_57\ (NTFS)	190GB 10GB 598GB	Growing_57 Scaling_57 Backup_57
42	20		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_58\ (RAW) Z:\Device\Scaling_58\ (RAW) Z:\Device\Backup_58\ (NTFS)	190GB 10GB 598GB	Growing_58 Scaling_58 Backup_58
43	21		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_63\ (RAW) Z:\Device\Scaling_63\ (RAW) Z:\Device\Backup_63\ (NTFS)	190GB 10GB 598GB	Growing_63 Scaling_63 Backup_63
44	21		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_64\ (RAW) Z:\Device\Scaling_64\ (RAW) Z:\Device\Backup_64\ (NTFS)	190GB 10GB 598GB	Growing_64 Scaling_64 Backup_64
45	22		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_59\ (RAW) Z:\Device\Scaling_59\ (RAW) Z:\Device\Backup_59\ (NTFS)	190GB 10GB 598GB	Growing_59 Scaling_59 Backup_59
46	22		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_60\ (RAW) Z:\Device\Scaling_60\ (RAW) Z:\Device\Backup_60\ (NTFS)	190GB 10GB 598GB	Growing_60 Scaling_60 Backup_60
47	23		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_61\ (RAW) Z:\Device\Scaling_61\ (RAW) Z:\Device\Backup_61\ (NTFS)	190GB 10GB 598GB	Growing_61 Scaling_61 Backup_61
48	23		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_62\ (RAW) Z:\Device\Scaling_62\ (RAW) Z:\Device\Backup_62\ (NTFS)	190GB 10GB 598GB	Growing_62 Scaling_62 Backup_62

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

49	24	2-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_69\ (RAW) Z:\Device\Scaling_69\ (RAW) Z:\Device\Backup_69\ (NTFS)	190GB 10GB 598GB	Growing_69 Scaling_69 Backup_69
50	24		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_70\ (RAW) Z:\Device\Scaling_70\ (RAW) Z:\Device\Backup_70\ (NTFS)	190GB 10GB 598GB	Growing_70 Scaling_70 Backup_70
51	25		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_71\ (RAW) Z:\Device\Scaling_71\ (RAW) Z:\Device\Backup_71\ (NTFS)	190GB 10GB 598GB	Growing_71 Scaling_71 Backup_71
52	25		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_72\ (RAW) Z:\Device\Scaling_72\ (RAW) Z:\Device\Backup_72\ (NTFS)	190GB 10GB 598GB	Growing_72 Scaling_72 Backup_72
53	26		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_73\ (RAW) Z:\Device\Scaling_73\ (RAW) Z:\Device\Backup_73\ (NTFS)	190GB 10GB 598GB	Growing_73 Scaling_73 Backup_73
54	26		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_74\ (RAW) Z:\Device\Scaling_74\ (RAW) Z:\Device\Backup_74\ (NTFS)	190GB 10GB 598GB	Growing_74 Scaling_74 Backup_74
55	27		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_77\ (RAW) Z:\Device\Scaling_77\ (RAW) Z:\Device\Backup_77\ (NTFS)	190GB 10GB 598GB	Growing_77 Scaling_77 Backup_77
56	27		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_78\ (RAW) Z:\Device\Scaling_78\ (RAW) Z:\Device\Backup_78\ (NTFS)	190GB 10GB 598GB	Growing_78 Scaling_78 Backup_78
57	28		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_75\ (RAW) Z:\Device\Scaling_75\ (RAW) Z:\Device\Backup_75\ (NTFS)	190GB 10GB 598GB	Growing_75 Scaling_75 Backup_75
58	28		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_76\ (RAW) Z:\Device\Scaling_76\ (RAW) Z:\Device\Backup_76\ (NTFS)	190GB 10GB 598GB	Growing_76 Scaling_76 Backup_76
59	29		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_79\ (RAW) Z:\Device\Scaling_79\ (RAW) Z:\Device\Backup_79\ (NTFS)	190GB 10GB 598GB	Growing_79 Scaling_79 Backup_79
60	29		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_80\ (RAW) Z:\Device\Scaling_80\ (RAW) Z:\Device\Backup_80\ (NTFS)	190GB 10GB 598GB	Growing_80 Scaling_80 Backup_80

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

61	30	2-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_43\ (RAW) Z:\Device\Scaling_43\ (RAW) Z:\Device\Backup_43\ (NTFS)	190GB 10GB 598GB	Growing_43 Scaling_43 Backup_43
62	30		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_44\ (RAW) Z:\Device\Scaling_44\ (RAW) Z:\Device\Backup_44\ (NTFS)	190GB 10GB 598GB	Growing_44 Scaling_44 Backup_44
63	31		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_47\ (RAW) Z:\Device\Scaling_47\ (RAW) Z:\Device\Backup_47\ (NTFS)	190GB 10GB 598GB	Growing_47 Scaling_47 Backup_47
64	31		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_48\ (RAW) Z:\Device\Scaling_48\ (RAW) Z:\Device\Backup_48\ (NTFS)	190GB 10GB 598GB	Growing_48 Scaling_48 Backup_48
65	32		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_37\ (RAW) Z:\Device\Scaling_37\ (RAW)	190GB 10GB	Growing_37 Scaling_37
66	32		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_38\ (RAW) Z:\Device\Scaling_38\ (RAW)	190GB 10GB	Growing_38 Scaling_38
67	33		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_41\ (RAW) Z:\Device\Scaling_41\ (RAW) Z:\Device\Backup_41\ (NTFS)	190GB 10GB 598GB	Growing_41 Scaling_41 Backup_41
68	33		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_42\ (RAW) Z:\Device\Scaling_42\ (RAW) Z:\Device\Backup_42\ (NTFS)	190GB 10GB 598GB	Growing_42 Scaling_42 Backup_42
69	34		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_39\ (RAW) Z:\Device\Scaling_39\ (RAW)	190GB 10GB	Growing_39 Scaling_39
70	34		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_40\ (RAW) Z:\Device\Scaling_40\ (RAW)	190GB 10GB	Growing_40 Scaling_40
71	35		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_45\ (RAW) Z:\Device\Scaling_45\ (RAW) Z:\Device\Backup_45\ (NTFS)	190GB 10GB 598GB	Growing_45 Scaling_45 Backup_45
72	35		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_46\ (RAW) Z:\Device\Scaling_46\ (RAW) Z:\Device\Backup_46\ (NTFS)	190GB 10GB 598GB	Growing_46 Scaling_46 Backup_46

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

73	36	3-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_53\ (RAW) Z:\Device\Scaling_53\ (RAW) Z:\Device\Backup_53\ (NTFS)	190GB 10GB 598GB	Growing_53 Scaling_53 Backup_53
74	36		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_54\ (RAW) Z:\Device\Scaling_54\ (RAW) Z:\Device\Backup_54\ (NTFS)	190GB 10GB 598GB	Growing_54 Scaling_54 Backup_54
75	37		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_55\ (RAW) Z:\Device\Scaling_55\ (RAW) Z:\Device\Backup_55\ (NTFS)	190GB 10GB 598GB	Growing_55 Scaling_55 Backup_55
76	37		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_56\ (RAW) Z:\Device\Scaling_56\ (RAW) Z:\Device\Backup_56\ (NTFS)	190GB 10GB 598GB	Growing_56 Scaling_56 Backup_56
77	38		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_81\ (RAW) Z:\Device\Scaling_81\ (RAW)	190GB 10GB	Growing_81 Scaling_81
78	38		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_82\ (RAW) Z:\Device\Scaling_82\ (RAW)	190GB 10GB	Growing_82 Scaling_82
79	39		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_83\ (RAW) Z:\Device\Scaling_83\ (RAW)	190GB 10GB	Growing_83 Scaling_83
80	39		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_84\ (RAW) Z:\Device\Scaling_84\ (RAW)	190GB 10GB	Growing_84 Scaling_84
81	40		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_93\ (RAW) Z:\Device\Scaling_93\ (RAW)	190GB 10GB	Growing_93 Scaling_93
82	40		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_94\ (RAW) Z:\Device\Scaling_94\ (RAW)	190GB 10GB	Growing_94 Scaling_94
83	41		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_91\ (RAW) Z:\Device\Scaling_91\ (RAW)	190GB 10GB	Growing_91 Scaling_91
84	41		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_92\ (RAW) Z:\Device\Scaling_92\ (RAW)	190GB 10GB	Growing_92 Scaling_92

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

85	42	3-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_97\ (RAW) Z:\Device\Scaling_97\ (RAW)	190GB 10GB	Growing_97 Scaling_97
86	42		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_98\ (RAW) Z:\Device\Scaling_98\ (RAW)	190GB 10GB	Growing_98 Scaling_98
87	43		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_86\ (RAW) Z:\Device\Scaling_86\ (RAW)	190GB 10GB	Growing_86 Scaling_86
88	43		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_87\ (RAW) Z:\Device\Scaling_87\ (RAW)	190GB 10GB	Growing_87 Scaling_87
89	44		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_99\ (RAW) Z:\Device\Scaling_99\ (RAW)	190GB 10GB	Growing_99 Scaling_99
90	44		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_85\ (RAW) Z:\Device\Scaling_85\ (RAW)	190GB 10GB	Growing_85 Scaling_85
91	45		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_88\ (RAW) Z:\Device\Scaling_88\ (RAW)	190GB 10GB	Growing_88 Scaling_88
92	45		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_89\ (RAW) Z:\Device\Scaling_89\ (RAW)	190GB 10GB	Growing_89 Scaling_89
93	46		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_96\ (RAW) Z:\Device\Scaling_96\ (RAW)	190GB 10GB	Growing_96 Scaling_96
94	46		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_100\ (RAW) Z:\Device\Scaling_100\ (RAW)	190GB 10GB	Growing_100 Scaling_100
95	47		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_101\ (RAW) Z:\Device\Scaling_101\ (RAW)	190GB 10GB	Growing_101 Scaling_101
96	47		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_102\ (RAW) Z:\Device\Scaling_102\ (RAW)	190GB 10GB	Growing_102 Scaling_102

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

97	48	4-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_103\ (RAW) Z:\Device\Scaling_103\ (RAW)	190GB 10GB	Growing_103 Scaling_103
98	48		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_104\ (RAW) Z:\Device\Scaling_104\ (RAW)	190GB 10GB	Growing_104 Scaling_104
99	49		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_90\ (RAW) Z:\Device\Scaling_90\ (RAW)	190GB 10GB	Growing_90 Scaling_90
100	49		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_95\ (RAW) Z:\Device\Scaling_95\ (RAW)	190GB 10GB	Growing_95 Scaling_95
101	50		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_105\ (RAW) Z:\Device\Scaling_105\ (RAW)	190GB 10GB	Growing_105 Scaling_105
102	50		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_106\ (RAW) Z:\Device\Scaling_106\ (RAW)	190GB 10GB	Growing_106 Scaling_106
103	51		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_107\ (RAW) Z:\Device\Scaling_107\ (RAW)	190GB 10GB	Growing_107 Scaling_107
104	51		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_108\ (RAW) Z:\Device\Scaling_108\ (RAW)	190GB 10GB	Growing_108 Scaling_108
105	52		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_109\ (RAW) Z:\Device\Scaling_109\ (RAW)	190GB 10GB	Growing_109 Scaling_109
106	52		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_110\ (RAW) Z:\Device\Scaling_110\ (RAW)	190GB 10GB	Growing_110 Scaling_110
107	53		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_111\ (RAW) Z:\Device\Scaling_111\ (RAW)	190GB 10GB	Growing_111 Scaling_111
108	53		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_112\ (RAW) Z:\Device\Scaling_112\ (RAW)	190GB 10GB	Growing_112 Scaling_112



**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

109	54	4-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_113\ (RAW) Z:\Device\Scaling_113\ (RAW)	190GB 10GB	Growing_113 Scaling_113
110	54		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_114\ (RAW) Z:\Device\Scaling_114\ (RAW)	190GB 10GB	Growing_114 Scaling_114
111	55		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_115\ (RAW) Z:\Device\Scaling_115\ (RAW)	190GB 10GB	Growing_115 Scaling_115
112	55		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_116\ (RAW) Z:\Device\Scaling_116\ (RAW)	190GB 10GB	Growing_116 Scaling_116
113	56		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_117\ (RAW) Z:\Device\Scaling_117\ (RAW)	190GB 10GB	Growing_117 Scaling_117
114	56		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_118\ (RAW) Z:\Device\Scaling_118\ (RAW)	190GB 10GB	Growing_118 Scaling_118
115	57		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_119\ (RAW) Z:\Device\Scaling_119\ (RAW)	190GB 10GB	Growing_119 Scaling_119
116	57		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_120\ (RAW) Z:\Device\Scaling_120\ (RAW)	190GB 10GB	Growing_120 Scaling_120
117	58		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_121\ (RAW) Z:\Device\Scaling_121\ (RAW)	190GB 10GB	Growing_121 Scaling_121
118	58		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_122\ (RAW) Z:\Device\Scaling_122\ (RAW)	190GB 10GB	Growing_122 Scaling_122
119	59		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_123\ (RAW) Z:\Device\Scaling_123\ (RAW)	190GB 10GB	Growing_123 Scaling_123
120	59		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_124\ (RAW) Z:\Device\Scaling_124\ (RAW)	190GB 10GB	Growing_124 Scaling_124

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

121	60	5-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_125\ (RAW) Z:\Device\Scaling_125\ (RAW)	190GB 10GB	Growing_125 Scaling_125
122	60		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_126\ (RAW) Z:\Device\Scaling_126\ (RAW)	190GB 10GB	Growing_126 Scaling_126
123	61		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_127\ (RAW) Z:\Device\Scaling_127\ (RAW)	190GB 10GB	Growing_127 Scaling_127
124	61		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_128\ (RAW) Z:\Device\Scaling_128\ (RAW)	190GB 10GB	Growing_128 Scaling_128
125	62		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_129\ (RAW) Z:\Device\Scaling_129\ (RAW)	190GB 10GB	Growing_129 Scaling_129
126	62		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_130\ (RAW) Z:\Device\Scaling_130\ (RAW)	190GB 10GB	Growing_130 Scaling_130
127	63		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_131\ (RAW) Z:\Device\Scaling_131\ (RAW)	190GB 10GB	Growing_131 Scaling_131
128	63		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_132\ (RAW) Z:\Device\Scaling_132\ (RAW)	190GB 10GB	Growing_132 Scaling_132
129	64		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_143\ (RAW) Z:\Device\Scaling_143\ (RAW)	190GB 10GB	Growing_143 Scaling_143
130	64		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_144\ (RAW) Z:\Device\Scaling_144\ (RAW)	190GB 10GB	Growing_144 Scaling_144
131	65		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_133\ (RAW) Z:\Device\Scaling_133\ (RAW)	190GB 10GB	Growing_133 Scaling_133
132	65		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_134\ (RAW) Z:\Device\Scaling_134\ (RAW)	190GB 10GB	Growing_134 Scaling_134

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

133	66	5-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_135\ (RAW) Z:\Device\Scaling_135\ (RAW)	190GB 10GB	Growing_135 Scaling_135
134	66		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_136\ (RAW) Z:\Device\Scaling_136\ (RAW)	190GB 10GB	Growing_136 Scaling_136
135	67		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_137\ (RAW) Z:\Device\Scaling_137\ (RAW)	190GB 10GB	Growing_137 Scaling_137
136	67		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_138\ (RAW) Z:\Device\Scaling_138\ (RAW)	190GB 10GB	Growing_138 Scaling_138
137	68		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_139\ (RAW) Z:\Device\Scaling_139\ (RAW)	190GB 10GB	Growing_139 Scaling_139
138	68		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_140\ (RAW) Z:\Device\Scaling_140\ (RAW)	190GB 10GB	Growing_140 Scaling_140
139	69		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_141\ (RAW) Z:\Device\Scaling_141\ (RAW)	190GB 10GB	Growing_141 Scaling_141
140	69		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_142\ (RAW) Z:\Device\Scaling_142\ (RAW)	190GB 10GB	Growing_142 Scaling_142
141	70		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_145\ (RAW) Z:\Device\Scaling_145\ (RAW)	190GB 10GB	Growing_145 Scaling_145
142	70		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_146\ (RAW) Z:\Device\Scaling_146\ (RAW)	190GB 10GB	Growing_146 Scaling_146
143	71		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_147\ (RAW) Z:\Device\Scaling_147\ (RAW)	190GB 10GB	Growing_147 Scaling_147
144	71		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_148\ (RAW) Z:\Device\Scaling_148\ (RAW)	190GB 10GB	Growing_148 Scaling_148

**Table 2.2: Data Distribution for the Measured and Priced Configuration (Cont)**

145	72	6-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_149\ (RAW) Z:\Device\Scaling_149\ (RAW)	190GB 10GB	Growing_149 Scaling_149
146	72		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_150\ (RAW) Z:\Device\Scaling_150\ (RAW)	190GB 10GB	Growing_150 Scaling_150
147	73		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_151\ (RAW) Z:\Device\Scaling_151\ (RAW)	190GB 10GB	Growing_151 Scaling_151
148	73		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_152\ (RAW) Z:\Device\Scaling_152\ (RAW)	190GB 10GB	Growing_152 Scaling_152
149	74		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_153\ (RAW) Z:\Device\Scaling_153\ (RAW)	190GB 10GB	Growing_153 Scaling_153
150	74		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_154\ (RAW) Z:\Device\Scaling_154\ (RAW)	190GB 10GB	Growing_154 Scaling_154
151	75		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_155\ (RAW) Z:\Device\Scaling_155\ (RAW)	190GB 10GB	Growing_155 Scaling_155
152	75		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_156\ (RAW) Z:\Device\Scaling_156\ (RAW)	190GB 10GB	Growing_156 Scaling_156
154	76		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_49\ (RAW) Z:\Device\Scaling_49\ (RAW) Z:\Device\Backup_49\ (NTFS)	190GB 10GB 598GB	Growing_49 Scaling_49 Backup_49
155	76		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_50\ (RAW) Z:\Device\Scaling_50\ (RAW) Z:\Device\Backup_50\ (NTFS)	190GB 10GB 598GB	Growing_50 Scaling_50 Backup_50
156	77		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Growing_51\ (RAW) Z:\Device\Scaling_51\ (RAW) Z:\Device\Backup_51\ (NTFS)	190GB 10GB 598GB	Growing_51 Scaling_51 Backup_51
157	77		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Growing_52\ (RAW) Z:\Device\Scaling_52\ (RAW) Z:\Device\Backup_52\ (NTFS)	190GB 10GB 598GB	Growing_52 Scaling_52 Backup_52
153	78		6-1	12x300GB, 15K, SAS D3-10 Base model RAID50 8x300GB, 15K, SAS D3-10 Disk Enclosure RAID50	Z: (NTFS) Z:\Device\TPCE_Log\ (RAW)	10GB 800GB

## Type of Database

*A statement must be provided in the Report that describes:*

- *The Database Interface (e.g., embedded, call level) and access language (e.g., SQL, COBOL read/write) used to implement the TPC-E Transactions. If more than one interface / access language is used to implement TPC-E, each interface / access language must be described and a list of which interface /access language is used with which Transaction type must be reported.*
- *The data model implemented by the DBMS (e.g., relational, network, hierarchical).*
- *The methodology used to load the database must be reported.*

Microsoft® SQL Server® 2008 R2, a relational database, was used in this benchmark. Microsoft® SQL Server® 2008 R2 stored procedures were used and invoked through library function calls embedded in C++ code.

The methodology used to load the database used the flat files option on the EGenLoader command line. This generates flat files then a bulk insert of the data into the tables. For a more detailed description, refer to MSTPCE Database Setup Reference.pdf (included in the Supporting Files).

## Clause 3 : Transaction Related Items

### Vendor-Supplied Code

*A statement that vendor-supplied code is functionally equivalent to Pseudo-code in the specification (see Clause 3.2.1.6) must be reported in the Report.*

The vendor-supplied code is functionally equivalent to the Pseudo-code.

### Database Footprint Requirements

*A statement that the database footprint requirements (as described in Clause 3.3) were met must be reported in the Report.*

The database footprint requirements were met.

## Clause 4: SUT, Driver, and Network Related Items

### Network configurations and Driver system

*The Network configurations of both the measured and Priced Configurations must be described and reported in the Report. This includes the mandatory Network between the Driver and Tier A (see Clause 4.2.2) and any optional Database Server interface networks (see Clause 4.1.3.12).*

There is no difference between the measured and priced configurations in the network configuration. The network configuration of the measured configuration is provided as Figure 1.1 and 1.6.

## Clause 5: EGen Related Items

### **EGen Version**

*The version of EGen used in the benchmark must be reported in the Report (see Clause 5.3.1).*

EGen v1.9.0 was used in this benchmark.

### **EGen Code**

*A statement that all required TPC-provided EGen code was used in the benchmark must be reported in the Report.*

All required TPC-provided EGen code was used in this benchmark.

### **EGen Modifications**

*If the Test Sponsor modified EGen, a statement EGen has been modified must be reported in the Report. All formal waivers from the TPC documenting the allowed changes to EGen must also be reported in the Report (see Clause 5.3.7.1). If any of the changes to EGen do not have a formal waiver that must also be reported in the Report.*

EGen has not been modified in this benchmark.

### **EGenLoader Extensions**

*If the Test Sponsor extended EGenLoader (as described in Appendix A.6), the use of the extended EGenLoader and the audit of the extension code by an Auditor must be reported in the Report (see Clause 5.7.4).*

No extensions were made to the EGenLoader for this benchmark.



# Clause 6 : Performance Metrics and Response Time Related Items

## EGenDriver Items

The number of EGenDriverMEE and EGenDriverCE instances used in the benchmark must be reported in the Report (see Clause 6.2.5).

The number of EGenDriverMEE instances is thirty-two. The number of EGenDriverCE instances is thirty-two.

## Measured Throughput

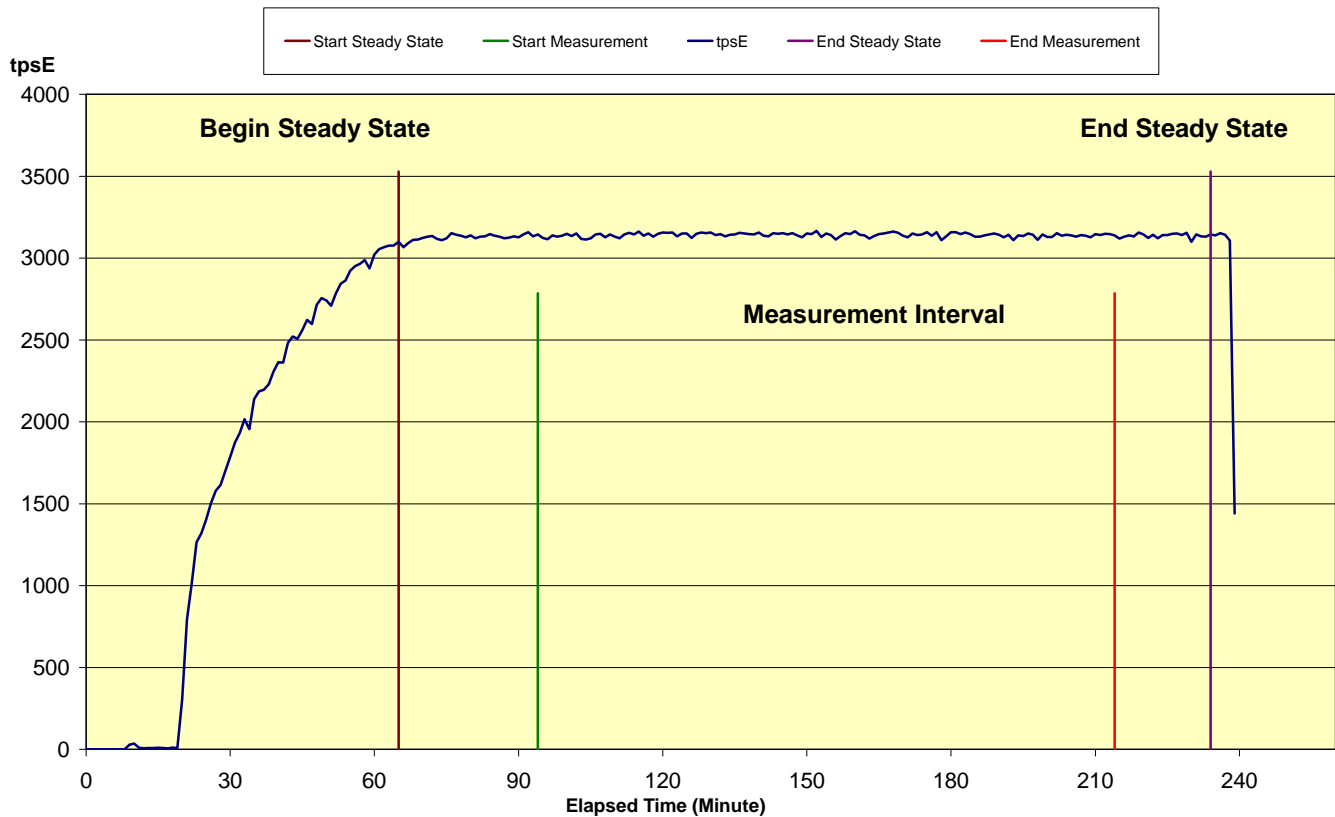
The Measured Throughput must be reported in the Report (see Clause 6.7.1.2).

**Measured tpsE**  
**3,141.76 tpsE**

## Trade-Result Throughput vs. Elapsed Wall Clock Time

A Test Run Graph of throughput versus elapsed wall clock time must be reported in the Report for the Trade-Result Transaction (see Clause 6.7.2).

**Figure 6.1: Test Run Graph**



## Steady State

The method used to determine that the SUT had reached a Steady State prior to commencing the Measurement Interval must be reported in the Report.

During the run, observation of the tpsE as the benchmark ran was used to determine steady state. After the run steady state was confirmed by:

1. Looked at the Test Run Graph and verified that tpsE was steady prior to commencing the Measurement Interval.
2. Calculated 60 minute average tpsE during the Steady State moving the time window 10 minutes each time. Then confirmed that the minimum 60 minute average tpsE was not less than 98% of the Reported Throughput, and that the maximum 60 minute average tpsE was not greater than 102% of the Reported Throughput.
3. Calculated 10 minute average tpsE during the Steady State moving the window 1 minute each time. Then confirmed that the minimum 10 minute average tpsE was not less than 80% of the Reported Throughput, and that the maximum 10 minute average tpsE was not greater than 120% of the Reported Throughput.

## Work Performed During Steady State

*A description of how the work normally performed during a Test Run, actually occurred during the Measurement Interval must be reported in the Report (for example checkpointing, writing Undo/Redo Log records, etc.).*

A checkpoint in Microsoft® SQL Server® 2008 R2 wrote to disk all updated memory pages that had not been yet actually written to disk. SQL Server® 2008 R2 recovery interval parameter was set to the maximum allowable value to perform checkpoint at specific intervals. Checkpoints were issued at specified duration (420 seconds) and specified intervals (448 seconds).

## Transaction Averages

*The recorded averages over the Measurement Interval for each of the Transaction input parameters specified by clause 6.4.1 must be reported in the Report.*

Table 6.1: Transaction Averages

Input Parameter	Value	Actual Pct	Required Range
<b>Customer-Position</b>			
by_tax_id	1	50.00%	48% to 52%
get_history	1	50.02%	48% to 52%
<b>Market-Watch</b>			
Securities chosen by	Watch list	60.00%	57% to 63%
	Account ID	35.00%	33% to 37%
	Industry	5.00%	4.5% to 5.5%
<b>Security-Detail</b>			
access_lob	1	1.00%	0.9% to 1.1%
<b>Trade-Lookup</b>			
frame_to_execute	1	30.00%	28.5% to 31.5%
	2	29.99%	28.5% to 31.5%
	3	30.01%	28.5% to 31.5%
	4	10.00%	9.5% to 10.5%
<b>Trade-Order</b>			
Transactions requested by a third party		10.00%	9.5% to 10.5%
Security chosen by company name and issue		39.99%	38% to 42%
type_is_margin	1	8.00%	7.5% to 8.5%
roll_it_back	1	0.99%	0.94% to 1.04%
is_lifo	1	34.97%	33% to 37%
trade_qty	100	24.99%	24% to 26%
	200	24.99%	24% to 26%
	400	25.01%	24% to 26%
	800	25.01%	24% to 26%
trade_type	TMB	30.00%	29.7% to 30.3%
	TMS	30.00%	29.7% to 30.3%
	TLB	19.99%	19.8% to 20.2%
	TLS	10.00%	9.9% to 10.1%
	TSL	10.00%	9.9% to 10.1%
<b>Trade-Update</b>			
frame_to_execute	1	33.05%	31% to 35%
	2	32.98%	31% to 35%
	3	33.97%	32% to 36%

# Clause 7 : Transaction and System Properties Related Items

## Transaction System Properties (ACID)

*The results of the ACID tests must be reported in the Report along with a description of how the ACID requirements were met, and how the ACID tests were run.*

The TPC Benchmark™ E Standard Specification defines a set of transaction processing system properties that a system under test (SUT) must support during the execution of the benchmark. Those properties are Atomicity, Consistency, Isolation and Durability (ACID). This section quotes the specification definition of each of those properties and describes the tests done as specified and monitored by the auditor, to demonstrate compliance. See also file MSTPCE ACID Procedures.pdf in the SupportingFiles directory. The ACID scripts and outputs are located in the directory SupportingFiles\Clause7\.

## Redundancy Level

*The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.6.7.1) and describe the Data Accessibility test(s) used to demonstrate compliance.*

Redundancy Level 1 was used for the Database Array.

## Durability Test for Data Accessibility

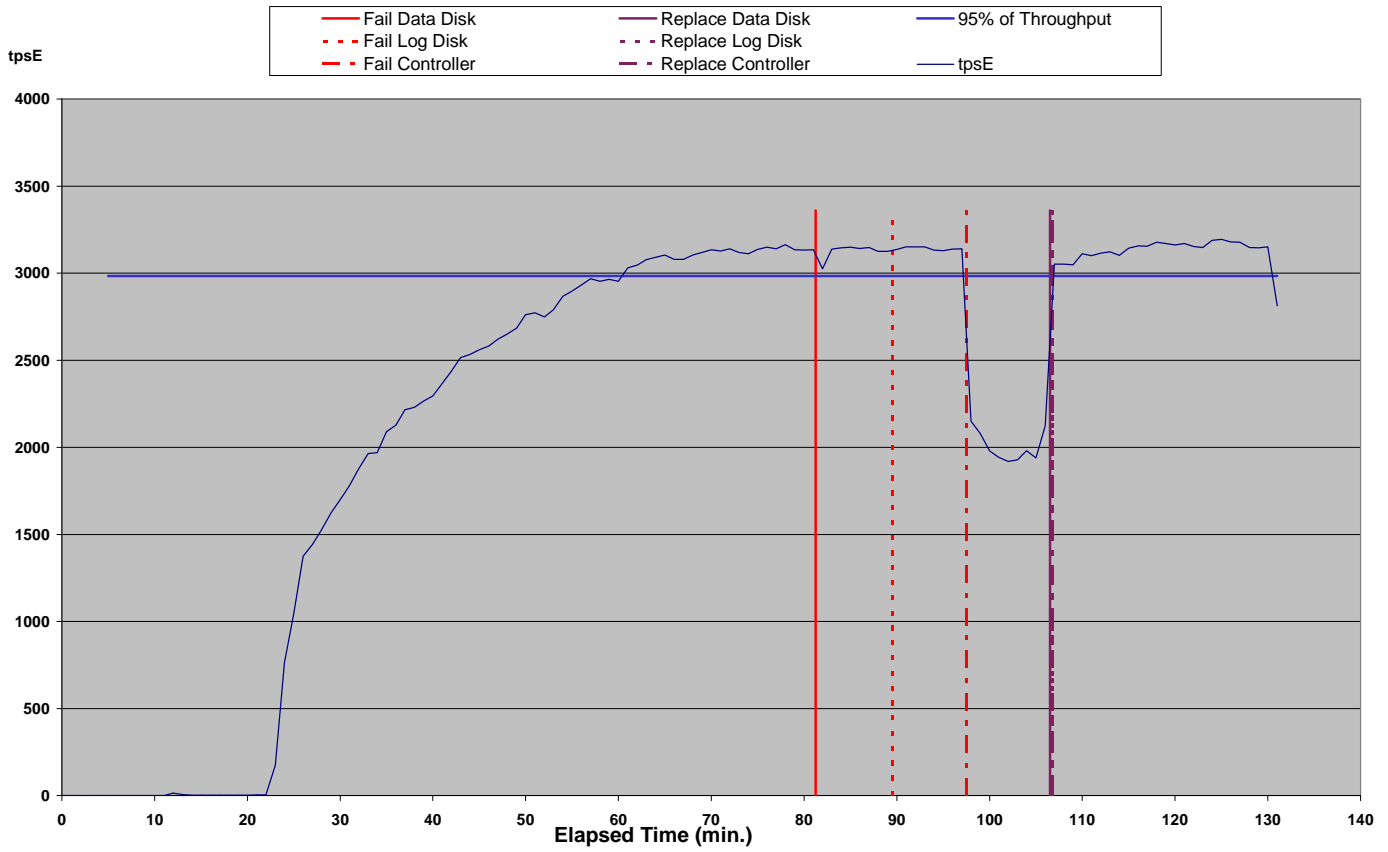
*A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.6.7.2).*

This benchmark result used Redundancy Level 1. To prove Redundancy Level 1, the following steps were successfully performed. The test for Redundancy Level 1 is the test for Permanent Irrecoverable Failure of any single Durable Medium.

1. Determine the current number of completed trades in the database by running: *select count(\*) as count1 from SETTLEMENT*
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.6.3) and satisfy those requirements for at least 5 minutes.
3. It was verified that the measured throughput was at least 95% of the reported throughput prior to inducing each failure.
4. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in one of the Database Data Array, fail a disk in the Database Log Array, and fail a controller module in the Database Log Array controller. Transactions should continue processing since the Database Log Array uses RAID-50, the Database Data Array uses RAID-10 and the Database Log Array controller has a mirrored cache module.
5. Begin the necessary recovery process, by replacing the failed Database Log Array controller, the failed drives in the Database Log Array and the Database Data Array. A rebuild on each replaced drive and a recovery on replaced controller should start automatically.
6. Continue running the Driver for 20 minutes.
7. Terminate the run gracefully from the Driver.
8. Retrieve the new number of completed trades in the database by running: *select count(\*) as count2 from SETTLEMENT*
9. Compare the number of executed Trade-Result Transactions on the Driver to (count2 – count1). Verify that (count2 - count1) is equal to the number of successful Trade-Result Transaction records in the Driver log file.
10. Allow recovery process to complete as needed.

Following is a graph of the measured throughput versus elapsed time that must be reported for the run portions of the Data Accessibility tests:

**Figure 7.1: Data Accessibility Graph**



## Durability Test for Business Recovery

*The Test Sponsor must describe in the Report the test(s) used to demonstrate Business Recovery.*

*The Business Recovery Time must be reported on the Executive Summary Statement and in the Report. If the failures described in Clauses 7.6.2.2, 7.6.2.3 and 7.6.2.4 were not combined into one Durability test (usually powering off the Database Server during the run), then the Business Recovery Time for the failure described for instantaneous interruption is the Business Recovery Time that must be reported in the Executive Summary Statement. All the Business Recovery Times for each test requiring Business Recovery must be reported in the Report.*

*The Business Recovery Time Graph (see Clause 7.6.7.4) must be reported in the Report for all Business Recovery tests.*

The tests for “Instantaneous interrupt,” “Failure of all or part of memory,” and “Loss of external power to the SUT” were combined.

Note: Two UPSs have been priced for the log controller.

The following steps were successfully performed.

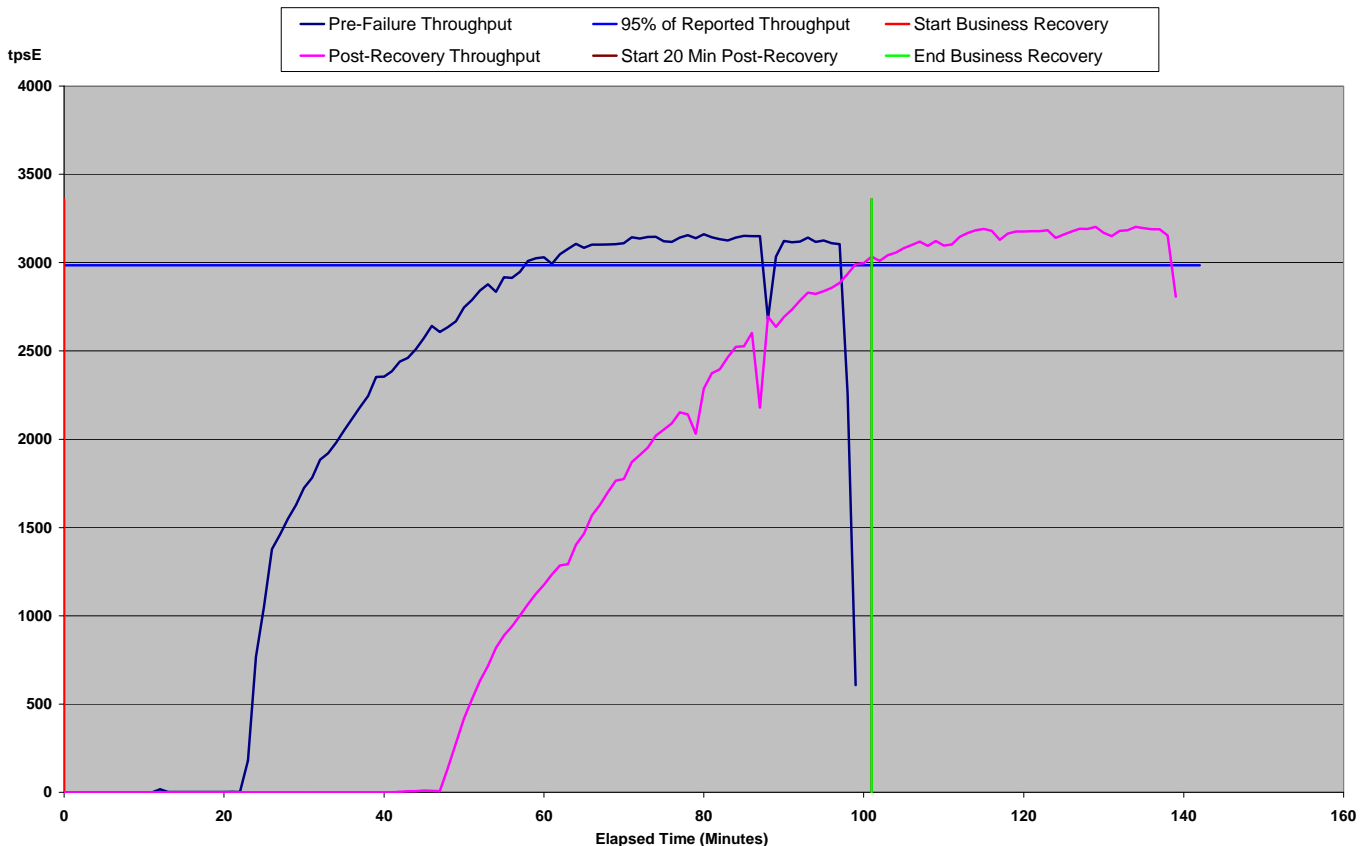
1. Determine the current number of completed trades in the database by running: `select count(*) as count1 from SETTLEMENT`
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.6.3) and satisfy those requirements for at least 20 minutes.
3. Removing power cords from the database server, NEC Express5800/A1080a-E.
4. Stop the Driver.
5. Re-power and restart the database server, NEC Express5800/A1080a-E.

6. On the NEC Express5800/A1080a-E when Windows has started, start up Microsoft® SQL Server® 2008 R2. Then database recovery starts automatically. Microsoft® SQL Server® 2008 R2 records timestamps out to the errorlog when the recovery procedure has begun. The timestamp defines the time when Database Recovery starts (as defined in Clause 7.6.6.4).
7. Wait for Microsoft® SQL Server® 2008 R2 to finish recovering the database. The timestamp in the errorlog of the message indicating that the recovery of database tpce is complete is considered the end of the Database Recovery (as defined in Clause 7.6.6.5).
8. Once the SUT will accept Transactions, start submitting Transactions and note this time as the start of Application Recovery (as defined in Clause 7.6.6.6). Ramp up to a Durability Throughput Requirements (as defined in Clause 7.6.3) and satisfy those requirements for at least 20 minutes.
9. Note the time of the beginning of that 20-minute window as the end of Application Recovery (as defined in Clause 7.6.6.7).
10. Terminate the Driver gracefully.
11. Verify that no errors were reported by the Driver during steps 7 through 9.
12. Retrieve the new number of completed trades in the database by running: *select count(\*) as count2 from SETTLEMENT*
13. Compare the number of completed Trade-Result Transactions on the Driver to (count2 – count1). Verify that (count2 - count1) is greater or equal to the aggregate number of successful Trade-Result Transaction records in the Driver log file for the runs performed in step 2 and step 7. If there is an inequality, the SETTLEMENT table must contain additional records and the difference must be less than or equal to the maximum number of Transactions which can be simultaneously in-flight from the Driver to the SUT. This number is specific to the implementation of the Driver and configuration settings at the time of the crash.
14. Verify consistency conditions as specified in Clause 7.3.1.1.

The database recovery time was 0:40:28. The application recovery time was 00:59:00. The Business Recovery Time, which is the sum of the database recovery time and the application recovery time, was 1:39:28.

Following is a graph of the measured throughput versus elapsed time that must be reported for the run portions of the Business Recover Time test:

**Figure 7.2: Business Recover Time Graph**



# Clause 8 : Pricing Related Items

## 60-Day Space

Details of the 60-Day Space computations (see Clause 8.2.2) along with proof that the database is configured to sustain a Business Day of growth (see Clause 6.6.6.1) must be reported in the Report.

### TPC-E Disk Space Requirements

Customers Used	1,650,000	Performance	3141.76 tpsE				
<b>Growing File Group</b>	<b>Initial Rows</b>	<b>Data (KB)</b>	<b>Index size (KB)</b>	<b>Extra 5% (KB)</b>	<b>Total + 5% (KB)</b>	<b>After run (KB)</b>	<b>Growth (KB)</b>
CASH_TRANSACTION	26,231,073,750	2,719,100,528	5,734,152		2,724,834,680	2,732,064,160	7,229,480
HOLDING	1,459,598,584	97,463,440	61,804,064		159,267,504	161,646,968	2,379,464
HOLDING_HISTORY	38,210,947,095	1,389,489,344	803,124,536		2,192,613,880	2,200,382,688	7,768,808
HOLDING_SUMMARY	82,049,088	3,590,208	15,760		3,605,968	3,605,968	0
SETTLEMENT	28,512,000,000	1,511,430,512	3,187,960		1,514,618,472	1,518,867,288	4,248,816
TRADE	28,512,000,000	3,403,309,936	1,714,580,176		5,117,890,112	5,136,049,688	18,159,576
TRADE_HISTORY	68,428,832,164	2,058,010,376	5,366,632		2,063,377,008	2,070,587,280	7,210,272
TRADE_REQUEST	0	0	0		0	160,096	160,096
<b>Scaling File Group</b>							
ACCOUNT_PERMISSION	11,715,137	997,416	7,776	50,260	1,055,452	1,005,408	216
ADDRESS	2,475,004	142,848	2,792	7,282	152,922	145,672	32
BROKER	16,500	1,208	1,560	138	2,906	2,768	0
COMPANY	825,000	180,112	54,000	11,706	245,818	234,120	8
COMPANY_COMPETITOR	2,475,000	66,624	57,040	6,183	129,847	123,664	0
CUSTOMER	1,650,000	279,632	76,096	17,786	373,514	355,736	8
CUSTOMER_ACCOUNT	8,250,000	747,736	162,872	45,530	956,138	910,616	8
CUSTOMER_TAXRATE	3,300,000	68,992	2,792	3,589	75,373	71,896	112
DAILY_MARKET	1,474,976,250	76,540,680	272,880	3,840,678	80,654,238	76,814,632	1,072
FINANCIAL	16,500,000	1,941,528	7,936	97,473	2,046,937	1,949,704	240
LAST_TRADE	1,130,250	70,608	2,792	3,670	77,070	73,400	0
NEWS_ITEM	1,650,000	178,891,128	4,568	8,944,785	187,840,481	178,895,696	0
NEWS_XREF	1,650,000	41,264	2,792	2,203	46,259	44,056	0
SECURITY	1,130,250	179,200	44,496	11,185	234,881	223,696	0
WATCH_ITEM	164,968,526	4,619,984	19,376	231,968	4,871,328	4,639,568	208
WATCH_LIST	1,650,000	41,224	36,968	3,910	82,102	78,192	0
<b>Fixed File Group</b>							
CHARGE	15	8	8	1	17	16	0
COMMISSION_RATE	240	16	16	2	34	32	0
EXCHANGE	4	8	8	1	17	16	0
INDUSTRY	102	8	24	2	34	32	0
SECTOR	12	8	24	2	34	32	0
STATUS_TYPE	5	8	8	1	17	16	0
TAXRATE	320	24	16	2	42	56	16
TRADE_TYPE	5	8	1,032	52	1,092	1,040	0
ZIP_CODE	14,741	488	16	25	529	504	0
<b>TOTALS (KB)</b>		<b>11,447,205,104</b>	<b>2,594,571,168</b>	<b>13,278,432</b>	<b>14,055,054,704</b>		
<b>Initial Database Size (MB)</b>		<b>13,712,672</b>	<b>13,391 GB</b>	<b>13.08 TB</b>			
<b>Db/Filegroups</b>	<b>LUN Count</b>	<b>Partition Size(KB)</b>	<b>MB allocated</b>	<b>MB Loaded</b>	<b>MB Loaded+5%</b>	<b>Ending size</b>	<b>8 Hours</b>
Growing_FG	156	194,560,000	29,640,000	13,453,328	13,453,328	13,499,379	13,560,324
Scaling_FG	156	10,240,000	1,560,000	259,343	272,310	259,345	259,347
Fixed_FG	1	512,000	500	1.69	2	2	2
<b>Settlements</b>	<b>38,943,719</b>						
<b>Initial Growing Space (MB)</b>	13,453,328						
<b>Final Growing Space (MB)</b>	13,499,379	<b>Data LUNS</b>	156	<b>Initial Log size (MB)</b>	14,209	<b>Log Disks</b>	20
<b>Delta (MB)</b>	46,051	<b>Disks per LUN</b>	12	<b>Final Log size (MB)</b>	267,395	<b>Disk Capacity (MB)</b>	274,624
<b>Data Space per TR (MB)</b>	0.001182509	<b>Disk Capacity (MB)</b>	136,192	<b>Log Growth (MB)</b>	253,186	<b>RAID50 overhead</b>	20%
<b>1 Day Data Growth (MB)</b>	106,997	<b>RAID10 overhead</b>	50%	<b>Log Growth/TR (MB)</b>	0.0065013388	<b>Tempdb Log</b>	-
<b>60 Day Space (MB)</b>	<b>20,132,465</b>	<b>Total Space (MB)</b>	<b>127,475,712</b>	<b>1 Day log space (MB)</b>	<b>588,259</b>	<b>Log Space (MB)</b>	<b>4,393,984</b>

# Auditor's Attestation Letter

The Auditor's Attestation Letter, which indicates compliance, must be included in the Report.



Manabu Miyazaki  
NEC Corporation  
1-10 Nisshincho  
Fuchu-City, Tokyo 183-8501, Japan

March 25, 2010

I verified the TPC Benchmark™ E performance of the following configuration:

Platform: NEC Express5800/A1080a-E  
Operating system: Microsoft Windows Server 2008 R2 Datacenter x64 Edition  
Database Manager: Microsoft SQL Server 2008 R2 Datacenter Edition

The results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
<b>Tier B, Server: NEC Express5800/A1080a-E</b>				
8 x Intel Xeon X7560 (2.26GHz)	1024 GB (24 MB L3)	2 x 300 GB SAS (int.) 1872 x 147 GB 15K SAS 20 x 300 GB 15K SAS	0.13 Seconds	3,141.76
<b>Tier A, Clients: 2 x NEC Express5800/R120a-2</b>				
1 x Intel Xeon X5550 (2.66 GHz)	4 GB (8 MB L3)	1x 147 GB SAS	n/a	n/a

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark.

The following verification items were given special attention:

- All EGen components were verified to be v1.9.0.
- The transactions were correctly implemented.
- The database was properly scaled and populated for 1,650,000 customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.



- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.
- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 1:39:28 was correctly measured.
- The 60 day storage requirement was correctly computed and configured.
- The system pricing was verified for major components and maintenance.

Additional Audit Note:

None.

Respectfully Yours,



François Raab, President

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## Clause 9 : Supporting Files

### Supporting Files Index Table

An index for all files required by Clause 9.4 Supporting Files must be provided in the Report. The Supporting Files index is presented in a tabular format where the columns specify the following:

- The first column denotes the clause in the TPC Specification
- The second column provides a short description of the file contents.
- The third column contains the path name for the file starting at the SupportingFiles directory.

If there are no Supporting Files provided then the description column must indicate that there is no supporting file and the path name column must be left blank.

Clause	Description	path	filename
Introduction	Disk Configuration	SupportingFiles/Introduction/Hardware/	D3-10diagram.doc sydskmap_[01..23].png mount.txt mkmp.cmd StorageSetup.doc SwitchSetup.doc
	TierB(server) cofiguration	SupportingFiles/Introduction/Hardware/	TierB_A1080a-E_R120a-2_setup.doc
	TierA(client) setup	SupportingFiles/Introduction/Hardware/	TierA_R120a-2_setup.doc
	Database Tunable Parameters	SupportingFiles/Introduction/Software/	sp_configure.out 128cpu-affinity.sql startSQL.cmd tempdb.sql SoftNUMA-node-cpumask.reg SoftNUMA-ports.reg
	OS Tunable Parameters	SupportingFiles/Introduction/Software/	syostune.doc syhwTierB.out syhwTierA_[1..2].out
	Tier A Scripts	SupportingFiles/Introduction/Software/	ce[1..32].cmd me[1..32].cmd

Clause2	Table creation scripts	SupportingFiles/Clause2/DDL/	Convert_NI_ITEM_Data.sql BulkInsert_[1..96].sql Create_Check_Constraints_Fixed.sql Create_Check_Constraints_Growing.sql Create_Check_Constraints_Scaling.sql Create_FK_Constraints.sql Create_Tables_Fixed.sql Create_Tables_Growing.sql Create_Tables_Scaling.sql Create_Tables_Scaling_Flat.sql Create_TPCE_Types.sql Drop_FK_Constraints.sql Drop_Tables_Fixed.sql Drop_Tables_Growing.sql Drop_Tables_Scaling.sql
	Index creation scripts	SupportingFiles/Clause2/DDL/	Create_Indexes_Fixed_Tables.sql Create_Indexes_Growing_Tables.sql Create_Indexes_Scaling_Tables.sql Unified_Create_Indexes.sql
	Load Transaction Frames	SupportingFiles/Clause2/DML/	BrokerVolume.sql CustomerPosition.sql DataMaintenance.sql MarketFeed.sql MarketWatch.sql SecurityDetail.sql TradeLookup.sql TradeOrder.sql TradeResult.sql TradeStatus.sql TradeUpdate.sql
	Create Database	SupportingFiles/Clause2/	Backup_Database.sql Backup_Devices.sql Checkpoint_TPCE_Database.SQL Count_Customers.sql Create_Database.sql Create_DM_Audit_Table.sql Create_TID_Ranges_Tables.sql Create_Timer_Table.sql Create_TPCE_VERSIONS_Table.sql Database_Options_1.sql Database_Options_2.sql Drop_and_Create_TPCE_INFO.sql End_Load_Timer.sql Get_Next_T_ID.sql Install_Load_Timer_Proc.sql Load_TPCE_Info.sql MSTPCE Database Setup Reference.pdf Output_TPCE_VERSIONS_Table.SQL Remove_Database.sql Restore_Database.sql SQL_Server_Configuration.sql tempdb.sql Trade_Cleanup.sql Version.sql
	Database Space Scripts	SupportingFiles/Clause2/Audit_Scripts/Space/	SPFiles.sql SPLog.sql SPUsed.sql
	Database Audit Scripts	SupportingFiles/Clause2/Audit_Scripts/Database/	Create_DB_Audit_Tables.SQL DB_Check.sql DB_FK_Constraints.sql DB_Primary_Key_Check.SQL DB_Tables.sql Drop_DB_Audit_Tables.SQL Insert_Duplicates_Tests.sql Referential_Integrity_Tests.sql

Output	SupportingFiles/Clause2/Outputs	165000customers_Load_Timer.log BrokerVolume.log BuildSteps.log BulkInsert_[1-96].out Check_Constraints_Fixed.log Check_Constraints_Growing.log Check_Constraints_Scaling.log Convert_NI_ITEM_Data.log Create_DM_Audit_Table.log Create_Indexes_Fixed_Tables.log Create_Indexes_Growing_Tables.log Create_Indexes_Scaling_Tables.log Create_TID_Ranges_Table.log Create_TL_TU_Warnings_Table.log Create_TPCE_VERSIONS_Table.log CreateDB.log CustomerPosition.log Database_Options_1.log Database_Options_2.log DataMaintenance.log Drop_Fixed_Tables.log Drop_FK_Constraints.log Drop_Growing_Tables.log Drop_Scaling_Tables.log FK_Constraints.log Get_Next_T_ID.log Load_Timer.log Load_Timer_Proc.log Load_TPCE_Info.log MarketFeed.log MarketWatch.log RemoveDB.log SecurityDetail.log SQL_Server_Configuration.log Tables_Fixed.log Tables_Growing.log Tables_Scaling.log TPCE_Types.log TPCE_VERSIONS.log TradeLookup.log TradeOrder.log TradeResult.log TradeStatus.log TradeUpdate.log Version.log
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Clause3	Transaction Frames	SupportingFiles/Clause3/	BrokerVolume.sql CustomerPosition.sql DataMaintenance.sql MarketFeed.sql MarketWatch.sql SecurityDetail.sql Trade_Cleanup.sql TradeLookup.sql TradeOrder.sql TradeResult.sql TradeStatus.sql TradeUpdate.sql
	SUT_CE_Server	SupportingFiles/Clause3/SUT_CE_Server/	CEServer.cpp CEServer.h CEServerMain.cpp PortDefinitions.h stdafx.cpp stdafx.h SUT_CE_Server.vcproj SUTServer.sln SUTServer.suo SUTStructs.h
	SUT_MEE_Server	SupportingFiles/Clause3/SUT_MEE_Server/	MEEServer.cpp MEEServer.h MEEServerMain.cpp stdafx.cpp stdafx.h SUT_MEE_Server.vcproj
Clause4	No requirements		Moved to clause 5
Clause5	No EGen modifications		
	No EGenLoader extensions		
	EGenDriver Configurati	SupportingFiles/Clause5/	1650Kcust.xml
	EGenLoader Parameters	SupportingFiles/Clause5/	BuildSteps.log EGenLoaderFrom1To17000.log EGenLoaderFrom17001To34000.log EGenLoaderFrom34001To52000.log EGenLoaderFrom52001To69000.log EGenLoaderFrom69001To86000.log EGenLoaderFrom86001To103000.log EGenLoaderFrom103001To120000.log EGenLoaderFrom120001To138000.log EGenLoaderFrom138001To155000.log EGenLoaderFrom155001To172000.log EGenLoaderFrom172001To189000.log EGenLoaderFrom189001To206000.log EGenLoaderFrom206001To223000.log EGenLoaderFrom223001To241000.log EGenLoaderFrom241001To258000.log EGenLoaderFrom258001To275000.log EGenLoaderFrom275001To292000.log EGenLoaderFrom292001To309000.log EGenLoaderFrom309001To327000.log EGenLoaderFrom327001To344000.log EGenLoaderFrom344001To361000.log EGenLoaderFrom361001To378000.log EGenLoaderFrom378001To395000.log EGenLoaderFrom395001To413000.log EGenLoaderFrom413001To430000.log EGenLoaderFrom430001To447000.log EGenLoaderFrom447001To464000.log EGenLoaderFrom464001To481000.log EGenLoaderFrom481001To498000.log EGenLoaderFrom498001To516000.log EGenLoaderFrom516001To533000.log EGenLoaderFrom533001To550000.log EGenLoaderFrom550001To567000.log EGenLoaderFrom567001To584000.log EGenLoaderFrom584001To602000.log EGenLoaderFrom602001To619000.log EGenLoaderFrom619001To636000.log

			EGenLoaderFrom636001To653000.log EGenLoaderFrom653001To670000.log EGenLoaderFrom670001To688000.log EGenLoaderFrom688001To705000.log EGenLoaderFrom705001To722000.log EGenLoaderFrom722001To739000.log EGenLoaderFrom739001To756000.log EGenLoaderFrom756001To773000.log EGenLoaderFrom773001To791000.log EGenLoaderFrom791001To808000.log EGenLoaderFrom808001To825000.log EGenLoaderFrom825001To842000.log EGenLoaderFrom842001To859000.log EGenLoaderFrom859001To877000.log EGenLoaderFrom877001To894000.log EGenLoaderFrom894001To911000.log EGenLoaderFrom911001To928000.log EGenLoaderFrom928001To945000.log EGenLoaderFrom945001To963000.log EGenLoaderFrom963001To980000.log EGenLoaderFrom980001To997000.log EGenLoaderFrom997001To1014000.log EGenLoaderFrom1014001To1031000.log EGenLoaderFrom1031001To1048000.log EGenLoaderFrom1048001To1066000.log EGenLoaderFrom1066001To1083000.log EGenLoaderFrom1083001To1100000.log EGenLoaderFrom1100001To1117000.log EGenLoaderFrom1117001To1134000.log EGenLoaderFrom1134001To1152000.log EGenLoaderFrom1152001To1169000.log EGenLoaderFrom1169001To1186000.log EGenLoaderFrom1186001To1203000.log EGenLoaderFrom1203001To1220000.log EGenLoaderFrom1220001To1238000.log EGenLoaderFrom1238001To1255000.log EGenLoaderFrom1255001To1272000.log EGenLoaderFrom1272001To1289000.log EGenLoaderFrom1289001To1306000.log EGenLoaderFrom1306001To1323000.log EGenLoaderFrom1323001To1341000.log EGenLoaderFrom1341001To1358000.log EGenLoaderFrom1358001To1375000.log EGenLoaderFrom1375001To1392000.log EGenLoaderFrom1392001To1409000.log EGenLoaderFrom1409001To1427000.log EGenLoaderFrom1427001To1444000.log EGenLoaderFrom1444001To1461000.log EGenLoaderFrom1461001To1478000.log EGenLoaderFrom1478001To1495000.log EGenLoaderFrom1495001To1513000.log EGenLoaderFrom1513001To1530000.log EGenLoaderFrom1530001To1547000.log EGenLoaderFrom1547001To1564000.log EGenLoaderFrom1564001To1581000.log EGenLoaderFrom1581001To1598000.log EGenLoaderFrom1598001To1616000.log EGenLoaderFrom1616001To1633000.log EGenLoaderFrom1633001To1650000.log
	EGenLogger Output	SupportingFiles/Clause5/	EGENLOG.xlt
Clause6	EGenValidate Output	SupportingFiles/Clause6/	EGenValidate.out

Clause7	ACID Procedure documents	SupportingFiles/Clause7/	MSTPCE ACID Procedures.pdf
	ACID procedures	SupportingFiles/Clause7/AcidProcs/	AcidProc.cmd Remove_AcidProcs.cmd AcidProc.out
		SupportingFiles/Clause7/AcidProcs/Scripts/	AcidProc.vbs CustomerPosition_Iso3.sql CustomerPosition_Iso4.sql Remove_AcidProcs.vbs TradeOrder_C.sql TradeOrder_Iso1_1.sql TradeOrder_Iso1_2.sql TradeOrder_Iso2.sql TradeOrder_Iso3.sql TradeOrder_Iso4.sql TradeOrder_RB.sql TradeResult_Iso1_1.sql TradeResult_Iso1_2.sql TradeResult_Iso2_1.sql TradeResult_Iso2_2.sql TradeResult_Iso3.sql TradeResult_Iso4.sql
	Atomicity Scripts	SupportingFiles/Clause7/Atomicity/	Atomicity.cmd
		SupportingFiles/Clause7/Atomicity/Scripts/	atom.vbs Atomicity_C.sql Atomicity_RB.sql
	Atomicity Output	SupportingFiles/Clause7/Atomicity/	Atomicity_C.out Atomicity_RB.out
	Consistency Scripts	SupportingFiles/Clause7/Consistency/	Consistency.cmd
		SupportingFiles/Clause7/Consistency/Scripts/	Consistency.sql Consistency.vbs
	Consistency Output	SupportingFiles/Clause7/Consistency/	Consistency1.out
	Isolation Scripts	SupportingFiles/Clause7/Isolation/Scripts/	Isolation1_S1.sql Isolation1_S2.sql Isolation1_S3.sql Isolation1_S4.sql Isolation2_S1.sql Isolation2_S2.sql Isolation2_S3.sql Isolation2_S4.sql Isolation3_S1.sql Isolation3_S2.sql Isolation3_S3.sql Isolation4_S1.sql Isolation4_S2.sql Isolation4_S3.sql
		Isolation Output	SupportingFiles/Clause7/Isolation/

	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecover	BusinessRecoveryTimeGraph.xls Consistency2.out count1.sql count1BR.out count2.sql count2BR.out dblgBRpart1.out dblgBRpart2.out dblgRecovery.out DsymTierBoslg.out Part1Step.xlt Part1TxnReport20min.xlt Part1TxnReportAll.xlt Part2Step.xlt Part2TxnReport20min.xlt Part2TxnReportAll.xlt
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/DataAccessibility/	count1.sql count1DA.out count2.sql count2DA.out DataAccessibility_wholeRun_TxnReportE.xlt DataAccessibilityGraph.xls DBlgDataAccessibility.out pulledDataDisk.png pulledLogCont.png pulledLogDisk.png rebuildingDataDisk.png rebuildingLogDisk.png replacingLogCnt.png
Clause8	60-Day Space Calculations	SupportingFiles/Clause8/	tpce_space.xls



# Appendix A : Price Quotation

Microsoft Corporation  
One Microsoft Way  
Redmond, WA 98052-6399

Tel 425 882 8080  
Fax 425 936 7329  
<http://www.microsoft.com/>

**Microsoft**

March 4, 2010

NEC Corporation  
Keiichi Yamada  
1-10 Nisshin-cho, Fuchu-shi  
Tokyo, Japan 1838501

Here is the information you requested regarding pricing for several Microsoft products to be used in conjunction with your TPC-E benchmark testing.

All pricing shown is in US Dollars (\$).

Part Number	Description	Unit Price	Quantity	Price
*	<b>SQL Server 2008 R2 Datacenter Edition</b> <i>Per Processor License Open Program - Level C Unit Price reflects a 15% discount from the retail unit price of \$53,700.</i>	\$45,807	8	\$366,456
P73-04165	<b>Windows Server 2008 Standard Edition</b> <i>Server License with 5 CALs Open Program - Level C Unit Price reflects a 29% discount from the retail unit price of \$999.</i>	\$711	5	\$3,555
N/A	<b>Microsoft Problem Resolution Services</b> <i>Professional Support (1 Incident).</i>	\$259	1	\$259

Windows Server 2008 Standard Edition is currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found at the Microsoft Product Information Center at <http://www.microsoft.com/products/info/render.aspx?view=22&type=how>

SQL Server 2008 R2 Datacenter Edition will be orderable and available by May 6, 2010.

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at \$259 per call.






This quote is valid for the next 90 days.

Reference ID: TPCE\_g3wOpiq6ZAujPR6sA302ZdnE668UkrdN\_V1.0.0.



800.750.4239

Shopping Cart

Quantity	Product	CDW	Availability	Price	Ext. Price
10	 NEC AccuSync 73VX 17" LCD Display	1372835	In Stock	\$118.99	\$1,189.90
102	 Belkin 10 meter Multimode LC/LC 62.5/125 Duplex Fiber Optic cable	405050	In Stock	\$39.99	\$4,078.98
94	 Tripp Lite 25' Blue Cat5e or Cat5 Snagless RJ45 UTP Patch Cable 25ft	324500	In Stock	\$5.99	\$563.06
7	 Tripp Lite 10' Gray Cat5e or Cat5 Snagless Crossover Cable 10ft	324527	In Stock	\$4.99	\$34.93
6	 Cisco SR2024C Compact 24-port 10/100/1000 Gigabit Switch	1012601	4-6 days	\$285.99	\$1,715.94
Sub-Total					\$7,562.81

Related Top Sellers For: Cisco SR2024C Compact 24-port 10/100/1000 Gigabit Switch

Recommended Accessories	Recommended Warranties
 Belkin 8 Outlet, 6' Cord Surge \$18.99	 2 Extra Years Replacement Extended Warranty \$201-\$400 \$69.99
 Tripp Lite 7' Gray Cat5 Gigabit Snagless Patch Cable \$5.99	 1 Extra Year Replacement Extended Warranty \$201-\$400 \$29.99
 Belkin 14' 650MHz Certified CAT 6 Patch Cable Blue \$14.99	

<http://www.cdw.com/shop/cart/default.aspx?1012601Qty=6&EDC=1012601&1012601Co...> 3/19/2010