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

***NEC Express5800/A1160 (12 Processors)***

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

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**First Edition  
Submitted for Review  
06-Nov-2008**

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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/A1160 client/server system with version 1.5.1 of the TPC Benchmark™ E Standard Specification. Two Clients (NEC Express5800/120Rj-2) were used as the Tier-A clients.

The operating system and the DBMS used on the server were Microsoft® Windows Server® 2008 Datacenter x64 Edition and Microsoft® SQL Server® 2008 Enterprise x64 Edition. The operating system on the clients was Microsoft® Windows Server® 2003 R2 Standard Edition with SP2.

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 /A1160	Microsoft® SQL Server® 2008 Enterprise x64 Edition Microsoft® Windows Server® 2008 Datacenter x64 Edition	\$1,666,334 (USD)	1400.00	\$1,190.24	31-Dec-2008

## *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/A1160 (12 Processors)</b>		<b>TPC-E 15.1 TPC Pricing 1.3.0</b>
			Report Date November 6, 2008
TPC-E Throughput <b>1400.00 tpsE</b>	Price/Performance <b>\$1,190.24 USD per tpsE</b>	Availability Date <b>December 31, 2008</b>	Total System Cost <b>\$1,666,334 USD</b>
<b>Database Server Configuration</b>			
Operating System <b>Microsoft® Windows Server® 2008 Datacenter x64 Edition</b>	Database Manager <b>Microsoft® SQL Server® 2008 Enterprise x64 Edition</b>	Processors/Cores/ Threads <b>12 / 64 / 64</b>	Memory <b>384GB</b>
<p><b><u>Tier B: Server</u></b>  <b>NEC Express5800/A1160</b>  12x Intel® Xeon® processor X7460 2.66GHz, 16MB L3 cache,  6 processor cores*, 6 threads  384GB Memory, 2x 73GB SAS drives  5x 2-port 4Gbps FC HBA  1x Internal SAS RAID Controller  6x Onboard 1Gbps Ether Controllers</p> <p>* 8 processor cores out of 72 were disabled</p>		<p><b><u>Tier B: System Console</u></b>  <b>2x NEC Express5800/120Rj-2</b>  1x Intel® Xeon® processor E5450  3.0GHz, 12MB L2 cache, 4 processor  cores, 4 threads  4GB Memory  1x 73GB SAS drive  2x Onboard 1Gbps Ether Controllers</p>	
<p><b><u>Driver</u></b></p>	<p><b><u>Tier A: Client</u></b>  <b>2x NEC Express5800/120Rj-2</b>  1x Intel® Xeon® processor E5450 3.0GHz, 12MB L2  cache, 4 processor cores, 4 threads  4GB Memory  1x 73GB SAS drive  2x Onboard 1Gbps Ether Controllers</p>	<p><b><u>Tier B: Storage</u></b>  <b>NEC Storage D3-10</b>  37x NEC Storage D3-10 Controllers  37x NEC Storage D3-10 SAS/SATA  Disk Enclosures  864x 147GB 15k RPM SAS drives  20x 300GB 15k RPM SAS drives</p>	
Initial <b>5,421 GB</b>	Redundancy Level : 1 <b>RAID50 : Log / RAID10 : Data</b>	Storage <b>864 x 147GB 15K 20 x 300GB 15K</b>	



## NEC Express5800/A1160 (12 Processors)

**TPC-E 15.1  
TPC Pricing 1.3.0**

Report Date  
November 6, 2008

Available Date  
December 31, 2008

Description	Part Number	Third Party Brand	Pricing	Unit Price	Qty	Extended Price	3-yr Mnt. Price
<b>Server Hardware</b>							
NEC Express5800/A1160							
A1160 Server Base Model w/6core Intel Xeon X7460	850200723	NEC	1	36,399	3	109,197	
- 4x 6core Xeon X7460 (2.66GHz/16MB)	included						
- 16GB (2x 8GB Memory Option)	included						
8GB Memory Option (2x 4GB DIMMs)	062-03502-000	NEC	1	899	42	37,758	
Internal SAS RAID (PCIe x4)	062-03503-000	NEC	1	1,399	1	1,399	
73GB 2.5" SAS HDD 15k RPM	062-03504-000	NEC	1	649	2	1,298	
2-port 4Gbps FC-HBA (PCIex4)	062-03507-000	NEC	1	4,149	5	20,745	
HSI Cable(1)	050-03511-000	NEC	1	799	3	2,397	
42U Rackframe	050-02378-001	NEC	1	1,799	1	1,799	
Installation	SP-MX00-STIN001	NEC	1	5,000	1	5,000	
Microsoft Windows Server 2008 Datacenter per 4p	050-03518-000	NEC	1	11,996	3	35,988	
Platinum Warranty (Yr 1,2 & 3)	OSMX-SD4HR-YYY	NEC	1	5,990	3		17,970
NEC Express5800/120Rj-2 (for System Maintenance)							
Model 120Rj-2 Base Unit, E5450, 2G DIMM, DVD-Combo	850195003	NEC	1	4,490	2	8,980	
2GB (1GB x2) DDR2 667 FB-DIMM	062-03118-000	NEC	1	240	2	480	
73GB SAS HDD (3.5"), 15k rpm	062-02782-000	NEC	1	263	2	526	
Upgrade to Platinum Warranty for 3 yrs	4HR-GP-YYY	NEC	1	799	2		1,598
NEC AccuSync LCD52V 15"LCD Display (+2 spares)	ASLCD52V-BK	NEC	3	175	5	875	
					<b>Subtotal</b>	<b>226,442</b>	<b>19,568</b>
<b>Disk Subsystem</b>							
NEC Storage D3-10							
NEC Storage D3-10 Base Model	850193310	NEC	1	7,830	37	289,710	
SAS/SATA Enclosure	NF5021-SE60E	NEC	1	2,941	37	108,817	
SAS disk drive (15k rpm/147GB) (+10% spares)	NF5021-SM624E	NEC	1	486	951	462,186	
SAS disk drive (15k rpm/300GB) (+10% spares)	NF5021-SM625E	NEC	1	768	22	16,896	
1 yr of Standard SW Maintenance for Base SW	UFSD0M-310000AMAS	NEC	1	1,195	111		132,645
3 yrs of Platinum Warranty Upgrade	OS2X-SD4HR-YYY	NEC	1	175,522	1		175,522
UPS 3kVA	050-02424-000	NEC	1	1,799	2	3,598	
42U Rackframe	050-02378-001	NEC	1	1,799	4	7,196	
FC Cable 10M LC-LC (+10% spares)	F2F202LL-10M	Belkin	3	40	51	2,040	
					<b>Subtotal</b>	<b>890,443</b>	<b>308,167</b>
<b>Server Software</b>							
Microsoft SQL Server 2008 Enterprise x64 Edition	810-07507	Microsoft	2	23,432	12	281,184	245
					<b>Subtotal</b>	<b>281,184</b>	<b>245</b>

*continued on the next page*



## NEC Express5800/A1160 (12 Processors)

### TPC-E 15.1 TPC Pricing 1.3.0

Report Date  
November 6, 2008

Available Date  
December 31, 2008

#### Client Hardware

NEC Express5800/120Rj-2								
Model 120Rj-2 Base Unit, E5450, 2G DIMM, DVD-Combo	850195003	NEC	1	4,490	2	8,980		
2GB (1GB x2) DDR2 667 FB-DIMM	062-03118-000	NEC	1	240	2	480		
73GB SAS HDD (3.5"), 15k rpm	062-02782-000	NEC	1	263	2	526		
Upgrade to Platinum Warranty for 3 yrs	4HR-GP-YYY	NEC	1	799	2		1,598	
NEC AccuSync LCD52V 15"LCD Display (+2 spares)	ASLCD52V-BK	NEC	3	175	4	700		
42U Rackframe	050-02378-001	NEC	1	1,799	1	1,799		
USB Floppy Disk Drive (+2 spares)	FDUSB-TM2	Verbatim	3	29	3	87		
Floppy Disk (10 Pack)	86269	Verbatim	3	4	1	4		
Cat5e Patch Cable 25' RJ45-RJ45 (+10% spares)	N001-025-BL	Tripp Lite	3	6	48	288		
Cat5e Crossover Cable 10' RJ45-RJ45 (+2 spares)	N010-010-GY	Tripp Lite	3	5	6	30		
						<b>Subtotal</b>	<b>12,894</b>	<b>1,598</b>

#### Client Software

Windows Server 2003 R2 Standard Edition*	P73-01972	Microsoft	2	719	4	2,876	(Included)	
						<b>Subtotal</b>	<b>2,876</b>	<b>0</b>

#### Infrastructure

Brocade Silkworm 200E 16 Port Fibre Switch (+2 spares)	BR-240E-R001-A	Brocade	4	5,175	5	25,875		
Brocade 4 Port License Upgrade	XBR-SMEDP4POD-0001	Brocade	4	1,050	10	10,500		
6' Null Modem Adapter Cable (+2 spares)	P450-006	Tripp Lite	3	6	3	18		
24-Port 10/100/1000 Gigabit Switch (+2 spares)	SR2024C	Linksys	3	280	4	1,120		
5-port 10/100 switch (+2 spares)	SD205	Linksys	3	32	3	96		
						<b>Subtotal</b>	<b>37,609</b>	<b>0</b>

**TOTAL** 1,451,448 329,578

NEC Large Volume Discount\*\* -10% -112,576 -2,117

#### Notes:

Pricing: 1-NEC Contact: 1-866-632-3226, 2-Microsoft 3-CDW 4-Synegi  
 \* Qty of Windpws Server 2003 R2 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 be vary based on the components in quotation

3-Yr. Cost of Ownership: **\$1,666,334**

tpsE Throughput: **1400.00**

**\$ / tpsE \$1,190.24**

#### 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. Thank you.



NEC Express5800/A1160 (12 Processors)

TPC-E 15.1  
TPC Pricing 1.3.0

Report Date  
November 6, 2008

Available Date  
December 31, 2008

**Numerical Quantities Summary**

**Reported Throughput : 1400.00 tpsE**      **Configured Customers : 700,000**

Response Times (in seconds)	Minimum	Average	90 <sup>th</sup> %tile	Maximum
Broker Volume	0.01	0.05	0.09	1.63
Customer Position	0.00	0.03	0.06	6.14
Market Feed	0.00	0.03	0.07	2.56
Market Watch	0.00	0.04	0.08	10.71
Security Detail	0.00	0.01	0.03	1.51
Trade Lookup	0.00	0.55	0.76	59.42
Trade Order	0.00	0.09	0.15	12.41
Trade Result	0.00	0.09	0.16	12.81
Trade Status	0.00	0.02	0.04	5.45
Trade Update	0.01	0.64	0.82	2.56
Data Maintenance	0.01	0.25		5.25

Transaction Mix	Transaction Count	Mix %
Broker Volume	4,954,393	4.900%
Customer Position	13,144,303	13.000%
Market Feed	1,011,433	1.000%
Market Watch	18,200,170	18.000%
Security Detail	14,155,481	14.000%
Trade Lookup	8,088,360	7.999%
Trade Order	10,212,064	10.100%
Trade Result	10,114,241	10.003%
Trade Status	19,211,202	19.000%
Trade Update	2,022,069	2.000%
Data Maintenance	120	

Test Duration and Timings	
Ramp-up Time	0:29:09
Measurement Interval	2:00:00
Business Recovery Time	1:56:30
Total Number of Transactions Completed in Measurement Interval	101,113,716

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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

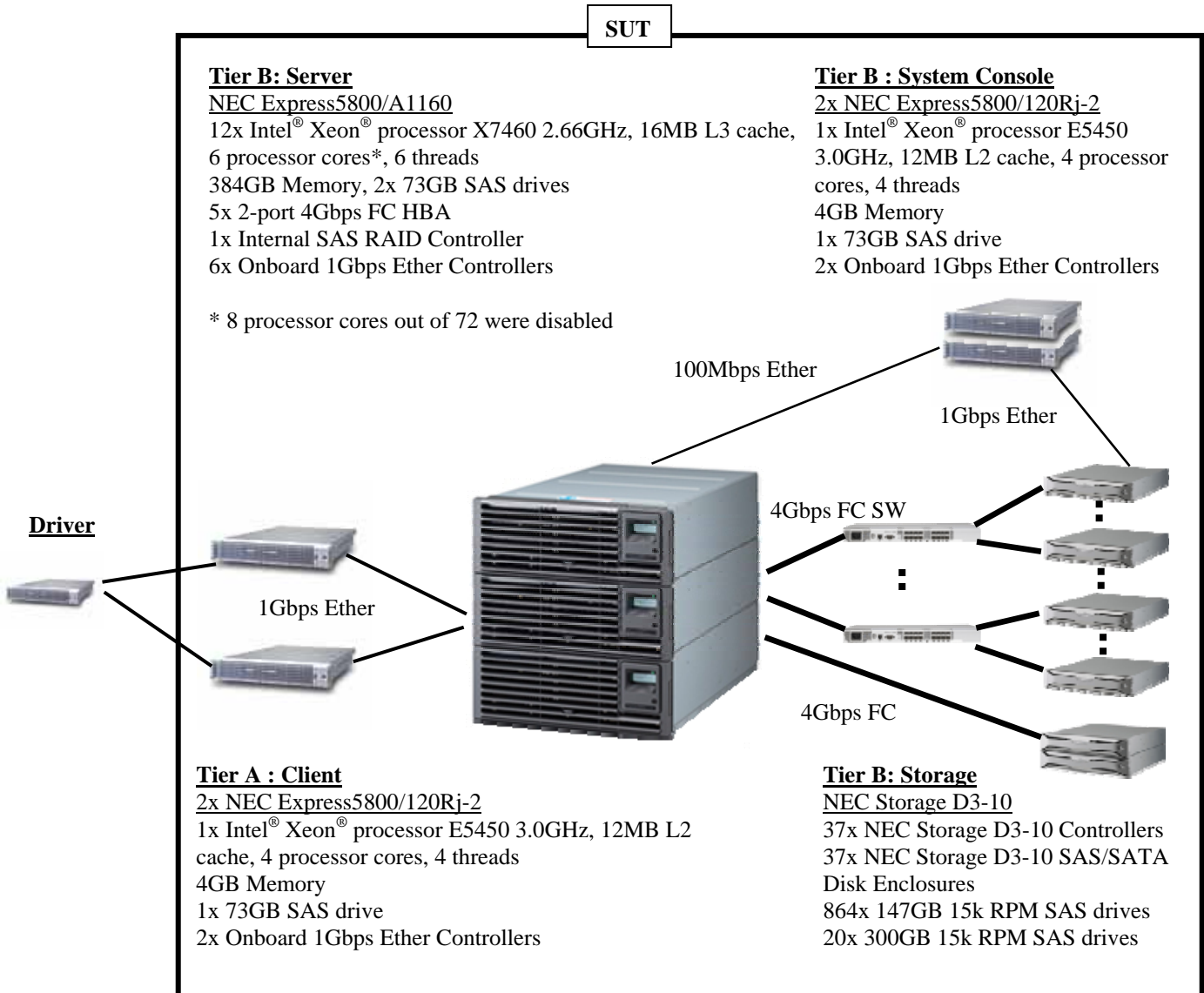
*Diagrams of both measured and Priced Configurations must be reported in the Report, accompanied by a description of the differences. This includes, but is not limited to:*

- *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.).Size of allocated memory, and any specific mapping/partitioning of memory unique to the test.*

## Measured and Priced Configuration

The following figure represents the measured and priced configuration.

**Figure1.1: Express5800/A1160, 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.

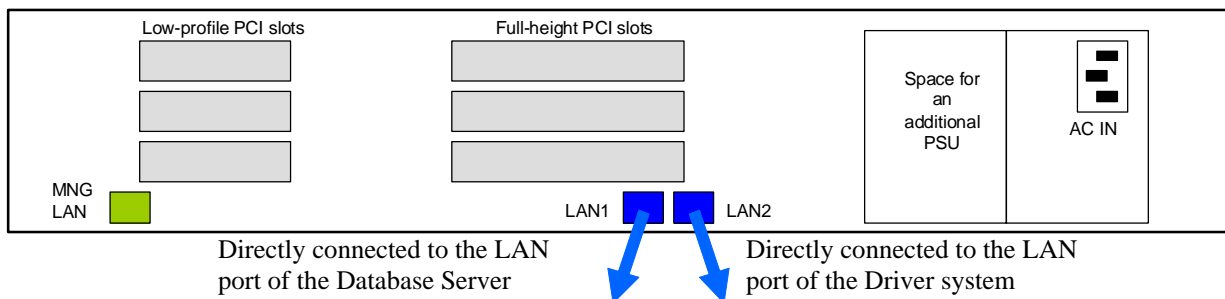
## Driver

The driver is not included in the priced configuration or SUT. In this benchmark, the NEC Express5800/120Rj-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 Express5800/120Rj-2 has 1x Intel® Xeon® processor E5450, 4GB of Memory, 1x 73GB SAS drive. One external USB floppy disk drive, which is priced, is temporarily necessary when OS is to be installed. Tier-A consists of 2x NEC Express5800/120Rj-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 Express5800/120Rj-2)**

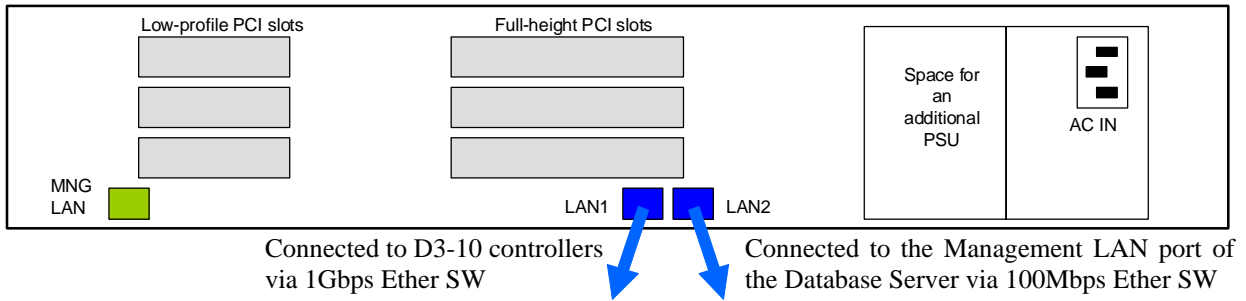


## Tier-B installation / configuration

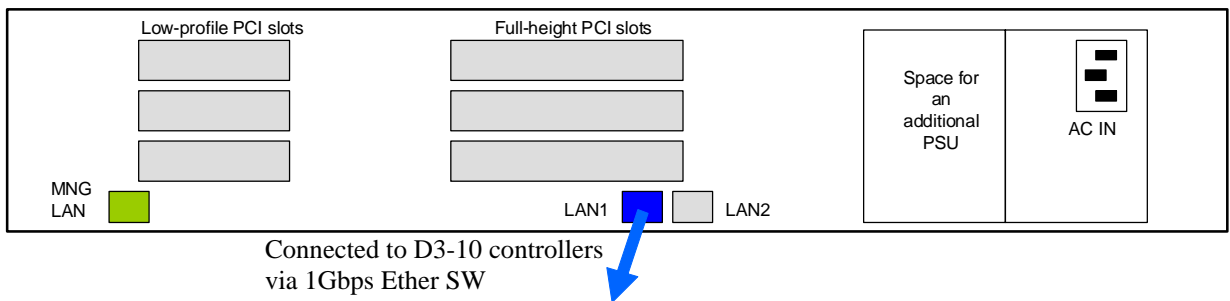
Tier-B hardware consists of three nodes of the NEC Express5800/A1160 as the database server, thirty-seven NEC Storage D3-10 as the Database Array and two NEC Express5800/120Rj-2 as the System Console of the NEC Express5800/A1160 and the NEC Storage D3-10.

The hardware configuration of the System Consoles (NEC Express5800/120Rj-2) is same as that of a Client. The difference is the network configuration. The System Console #1 is connected to the Management LAN port of the Database Server via 100Mbps Ether switch and D3-10 controllers via 1Gbps Ether switch. The System Console #2 is connected to D3-10 controllers via 1Gbps Ether switch.

**Figure1.3: Rear view of the System Console #1 (NEC Express5800/120Rj-2)**



**Figure1.4: Rear view of the System Console #2 (NEC Express5800/120Rj-2)**



The NEC Express5800/A1160 was configured to three nodes in this benchmark. Each node has 4x Intel® Xeon® processor X7460 2.66GHz, 16MB L3 cache, 32x 4GB DIMMs, 2x Onboard 1Gbps Ether Controllers. Only Node#0 has one internal SAS RAID Controller and 2x 73GB SAS drive with Microsoft® Windows Server® 2008 Datacenter x64 Edition.

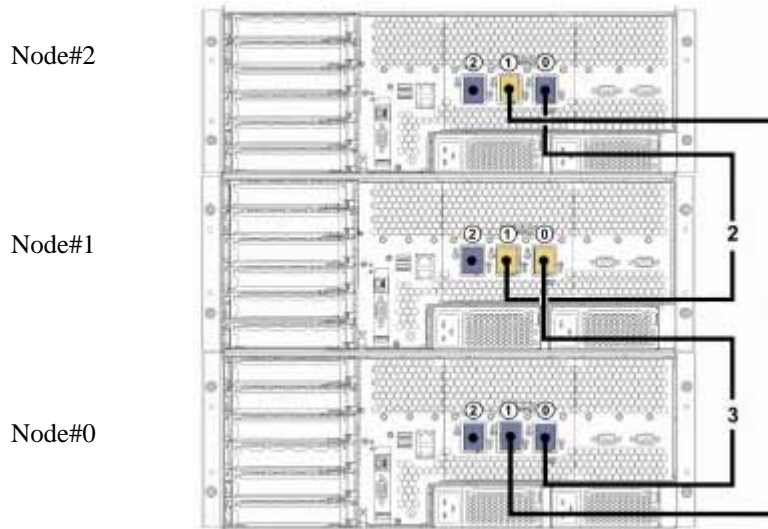
With the NEC Express5800/A1160, customer can request that one to five cores on each Intel® Xeon® X7460 processor be disabled. Disabling of cores at customer's request, is done by NEC prior to customer shipment. Once disable by NEC, the cores can only be re-enabled by NEC personnel.

In this benchmark eight processor cores out of 72 were disabled on the three nodes of the NEC Express5800/A1160 as follows:

Node#0	Socket#2	Core#5
	Socket#3	Core#5
Node#1	Socket#1	Core#5
	Socket#2	Core#5
	Socket#3	Core#5
Node#2	Socket#1	Core#5
	Socket#2	Core#5
	Socket#3	Core#5

Three nodes of NEC Express5800/A1160 were connected with three HSI cables as Figure 1.5.

**Figure1.5: Connection diagram for the NEC Express5800/A1160 three nodes**



The 2x 2-port 4Gbps FC HBAs were installed to the PCI-Express slots of two nodes of the NEC Express5800/A1160 and one 2-port 4Gbps FC HBA was installed to the PCI-Express slot of one node of the NEC Express5800/A1160. They were connected to the Database Array via 16-port 4Gbps FC switches as follows:

---- Node#0 ----

Management LAN	to the system console #1 via 100Mbps Ether switch
Onboard LAN#0	to GbE NIC of client #1
Onboard LAN#1	to GbE NIC of client #2
PCI-Express #0: 2-port 4G bps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #2: 2-port 4G bps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch

---- Node#1 ----

Management LAN	to the system console #1 via 100Mbps Ether switch
PCI-Express #0: 2-port 4G bps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch
PCI-Express #2: 2-port 4G bps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch

---- Node#2 ----

Management LAN	to the system console #1 via 100Mbps Ether switch
PCI-Express #0: 2-port 4G bps FC HBA	to D3-10 Controllers via 16-port 4Gbps FC switch



**Figure1.6: Rear view of the Server (NEC Express5800/A1160)**

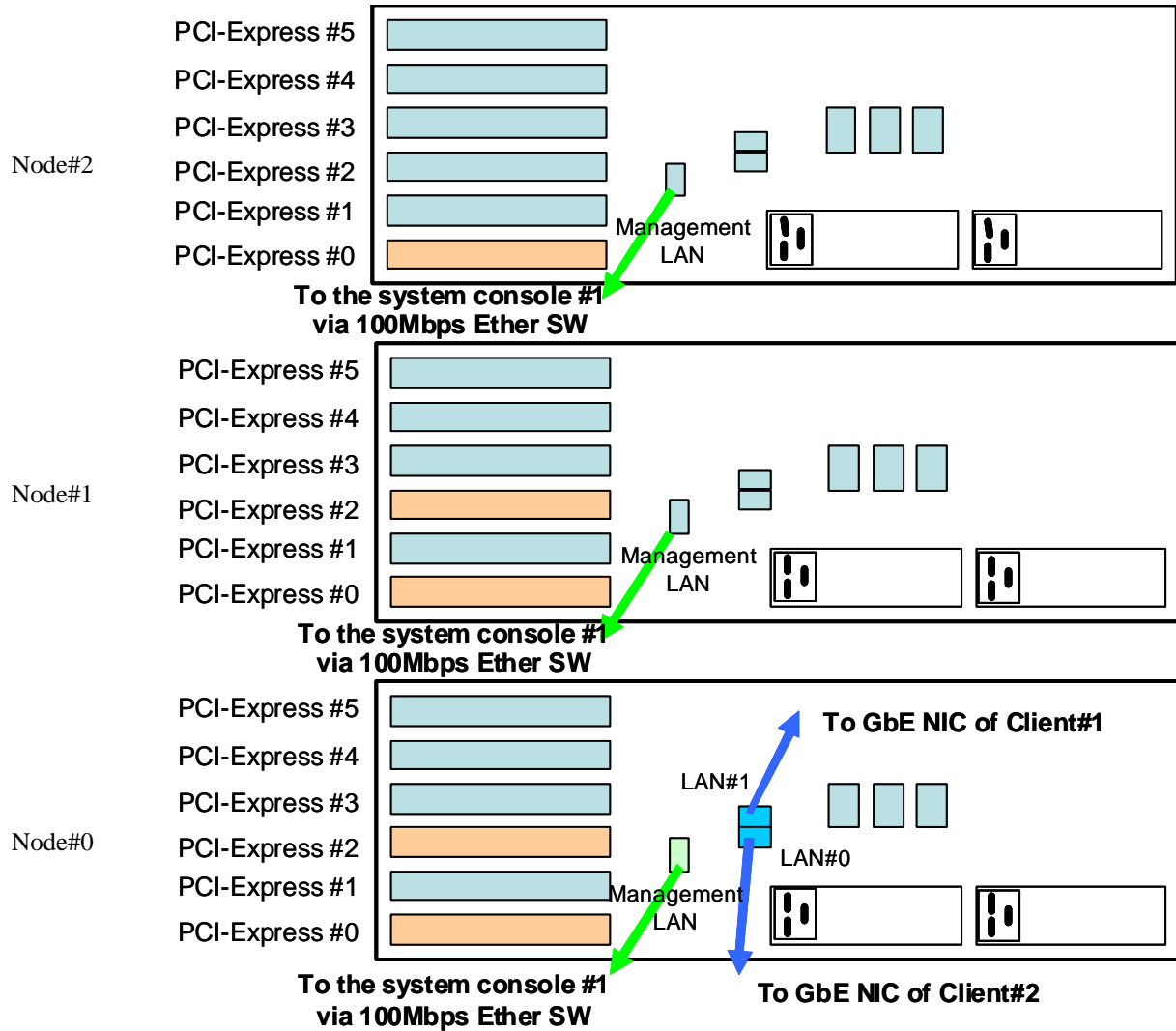
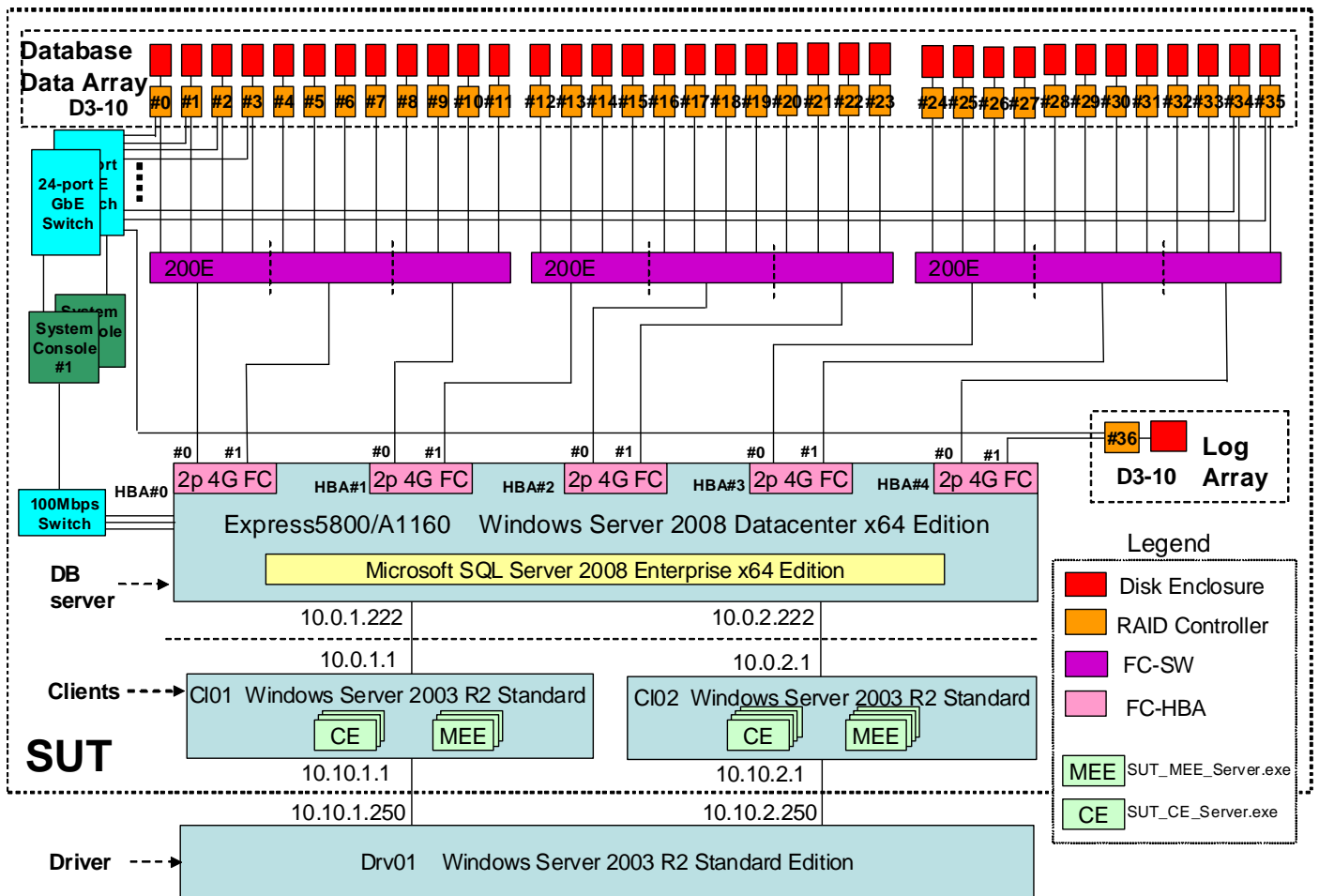


Figure1.7: Overview of the whole system connections



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

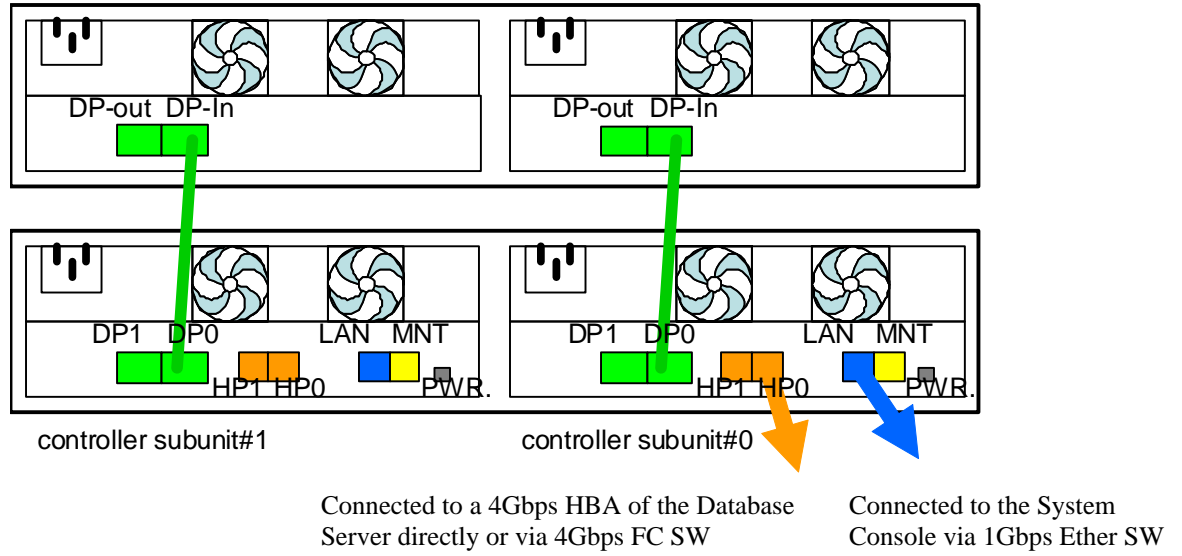
The Database Array consists of two types of disk array system. One is Database Data Array and the other is Log Array.

Database Data Array has thirty-six NEC Storage D3-10 controllers and thirty-six 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 1.8 to check the connection diagram for the NEC Storage D3-10 controller and the disk enclosure.

**Figure1.8: 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® 2003 R2 Standard Edition with SP2. Proprietary driver was installed on the machine.

## **Tier-A**

### **OS Installation**

**Step.1:** Create an “OEM-Disk”

1. Prepare a DVD medium attached to a NEC Express5800/120Rj-2 which contains a setup utility called “NEC EXPRESSBUILDER”.
2. Put the EXPRESSBUILDER DVD medium into the DVD drive of the NEC Express5800/120Rj-2.
3. Connect a USB Floppy Disk Drive to the NEC Express5800/120Rj-2 and power on it, then EXPRESSBUILDER tool boots from DVD.
4. Select “Create the OEM-Disk for Windows” from “Tools Menu” step.
5. Select “Create an Windows Server® 2003 OEM-Disk for EXPRESSBUILDER” at “Create OEM-Disk” and click “Perform”.
6. Insert a blank medium into the Floppy Disk Drive according to the instruction on the screen.
7. Wait for the creation completed.
8. Remove the EXPRESSBUILDER DVD medium from the DVD drive, and power off the NEC Express5800/120Rj-2.

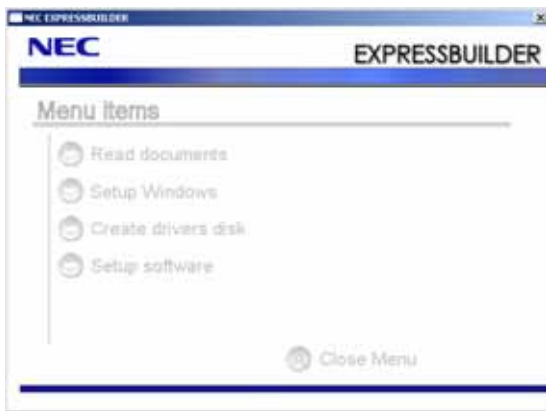
**Step.2:** Install “Windows Server® 2003 R2 with SP2”

1. Put an OS install medium into the DVD drive of the NEC Express5800/120Rj-2.
2. Power on the NEC Express5800/120Rj-2 with a USB Floppy Disk Drive attached, then “Windows Setup” boots from the OS install medium.
3. When you see “Press F6, If you need...” on the bottom of the “Windows Setup” screen, press “F6” key and confirm that there is the OEM-Disk in the Floppy Disk Drive.
4. When “Windows Setup” program requires, press “S” key and select “LSI Logic MegaRAID SAS Controller Driver (Server 2003 32bit)” from driver list.
5. Continue normal Windows installation.

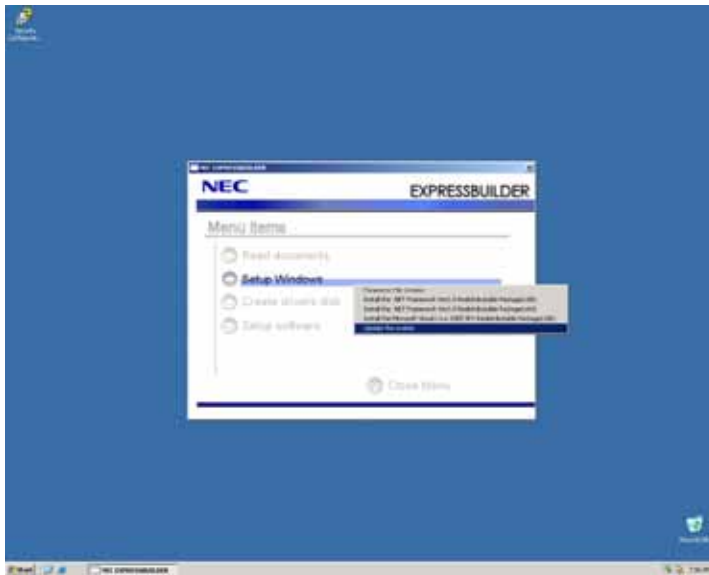
**Step.3:** Install driver

1. After Windows installation completes, put the EXPRESSBUILDER DVD medium into the DVD drive of the NEC Express5800/120Rj-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 Express5800/120Rj-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 "10.1.1.x".

"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® Installation (only client #1)**

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

## **Benchmark module Installation**

After the OS installed, install the VCREDIST\_X86.EXE, SUT\_CE\_Server.exe and SUT\_MEE\_Server.exe.

## **Tier-B**

Tier-B hardware consists of three nodes of the NEC Express5800/A1160 as the database server, thirty-seven NEC Storage D3-10 as the Database Array and two NEC Express5800/120Rj-2 as the System Console of the NEC Express5800/A1160 and the NEC Storage D3-10.

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

### **OS Installation**

The OS installation procedure on the System Console, NEC Express5800/120Rj-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 “192.168.0.201”.

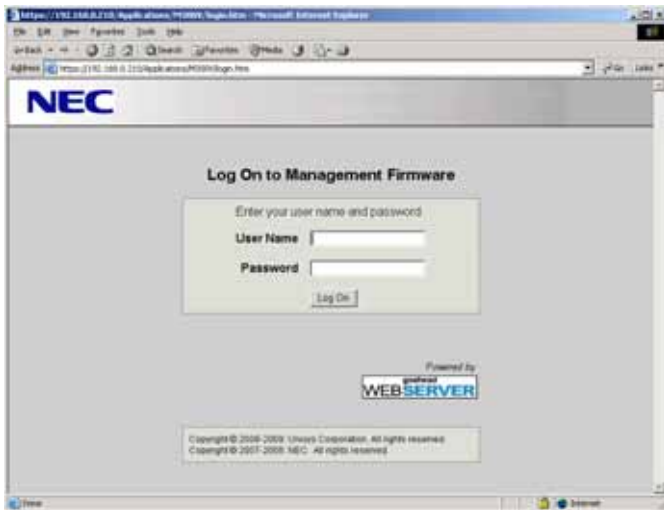
## **Tier-B : The Database Server**

### **Power up the database server, Express5800/A1160**

The System Console #1 is connected from its GbE port to the Management LAN port of the database server, NEC Express5800/A1160 via 100Mbps Ether Switch. Following steps are executed on the System Console #1.

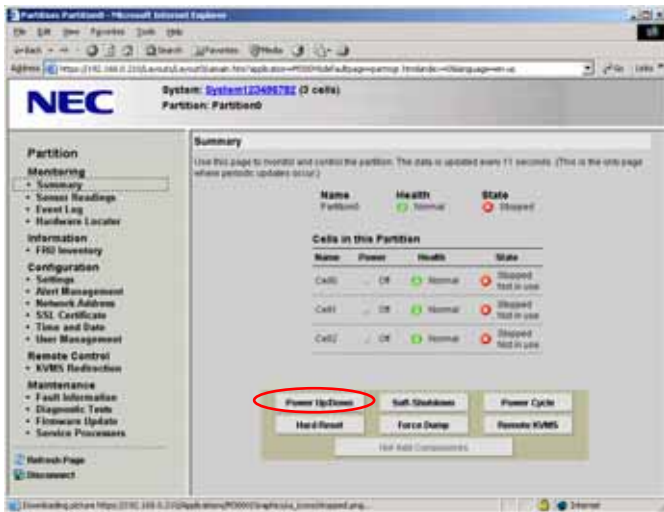
***Step.1:*** Start up “Internet Explorer”.

**Step.2:** Enter “http://192.168.0.210/” 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 Up/Down”.



**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 Datacenter x64 Edition installed.

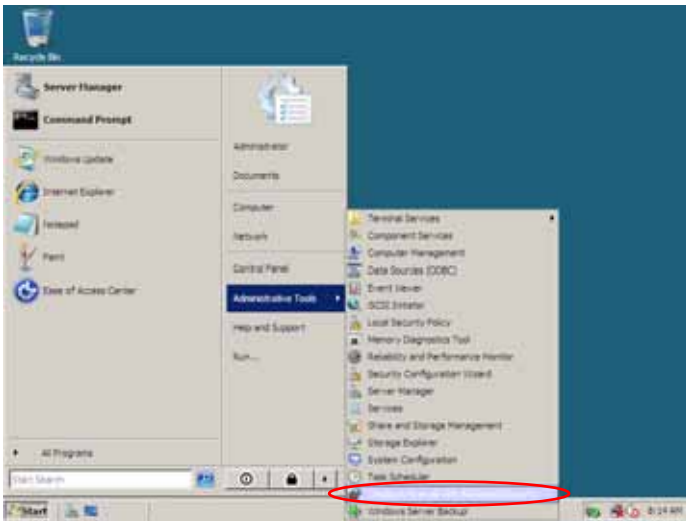
## OS Configuration

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

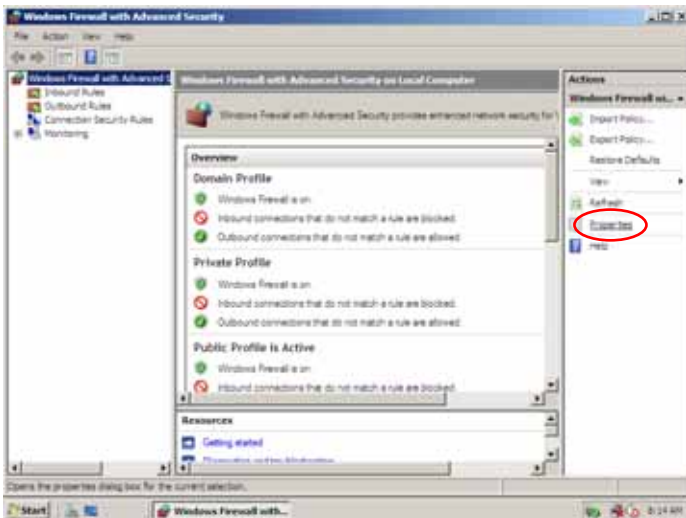
### Disable “Windows Firewall”

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

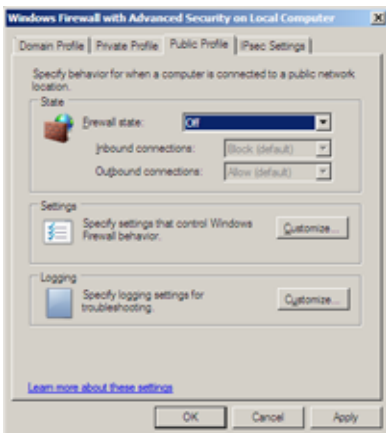
1. Launch “Administrator Tools” -> “Windows Firewall with Advanced Security”.



2. Click “Properties”.



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





## Configure “services”

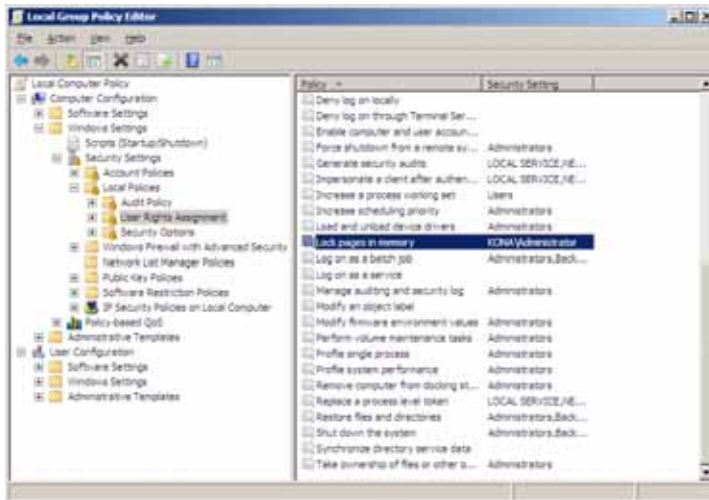
1. Run “services.msc” from “Run...” of the Start menu.
2. Configure each OS service as shown in the portion “[Services]” of syhwTierB.out (included in the Supporting Files).
3. Reboot OS to reflect new configuration.

## 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.

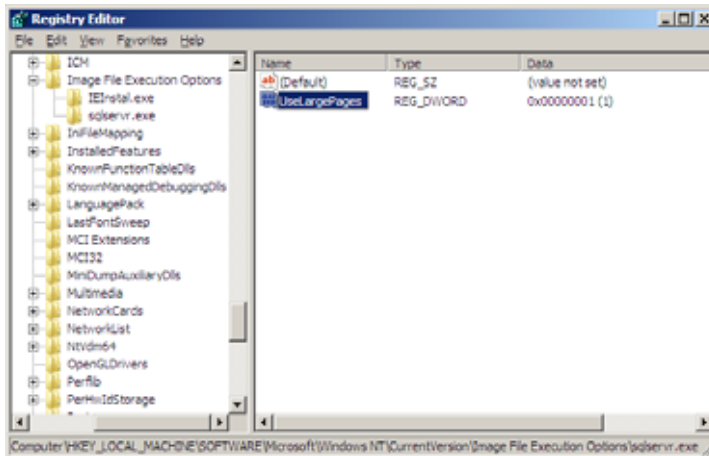
1. Start “regedit.exe” from “Run...” of the Start Menu.



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.

## 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\_[1..10].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

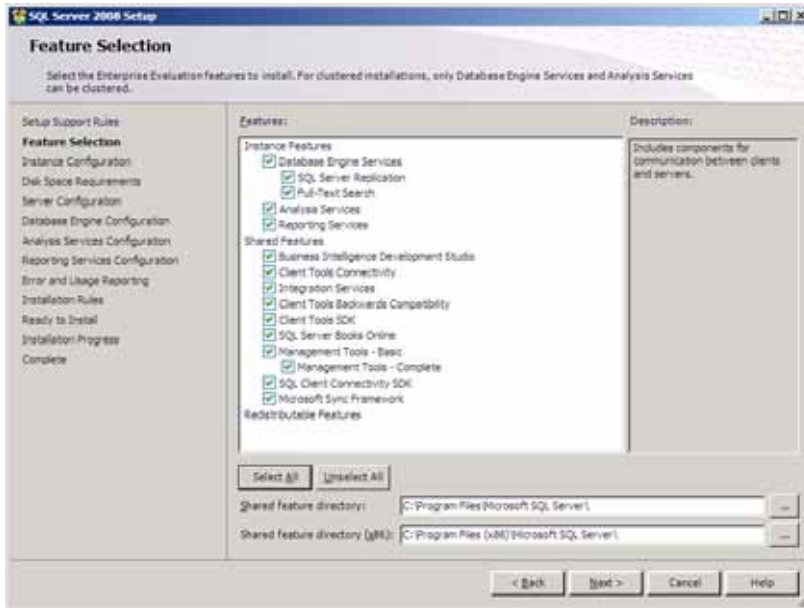
Assign mount points using diskpart command. Execute “diskpart /s mount.txt” from the command line. (the script file “mount.txt” is included in the Supporting Files).

## SQL Server® Installation

Install Microsoft® SQL Server® 2008 Enterprise x64 Edition. Here are the notes for the installation.

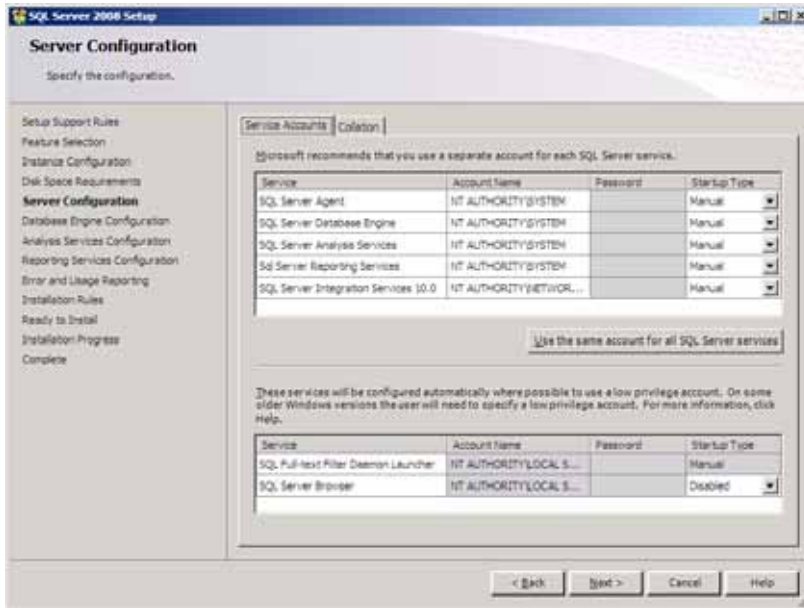
## Step.1: "Feature Selection"

Select all Features.



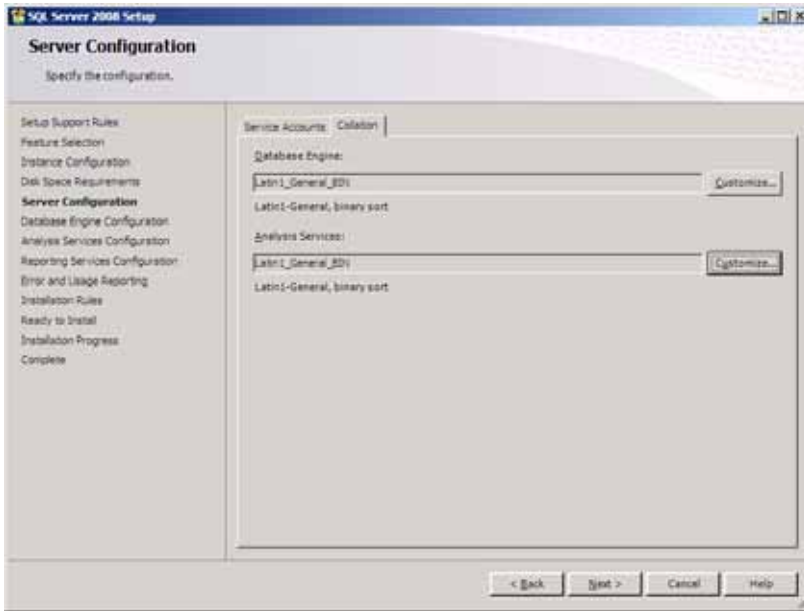
## Step.2: "Server Configuration"

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 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	1	1
awe enabled	0	1	0	0
backup compression default	0	1	0	0
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	1	1
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	64	1	1
max full-text crawl range	0	256	4	4
max server memory (MB)	16	2147483647	360448	360448
max text repl size (B)	-1	2147483647	65536	65536
max worker threads	128	32767	1900	1900
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	20	20
remote proc trans	0	1	0	0

remote query timeout (s)	0	2147483647	600	600
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 tempdb**

Run tempdb.sql to increase the size of the temporary database (the sql file “tempdb.sql” 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 700,000 customers. The SQL Server<sup>®</sup> scripts and setup command files are included in the Supporting Files\Clause2 folder. Four file groups are used for tables and indices. One filegroup called broker\_fg for the Broker-related TPC-E tables and one filegroup called market\_fg for the Market-related TPC-E tables and one filegroup called customer\_fg for the Customer-related TPC-E tables and the other filegroup called misc\_fg for all the other TPC-E tables. broker\_fg uses all the Z:\Device\Broker\_\* disk partitions. market\_fg uses all the Z:\Device\Market\_\* disk partitions. customer\_fg uses all the Z:\Device\Customer\_\* disk partitions. misc\_fg uses Z:\Device\Data\_01\TPCE\_Misc.ndf. The database log uses the Z:\Device\TPCE\_Log partition.

### Table Organization

*The physical organization of tables and indices, within the database, must be reported in the Report.*

Physical space was allocated to Microsoft<sup>®</sup> SQL Server<sup>®</sup> 2008 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 700,000 customers.

**Table 2.1 Number of Rows for Server**

Table Name	Rows Loaded
<b>Scaling Tables</b>	
ACCOUNT PERMISSION	4,970,435
ADDRESS	1,050,004
BROKER	7,000

COMPANY	350,000
COMPANY COMPETITOR	1,050,000
CUSTOMER	700,000
CUSTOMER ACCOUNT	3,500,000
CUSTOMER TAXRATE	1,400,000
DAILY MARKET	625,747,500
FINANCIAL	7,000,000
LAST TRADE	479,500
NEWS ITEM	700,000
NEWS XREF	700,000
SECURITY	479,500
WATCH ITEM	70,007,791
WATCH LIST	700,000
<b>Growing Tables</b>	
CASH TRANSACTION	11,128,317,034
HOLDING	619,295,975
HOLDING HISTORY	16,210,625,558
HOLDING SUMMARY	34,817,394
SETTLEMENT	12,096,000,000
TRADE	12,096,000,000
TRADE HISTORY	29,030,425,771
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	2x73GB, 15K, SAS internal RAID1	C: (NTFS)	67.05GB	OS
1	0	0-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_07\ (RAW) Z:\Device\Market_07\ (RAW) Z:\Device\Customer_07\ (RAW) Z:\Device\Backup_07\ (NTFS)	80GB 5GB 20GB 693GB	Broker_07 Market_07 Customer_07
2	0		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_08\ (RAW) Z:\Device\Market_08\ (RAW) Z:\Device\Customer_08\ (RAW) Z:\Device\Backup_08\ (NTFS)	80GB 5GB 20GB 693GB	Broker_08 Market_08 Customer_08
3	1		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_01\ (RAW) Z:\Device\Market_01\ (RAW) Z:\Device\Customer_01\ (RAW) Z:\Device\Backup_01\ (NTFS) -> <b>alias</b> Z:\Device\Data_01\ (NTFS)	80GB 5GB 20GB 693GB (693GB)	Broker_01 Market_01 Customer_01 TPCE_Misc.nfd
4	1		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_02\ (RAW) Z:\Device\Market_02\ (RAW) Z:\Device\Customer_02\ (RAW) Z:\Device\Backup_02\ (NTFS)	80GB 5GB 20GB 693GB	Broker_02 Market_02 Customer_02
5	2		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_03\ (RAW) Z:\Device\Market_03\ (RAW) Z:\Device\Customer_03\ (RAW) Z:\Device\Backup_03\ (NTFS)	80GB 5GB 20GB 693GB	Broker_03 Market_03 Customer_03
6	2		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_04\ (RAW) Z:\Device\Market_04\ (RAW) Z:\Device\Customer_04\ (RAW) Z:\Device\Backup_04\ (NTFS)	80GB 5GB 20GB 693GB	Broker_04 Market_04 Customer_04
7	3		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_05\ (RAW) Z:\Device\Market_05\ (RAW) Z:\Device\Customer_05\ (RAW) Z:\Device\Backup_05\ (NTFS)	80GB 5GB 20GB 693GB	Broker_05 Market_05 Customer_05
8	3		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_06\ (RAW) Z:\Device\Market_06\ (RAW) Z:\Device\Customer_06\ (RAW) Z:\Device\Backup_06\ (NTFS)	80GB 5GB 20GB 693GB	Broker_06 Market_06 Customer_06

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

9	4	0-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_09\ (RAW) Z:\Device\Market_09\ (RAW) Z:\Device\Customer_09\ (RAW) Z:\Device\Backup_09\ (NTFS)	80GB 5GB 20GB 693GB	Broker_09 Market_09 Customer_09
10	4		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_10\ (RAW) Z:\Device\Market_10\ (RAW) Z:\Device\Customer_10\ (RAW) Z:\Device\Backup_10\ (NTFS)	80GB 5GB 20GB 693GB	Broker_10 Market_10 Customer_10
11	5		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_11\ (RAW) Z:\Device\Market_11\ (RAW) Z:\Device\Customer_11\ (RAW) Z:\Device\Backup_11\ (NTFS) -> alias Z:\Device\TPCE_TempDB\ (NTFS)	80GB 5GB 20GB 693GB (693GB)	Broker_11 Market_11 Customer_11 tempdb.mdf
12	5		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_12\ (RAW) Z:\Device\Market_12\ (RAW) Z:\Device\Customer_12\ (RAW) Z:\Device\Backup_12\ (NTFS)	80GB 5GB 20GB 693GB	Broker_12 Market_12 Customer_12
13	6		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_15\ (RAW) Z:\Device\Market_15\ (RAW) Z:\Device\Customer_15\ (RAW) Z:\Device\Backup_15\ (NTFS)	80GB 5GB 20GB 693GB	Broker_15 Market_15 Customer_15
14	6		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_16\ (RAW) Z:\Device\Market_16\ (RAW) Z:\Device\Customer_16\ (RAW) Z:\Device\Backup_16\ (NTFS)	80GB 5GB 20GB 693GB	Broker_16 Market_16 Customer_16
15	7		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_13\ (RAW) Z:\Device\Market_13\ (RAW) Z:\Device\Customer_13\ (RAW) Z:\Device\Backup_13\ (NTFS)	80GB 5GB 20GB 693GB	Broker_13 Market_13 Customer_13
16	7		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_14\ (RAW) Z:\Device\Market_14\ (RAW) Z:\Device\Customer_14\ (RAW) Z:\Device\Backup_14\ (NTFS)	80GB 5GB 20GB 693GB	Broker_14 Market_14 Customer_14
17	8	1-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_37\ (RAW) Z:\Device\Market_37\ (RAW) Z:\Device\Customer_37\ (RAW)	80GB 5GB 20GB	Broker_37 Market_37 Customer_37
18	8		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_38\ (RAW) Z:\Device\Market_38\ (RAW) Z:\Device\Customer_38\ (RAW)	80GB 5GB 20GB	Broker_38 Market_38 Customer_38
19	9		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_39\ (RAW) Z:\Device\Market_39\ (RAW) Z:\Device\Customer_39\ (RAW)	80GB 5GB 20GB	Broker_39 Market_39 Customer_39
20	9		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_40\ (RAW) Z:\Device\Market_40\ (RAW) Z:\Device\Customer_40\ (RAW)	80GB 5GB 20GB	Broker_40 Market_40 Customer_40
21	10		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_33\ (RAW) Z:\Device\Market_33\ (RAW) Z:\Device\Customer_33\ (RAW) Z:\Device\Backup_33\ (NTFS)	80GB 5GB 20GB 693GB	Broker_33 Market_33 Customer_33
22	10		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_34\ (RAW) Z:\Device\Market_34\ (RAW) Z:\Device\Customer_34\ (RAW) Z:\Device\Backup_34\ (NTFS)	80GB 5GB 20GB 693GB	Broker_34 Market_34 Customer_34
23	11		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_35\ (RAW) Z:\Device\Market_35\ (RAW) Z:\Device\Customer_35\ (RAW) Z:\Device\Backup_35\ (NTFS)	80GB 5GB 20GB 693GB	Broker_35 Market_35 Customer_35
24	11		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_36\ (RAW) Z:\Device\Market_36\ (RAW) Z:\Device\Customer_36\ (RAW) Z:\Device\Backup_36\ (NTFS)	80GB 5GB 20GB 693GB	Broker_36 Market_36 Customer_36

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

25	12	1-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_41\ (RAW) Z:\Device\Market_41\ (RAW) Z:\Device\Customer_41\ (RAW)	80GB 5GB 20GB	Broker_41 Market_41 Customer_41
26	12		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_42\ (RAW) Z:\Device\Market_42\ (RAW) Z:\Device\Customer_42\ (RAW)	80GB 5GB 20GB	Broker_42 Market_42 Customer_42
27	13		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_43\ (RAW) Z:\Device\Market_43\ (RAW) Z:\Device\Customer_43\ (RAW)	80GB 5GB 20GB	Broker_43 Market_43 Customer_43
28	13		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_44\ (RAW) Z:\Device\Market_44\ (RAW) Z:\Device\Customer_44\ (RAW)	80GB 5GB 20GB	Broker_44 Market_44 Customer_44
29	14		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_47\ (RAW) Z:\Device\Market_47\ (RAW) Z:\Device\Customer_47\ (RAW)	80GB 5GB 20GB	Broker_47 Market_47 Customer_47
30	14		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_48\ (RAW) Z:\Device\Market_48\ (RAW) Z:\Device\Customer_48\ (RAW)	80GB 5GB 20GB	Broker_48 Market_48 Customer_48
31	15		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_45\ (RAW) Z:\Device\Market_45\ (RAW) Z:\Device\Customer_45\ (RAW)	80GB 5GB 20GB	Broker_45 Market_45 Customer_45
32	15		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_46\ (RAW) Z:\Device\Market_46\ (RAW) Z:\Device\Customer_46\ (RAW)	80GB 5GB 20GB	Broker_46 Market_46 Customer_46
33	16	2-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_23\ (RAW) Z:\Device\Market_23\ (RAW) Z:\Device\Customer_23\ (RAW) Z:\Device\Backup_23\ (NTFS)	80GB 5GB 20GB 693GB	Broker_23 Market_23 Customer_23
34	16		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_24\ (RAW) Z:\Device\Market_24\ (RAW) Z:\Device\Customer_24\ (RAW) Z:\Device\Backup_24\ (NTFS)	80GB 5GB 20GB 693GB	Broker_24 Market_24 Customer_24
35	17		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_19\ (RAW) Z:\Device\Market_19\ (RAW) Z:\Device\Customer_19\ (RAW) Z:\Device\Backup_19\ (NTFS)	80GB 5GB 20GB 693GB	Broker_19 Market_19 Customer_19
36	17		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_20\ (RAW) Z:\Device\Market_20\ (RAW) Z:\Device\Customer_20\ (RAW) Z:\Device\Backup_20\ (NTFS)	80GB 5GB 20GB 693GB	Broker_20 Market_20 Customer_20
37	18		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_21\ (RAW) Z:\Device\Market_21\ (RAW) Z:\Device\Customer_21\ (RAW) Z:\Device\Backup_21\ (NTFS) -> <b>alias</b> Z:\Device\TPCE_TempLog\ (NTFS)	80GB 5GB 20GB 693GB (693GB)	Broker_21 Market_21 Customer_21 templog.ldf
38	18		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_22\ (RAW) Z:\Device\Market_22\ (RAW) Z:\Device\Customer_22\ (RAW) Z:\Device\Backup_22\ (NTFS)	80GB 5GB 20GB 693GB	Broker_22 Market_22 Customer_22
39	19		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_17\ (RAW) Z:\Device\Market_17\ (RAW) Z:\Device\Customer_17\ (RAW) Z:\Device\Backup_17\ (NTFS)	80GB 5GB 20GB 693GB	Broker_17 Market_17 Customer_17
40	19		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_18\ (RAW) Z:\Device\Market_18\ (RAW) Z:\Device\Customer_18\ (RAW) Z:\Device\Backup_18\ (NTFS)	80GB 5GB 20GB 693GB	Broker_18 Market_18 Customer_18

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

41	20	2-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_29\ (RAW) Z:\Device\Market_29\ (RAW) Z:\Device\Customer_29\ (RAW) Z:\Device\Backup_29\ (NTFS)	80GB 5GB 20GB 693GB	Broker_29 Market_29 Customer_29
42	20		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_30\ (RAW) Z:\Device\Market_30\ (RAW) Z:\Device\Customer_30\ (RAW) Z:\Device\Backup_30\ (NTFS)	80GB 5GB 20GB 693GB	Broker_30 Market_30 Customer_30
43	21		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_25\ (RAW) Z:\Device\Market_25\ (RAW) Z:\Device\Customer_25\ (RAW) Z:\Device\Backup_25\ (NTFS)	80GB 5GB 20GB 693GB	Broker_25 Market_25 Customer_25
44	21		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_26\ (RAW) Z:\Device\Market_26\ (RAW) Z:\Device\Customer_26\ (RAW) Z:\Device\Backup_26\ (NTFS)	80GB 5GB 20GB 693GB	Broker_26 Market_26 Customer_26
45	22		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_31\ (RAW) Z:\Device\Market_31\ (RAW) Z:\Device\Customer_31\ (RAW) Z:\Device\Backup_31\ (NTFS)	80GB 5GB 20GB 693GB	Broker_31 Market_31 Customer_31
46	22		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_32\ (RAW) Z:\Device\Market_32\ (RAW) Z:\Device\Customer_32\ (RAW) Z:\Device\Backup_32\ (NTFS)	80GB 5GB 20GB 693GB	Broker_32 Market_32 Customer_32
47	23		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_27\ (RAW) Z:\Device\Market_27\ (RAW) Z:\Device\Customer_27\ (RAW) Z:\Device\Backup_27\ (NTFS)	80GB 5GB 20GB 693GB	Broker_27 Market_27 Customer_27
48	23		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_28\ (RAW) Z:\Device\Market_28\ (RAW) Z:\Device\Customer_28\ (RAW) Z:\Device\Backup_28\ (NTFS)	80GB 5GB 20GB 693GB	Broker_28 Market_28 Customer_28
49	24	3-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_57\ (RAW) Z:\Device\Market_57\ (RAW) Z:\Device\Customer_57\ (RAW)	80GB 5GB 20GB	Broker_57 Market_57 Customer_57
50	24		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_58\ (RAW) Z:\Device\Market_58\ (RAW) Z:\Device\Customer_58\ (RAW)	80GB 5GB 20GB	Broker_58 Market_58 Customer_58
51	25		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_59\ (RAW) Z:\Device\Market_59\ (RAW) Z:\Device\Customer_59\ (RAW)	80GB 5GB 20GB	Broker_59 Market_59 Customer_59
52	25		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_60\ (RAW) Z:\Device\Market_60\ (RAW) Z:\Device\Customer_60\ (RAW)	80GB 5GB 20GB	Broker_60 Market_60 Customer_60
53	26		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_61\ (RAW) Z:\Device\Market_61\ (RAW) Z:\Device\Customer_61\ (RAW)	80GB 5GB 20GB	Broker_61 Market_61 Customer_61
54	26		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_62\ (RAW) Z:\Device\Market_62\ (RAW) Z:\Device\Customer_62\ (RAW)	80GB 5GB 20GB	Broker_62 Market_62 Customer_62
55	27		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_63\ (RAW) Z:\Device\Market_63\ (RAW) Z:\Device\Customer_63\ (RAW)	80GB 5GB 20GB	Broker_63 Market_63 Customer_63
56	27		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_64\ (RAW) Z:\Device\Market_64\ (RAW) Z:\Device\Customer_64\ (RAW)	80GB 5GB 20GB	Broker_64 Market_64 Customer_64

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

57	28	3-1	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_71\ (RAW) Z:\Device\Market_71\ (RAW) Z:\Device\Customer_71\ (RAW)	80GB 5GB 20GB	Broker_71 Market_71 Customer_71
58	28		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_72\ (RAW) Z:\Device\Market_72\ (RAW) Z:\Device\Customer_72\ (RAW)	80GB 5GB 20GB	Broker_72 Market_72 Customer_72
59	29		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_65\ (RAW) Z:\Device\Market_65\ (RAW) Z:\Device\Customer_65\ (RAW)	80GB 5GB 20GB	Broker_65 Market_65 Customer_65
60	29		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_66\ (RAW) Z:\Device\Market_66\ (RAW) Z:\Device\Customer_66\ (RAW)	80GB 5GB 20GB	Broker_66 Market_66 Customer_66
61	30		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_69\ (RAW) Z:\Device\Market_69\ (RAW) Z:\Device\Customer_69\ (RAW)	80GB 5GB 20GB	Broker_69 Market_69 Customer_69
62	30		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_70\ (RAW) Z:\Device\Market_70\ (RAW) Z:\Device\Customer_70\ (RAW)	80GB 5GB 20GB	Broker_70 Market_70 Customer_70
63	31		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_67\ (RAW) Z:\Device\Market_67\ (RAW) Z:\Device\Customer_67\ (RAW)	80GB 5GB 20GB	Broker_67 Market_67 Customer_67
64	31		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_68\ (RAW) Z:\Device\Market_68\ (RAW) Z:\Device\Customer_68\ (RAW)	80GB 5GB 20GB	Broker_68 Market_68 Customer_68
65	32	4-0	12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_49\ (RAW) Z:\Device\Market_49\ (RAW) Z:\Device\Customer_49\ (RAW)	80GB 5GB 20GB	Broker_49 Market_49 Customer_49
66	32		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_50\ (RAW) Z:\Device\Market_50\ (RAW) Z:\Device\Customer_50\ (RAW)	80GB 5GB 20GB	Broker_50 Market_50 Customer_50
67	33		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_55\ (RAW) Z:\Device\Market_55\ (RAW) Z:\Device\Customer_55\ (RAW)	80GB 5GB 20GB	Broker_55 Market_55 Customer_55
68	33		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_56\ (RAW) Z:\Device\Market_56\ (RAW) Z:\Device\Customer_56\ (RAW)	80GB 5GB 20GB	Broker_56 Market_56 Customer_56
69	34		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_53\ (RAW) Z:\Device\Market_53\ (RAW) Z:\Device\Customer_53\ (RAW)	80GB 5GB 20GB	Broker_53 Market_53 Customer_53
70	34		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_54\ (RAW) Z:\Device\Market_54\ (RAW) Z:\Device\Customer_54\ (RAW)	80GB 5GB 20GB	Broker_54 Market_54 Customer_54
71	35		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_51\ (RAW) Z:\Device\Market_51\ (RAW) Z:\Device\Customer_51\ (RAW)	80GB 5GB 20GB	Broker_51 Market_51 Customer_51
72	35		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_52\ (RAW) Z:\Device\Market_52\ (RAW) Z:\Device\Customer_52\ (RAW)	80GB 5GB 20GB	Broker_52 Market_52 Customer_52
73	36	4-1	12x300GB, 15K, SAS D3-10 Base model RAID50 8x300GB, 15K, SAS D3-10 Disk Enclosure RAID50	Z: (NTFS) Z:\Device\TPCE_Log\ (RAW)	10GB 500GB	Log

## 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).*

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

## 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 1.7.



## 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). (9.3.5.1)*

EGen v1.5.1 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. (9.5.3.2)*

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.(9.3.5.3)*

EGen has not been modified in this benchmark.

### **EGenLoader Extentions**

*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) (9.3.5.4).*

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 instance is seven. The number of EGenDriverCE instance is seven.

## Measured Throughput

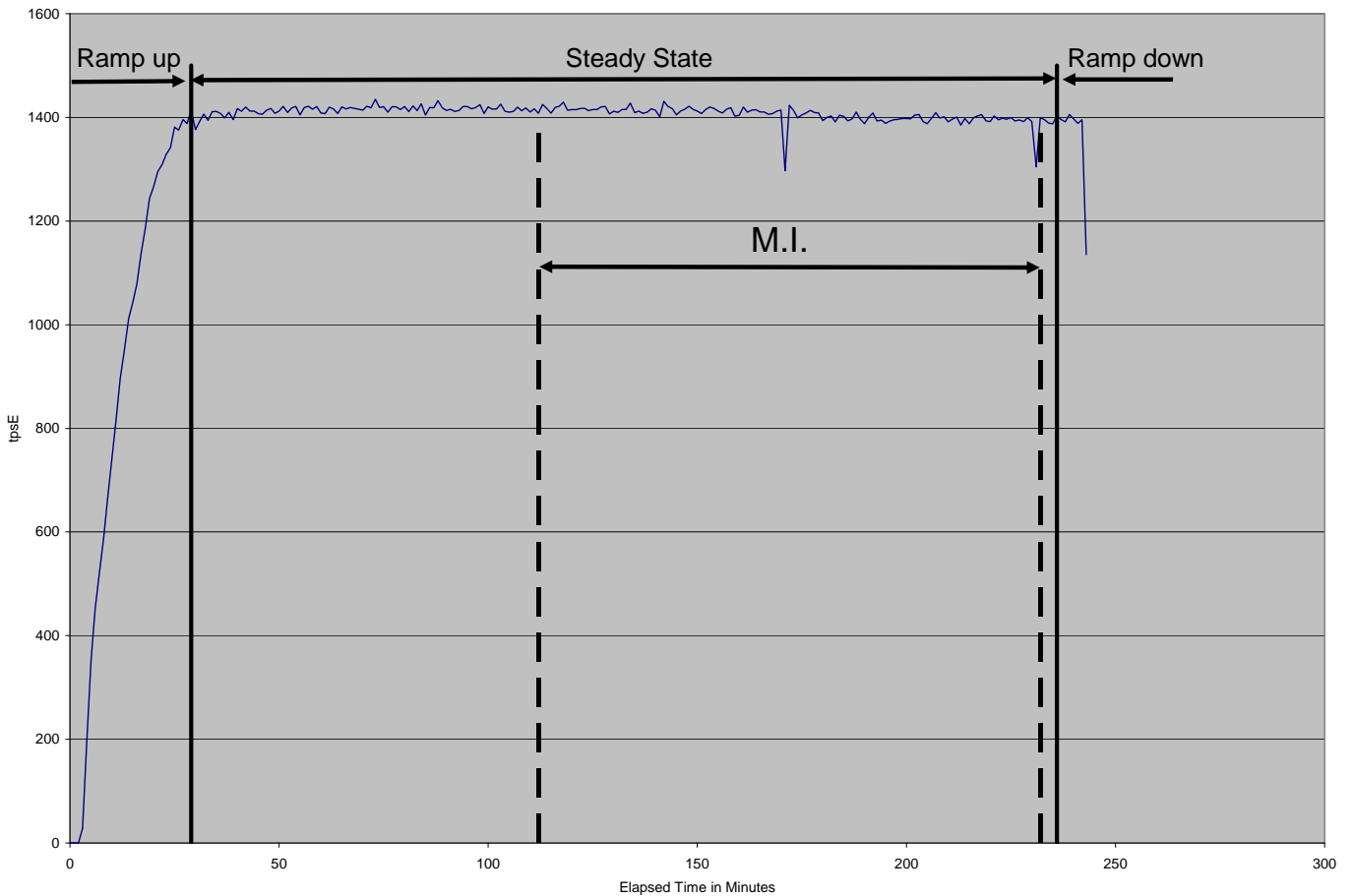
The Measured Throughput must be reported in the Report (see Clause 6.7.1.2).

**Measured tpsE**  
**1404.76 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 wrote to disk all updated memory pages that had not been yet actually written to disk. SQL Server® 2008 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 (445 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	49.99%	48% to 52%
get_history	1	50.00%	48% to 52%
<b>Market-Watch</b>			
Securities chosen by	Watch list	59.98%	57% to 63%
	Account ID	35.02%	33% to 37%
	Industry	4.99%	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	30.02%	28.5% to 31.5%
	2	30.00%	28.5% to 31.5%
	3	29.99%	28.5% to 31.5%
	4	10.00%	9.5% to 10.5%
<b>Trade-Order</b>			
Transactions requested by a third party		10.01%	9.5% to 10.5%
Security chosen by company name and issue		40.01%	38% to 42%
type_is_margin	1	7.99%	7.5% to 8.5%
roll_it_back	1	0.99%	0.94% to 1.04%
is_lifo	1	35.01%	33% to 37%
trade_qty	100	24.99%	24% to 26%
	200	25.03%	24% to 26%
	400	24.99%	24% to 26%
	800	24.99%	24% to 26%
trade_type	TMB	30.02%	29.7% to 30.3%
	TMS	30.01%	29.7% to 30.3%
	TLB	19.97%	19.8% to 20.2%
	TLS	9.99%	9.9% to 10.1%
	TSL	10.00%	9.9% to 10.1%
<b>Trade-Update</b>			
frame_to_execute	1	33.08%	31% to 35%
	2	32.97%	31% to 35%
	3	33.95%	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.

## Redundancy Level

*The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.5.7.1) and describe the Data Accessibility test(s) used to demonstrate compliance.*

Redundancy Level 1 was used for the Database Array.

## Atomicity Tests

*The System Under Test must guarantee that Database Transactions are atomic; the system will either perform all individual operations on the data, or will ensure that no partially completed operations leave any effects on the data.*

*Perform a market Trade-Order Transaction with the roll\_it\_back flag set to 0. Verify that the appropriate rows have been inserted in the TRADE and TRADE\_HISTORY tables.*

*Perform a market Trade-Order Transaction with the roll\_it\_back flag set to 1. Verify that no rows associated with the rolled back Trade-Order have been added to the TRADE and TRADE\_HISTORY tables.*

### EXECUTION OF ATOMICITY TESTS

1. Open a command prompt.
2. Change to the MSTPCE.1.5.1-1009\ACID\Atomicity directory.
3. Run Atomicity.cmd
4. The output will be in Atomicity\_C.out and Atomicity\_RB.out.

Atomicity.cmd runs a Trade-Order with a commit and notes the new T\_ID. Then it does a select on TRADE and TRADE\_HISTORY to return the rows in those tables with the new T\_ID. The output will be in Atomicity\_C.out

Atomicity.cmd also runs a Trade-Order with a roll back and notes the new T\_ID. Then it does a select on TRADE and TRADE\_HISTORY to return the rows in those tables with the new T\_ID. No rows should be returned. The output will be in Atomicity\_RB.out

### RESULTS OF ATOMICITY TESTS

The result files "Atomicity\_C.out" and "Atomicity\_RB.out" are placed in "SupportingFiles\Clause7\Atomicity".

## Consistency Tests

*Consistency is the property of the Application that requires any execution of a Database Transaction to take the database from one consistent state to another. A TPC-E database when first populated by EGenLoader must meet these consistency conditions. If data is replicated, as permitted under Clause 2.3.4, each copy must meet the consistency conditions defined in Clause 7.3.2.*

*Three consistency conditions are defined in the following clauses. Explicit demonstration that the conditions are satisfied is required for all three conditions.*

### Consistency condition 1

*Entries in the BROKER and TRADE tables must satisfy the relationship:  $B\_NUM\_TRADES = count(*)$*

*For each broker defined by:  $(B\_ID = CA\_B\_ID)$  and  $(CA\_ID = T\_CA\_ID)$  and  $(T\_ST\_ID = "CMPT□)$ .*

### Consistency condition 2

*Entries in the BROKER and TRADE tables must satisfy the relationship:  $B\_COMM\_TOTAL = sum(T\_COMM)$*

For each broker defined by: ( $B\_ID = CA\_B\_ID$ ) and ( $CA\_ID = T\_CA\_ID$ ) and ( $T\_ST\_ID = "CMPT□$ ).

### **Consistency condition 3**

Entries in the *HOLDING\_SUMMARY* and *HOLDING* tables must satisfy the relationship:  $HS\_QTY = sum(H\_QTY)$

For each holding summary defined by: ( $HS\_CA\_ID = H\_CA\_ID$ ) and ( $HS\_S\_SYMB = H\_S\_SYMB$ ).

The three consistency conditions must be tested after initial database population and after any Business Recovery tests.

Consistency conditions one through three were tested using a script to issue queries to the database, and we executed it after initial database population and after Business Recovery test.

## **EXECUTION OF CONSISTENCY TESTS**

1. Open a command prompt.
2. Change to the MSTPCE.1.5.1-1009\ACID\Consistency directory.
3. Run Consistency.cmd.
4. The output will be in Consistency.out.

## **RESULTS OF CONSISTENCY TESTS**

- For the test executed right after the initial database population, the result file "Consistency1.out" is placed in "SupportingFiles\Clause7\Consistency".
- For the test executed right after the Business Recovery test, the result file "Consistency2.out" is placed in "SupportingFiles\Clause7\Durability\BusinessRecovery".

## **Isolation Tests**

Systems that implement Transaction isolation using a locking and/or versioning scheme must demonstrate compliance with the isolation requirements by executing the tests described in Clause 7.4.2.

The following isolation tests are designed to verify that the configuration and implementation of the System Under Test provides the Transactions with the required isolation levels defined in Clause 7.4.1.3.

The isolation tests require that you use the SQL Server<sup>®</sup> Management Studio. You are required to copy values from one session to another and the Management Studio facilitates this. The instructions below assume that you are using the Management Studio.

## **EXECUTION OF ISOLATION TEST #1 (P3 TEST IN READ-WRITE)**

1. Open the SQL Server<sup>®</sup> Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1\_S1.sql in the Management Studio. When prompted, connect to your database server.
3. Click on Query/Results To/Results to Text in the menu bar.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1\_S2.sql in the Management Studio. When prompted, connect to your database server.
5. Click on Query/Results To/Results to Text in the menu bar.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1\_S3.sql in the Management Studio. When prompted, connect to your database server.
7. Click on Query/Results To/Results to Text in the menu bar.
8. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1\_S4.sql in the Management Studio. When prompted, connect to your database server.
9. Click on Query/Results To/Results to Text in the menu bar.
10. Execute Isolation1\_S1.
11. Scroll to the bottom of the Results window and record the "Trade ID Returned".
12. Copy the Customer Account Used to the @acct\_id variable near the top of Isolation1\_S2.
13. Copy the Symbol Used to the @symbol variable near the top of Isolation1\_S2.

14. Execute Isolation1\_S2.
15. Scroll to the bottom of the Results window and record the “Trade ID Returned”.
16. Copy the Trade ID Used in the Isolation1\_S1 results window to the @trade\_id variable near the top of Isolation1\_S3.
17. Copy the Trade ID Used in the Isolation1\_S2 results window to the @trade\_id variable near the top of Isolation1\_S4.
18. Execute Isolation1\_S3 and then execute Isolation1\_S4. Note, the SQL code and the instrumented stored procedure will do the appropriate pausing as required in the specification.

#### **VERIFICATION OF ISOLATION TEST #1 (P3 TEST IN READ-WRITE)**

1. Record the “Holding Summary After First Execution of Trade Result Frame 1:” value of HS\_QTY. This is found near the top of the results window of Isolation1\_S3. Verify that this is set to 0.
2. Record the “Holding Summary After Second Execution of Trade Result Frame 1:” value of HS\_QTY. This is found near the top of the results window of Isolation1\_S3. Verify that this is set to 0.
3. The Trade Result in Isolation1\_S3 should now block with the Trade Result in Isolation1\_S4.
4. Since the Isolation1\_S3 was blocked from continuing, the verification will use the “Case B” as defined in Clause 7.4.2.1, Items 6B and 7B.
5. Record the “Holding Summary After Trade Result Frame 1:” value of HS\_QTY. This is found near the top of the results window of Isolation1\_S4. It should be 0.

#### **RESULT OF ISOLATION TEST #1 (P3 TEST IN READ-WRITE)**

The result files “Iso1\_S1.out”, “Iso1\_S2.out”, “Iso1\_S3.out” and “Iso1\_S4.out” are placed in “SupportingFiles\Clause7\Isolation”.

#### **EXECUTION OF ISOLATION TEST #2 (P2 TEST IN READ-WRITE)**

1. Open the SQL Server<sup>®</sup> Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2\_S1.sql in the Management Studio. When prompted, connect to your database server.
3. Click on Query/Results To/Results to Text in the menu bar.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2\_S2.sql in the Management Studio. When prompted, connect to your database server.
5. Click on Query/Results To/Results to Text in the menu bar.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2\_S3.sql in the Management Studio. When prompted, connect to your database server.
7. Click on Query/Results To/Results to Text in the menu bar.
8. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2\_S4.sql in the Management Studio. When prompted, connect to your database server.
9. Click on Query/Results To/Results to Text in the menu bar.
10. Execute Isolation2\_S1.
11. Scroll to the bottom of the Results window of Isolation2\_S1 and record the “Holding Summary Quantity” and the “Trade ID Returned”.
12. Copy the Customer Account Used from the Results window of Isolation2\_S1 to the @acct\_id variable near the top of Isolation2\_S2.
13. Copy the Symbol Used from the Results window of Isolation2\_S1 to the @symbol variable near the top of Isolation2\_S2.
14. Execute Isolation2\_S2.
15. Scroll to the bottom of the Results window of Isolation2\_S2 and record the Trade ID Returned.
16. Copy the Trade ID Used in the Isolation2\_S1 results window to the @trade\_id variable near the top of Isolation2\_S3.
17. Copy the Trade ID Used in the Isolation2\_S2 results window to the @trade\_id variable near the top of Isolation2\_S4.
18. Execute Isolation2\_S3 and then execute Isolation2\_S4. Note, the SQL code and the instrumented stored procedure will do the appropriate pausing as required in the specification.

## **VERIFICATION OF ISOLATION TEST #2 (P2 TEST IN READ-WRITE)**

1. Record the “Holding Summary After First Execution of Trade Result Frame 1:” value of HS\_QTY. This is found near the top of the results window of Isolation2\_S3.
2. Record the “Holding Summary After Second Execution of Trade Result Frame 1:” value of HS\_QTY. This is found near the top of the results window of Isolation2\_S3. This value should match the value returned in number 1 above.
3. Record the “Holding Summary After Trade Result Frame 1:” value of HS\_QTY. This is found near the top of the results window of Isolation2\_S4.
4. Since the Isolation2\_S4 stalls in Frame 2, the verification will use the “Case A” as defined in Clause 7.4.2.2, Items 6A and 7A.
5. Verify that the HS\_QTY remains the same for each read of HOLDING SUMMARY throughput Isolation2\_S3.

## **RESULT OF ISOLATION TEST #2 (P2 TEST IN READ-WRITE)**

The result files “Iso2\_S1.out”, “Iso2\_S2.out”, “Iso2\_S3.out” and “Iso2\_S4.out” are placed in “SupportingFiles\Clause7\Isolation”.

## **EXECUTION OF ISOLATION TEST #3 (P1 TEST IN READ-WRITE)**

1. Open the SQL Server<sup>®</sup> Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation3\_S1.sql in the Management Studio. When prompted, connect to your database server.
3. Click on Query/Results To/Results to Text in the menu bar.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation3\_S2.sql in the Management Studio. When prompted, connect to your database server.
5. Click on Query/Results To/Results to Text in the menu bar.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation3\_S3.sql in the Management Studio. When prompted, connect to your database server.
7. Click on Query/Results To/Results to Text in the menu bar.
8. Execute Isolation3\_S1. This script will initiate the Customer Position and execute two Trade Orders for the remainder of this isolation test to access.
9. Scroll to the bottom of the Results window of Isolation3\_S1 and record the “Customer ID Used” and the “Customer Account Balance”.
10. Copy the first Trade ID Returned from Isolation3\_S1 to the top of Isolation3\_S2.sql.
11. Copy the Customer Account Used from Isolation3\_S1 to the top of Isolation3\_S2.sql.
12. Copy the second Trade ID Returned from Isolation3\_S1 to the top of Isolation3\_S3.sql.
13. Copy the Customer Account Used from Isolation3\_S1 to the top of Isolation3\_S3.sql.
14. Execute Isolation3\_S2, then execute Isolation3\_S3. Note, the SQL code and the instrumented stored procedure will do the appropriate pausing as required in the specification.
15. Scroll to the bottom of the Results window of Isolation3\_S2 and record the Customer Account Balance and the Settlement Amount.
16. Scroll to the bottom of the Results window of Isolation3\_S3 and record the Customer Account Balance and the Settlement Amount.

## **VERIFICATION OF ISOLATION TEST #3 (P2 TEST IN READ-WRITE)**

1. Record the Customer Account Balance from the bottom of the Results window of Isolation3\_S1.
2. Record the Customer Account Balance and the Settlement Amount from the bottom of the Results window of Isolation3\_S2.
3. Record the Customer Account Balance and the Settlement Amount from the bottom of the Results window of Isolation3\_S3.
4. Since the Trade Result in Isolation3\_S3 blocks until Isolation3\_S2 completes, you may verify the results as follows:
  - A)  $CA\_BAL$  (from Isolation3\_S1) + Settlement Amount (from Isolation3\_S2) + Settlement Amount (from Isolation3\_S3) = Customer Account Balance (from Isolation3\_S3)

## **RESULT OF ISOLATION TEST #3 (P2 TEST IN READ-WRITE)**

The result files “Iso3\_S1.out”, “Iso3\_S2.out” and “Iso3\_S3.out” are is placed in “SupportingFiles\Clause7\Isolation”.



## EXECUTION OF ISOLATION TEST #4 (P1 TEST IN READ-ONLY)

1. Open the SQL Server® Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation4\_S1.sql in the Management Studio. When prompted, connect to your database server.
3. Click on Query/Results To/Results to Text in the menu bar.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation4\_S2.sql in the Management Studio. When prompted, connect to your database server.
5. Click on Query/Results To/Results to Text in the menu bar.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation4\_S3.sql in the Management Studio. When prompted, connect to your database server.
7. Click on Query/Results To/Results to Text in the menu bar.
8. Execute Isolation4\_S1. This script will initiate the Customer Position and execute a Trade Order for the remainder of this isolation test to access.
9. Scroll to the bottom of the Results window of Isolation4\_S1 and record the “Customer ID Used”, “Customer Account ID Used”, “Customer Account Balance”, and the “Trade ID Returned”.
10. Copy the “Customer Account ID Used” from the Results window of Isolation4\_S1 to the @acct\_id variable near the top of Isolation4\_S2.
11. Copy the “Trade ID Returned” from the Results window of Isolation4\_S1 to the @trade\_id variable near the top of Isolation4\_S2.
12. Copy the “Customer ID” from the Results window of Isolation4\_S1 to the @cust\_id variable near the top of Isolation4\_S3.
13. Copy the “Customer Account ID Used” from the Results window of Isolation4\_S1 to the @acct\_id variable near the top of Isolation4\_S3.
14. Execute Isolation4\_S2, then execute Isolation4\_S3.

## VERIFICATION OF ISOLATION TEST #4 (P1 TEST IN READ-ONLY)

1. Record the Customer Account Balance from the bottom of the Results window of Isolation4\_S1.
2. Record the Customer Account Balance and the Settlement Amount from the bottom of the Results window of Isolation4\_S2.
3. Record the Customer Account Balance from the bottom of the Results window of Isolation4\_S3.
4. Since the Customer Position in Isolation4\_S3 blocks until Isolation4\_S2 completes, you may verify the results by CA\_BAL (from Isolation4\_S2) = Customer Account Balance (from Isolation4\_S3).

## RESULT OF ISOLATION TEST #4 (P1 TEST IN READ-ONLY)

The result files “Iso4\_S1.out”, “Iso4\_S2.out” and “Iso4\_S3.out” are placed in “SupportingFiles\Clause7\Isolation”.

## Durability Tests

*The System Under Test must be configured to satisfy the requirements for Durability detailed in this clause. Durability is demonstrated by the SUT preserving Committed Transactions and maintaining the consistency of the database after the failures listed in Clause 7.5.2. Durability tests are conducted by inducing Catastrophic and Non-catastrophic failures of components within the SUT. The Non-catastrophic failures of Clause 7.5.5 test the ability of the SUT to maintain access to the data. The Catastrophic failures of Clause 7.5.6 test the SUT’s capability of preserving the effects of Committed Transactions. The duration of the Catastrophic failure is reported as the Business Recovery Time in the Report. No system provides complete Durability (i.e., Durability under all possible types of failures). The specific set of single failures addressed in Clause 7.5.2 is defined sufficiently significant to justify demonstration of Durability across such failures. However, the limited nature of the tests listed must not be interpreted to allow other unrecoverable single points of failure.*

- *Permanent irrecoverable failure of any single Durable Medium.*
- *Instantaneous interruption (system crash/system hang) in processing that requires system reboot to recover.*
- *Failure of all or part of memory (loss of contents).*
- *Loss of all external power to the SUT for an indefinite time period (power failure). This must include at least all portions of the SUT that participate in the database portions of Transactions.*

## Durability Test for Data Accessibility

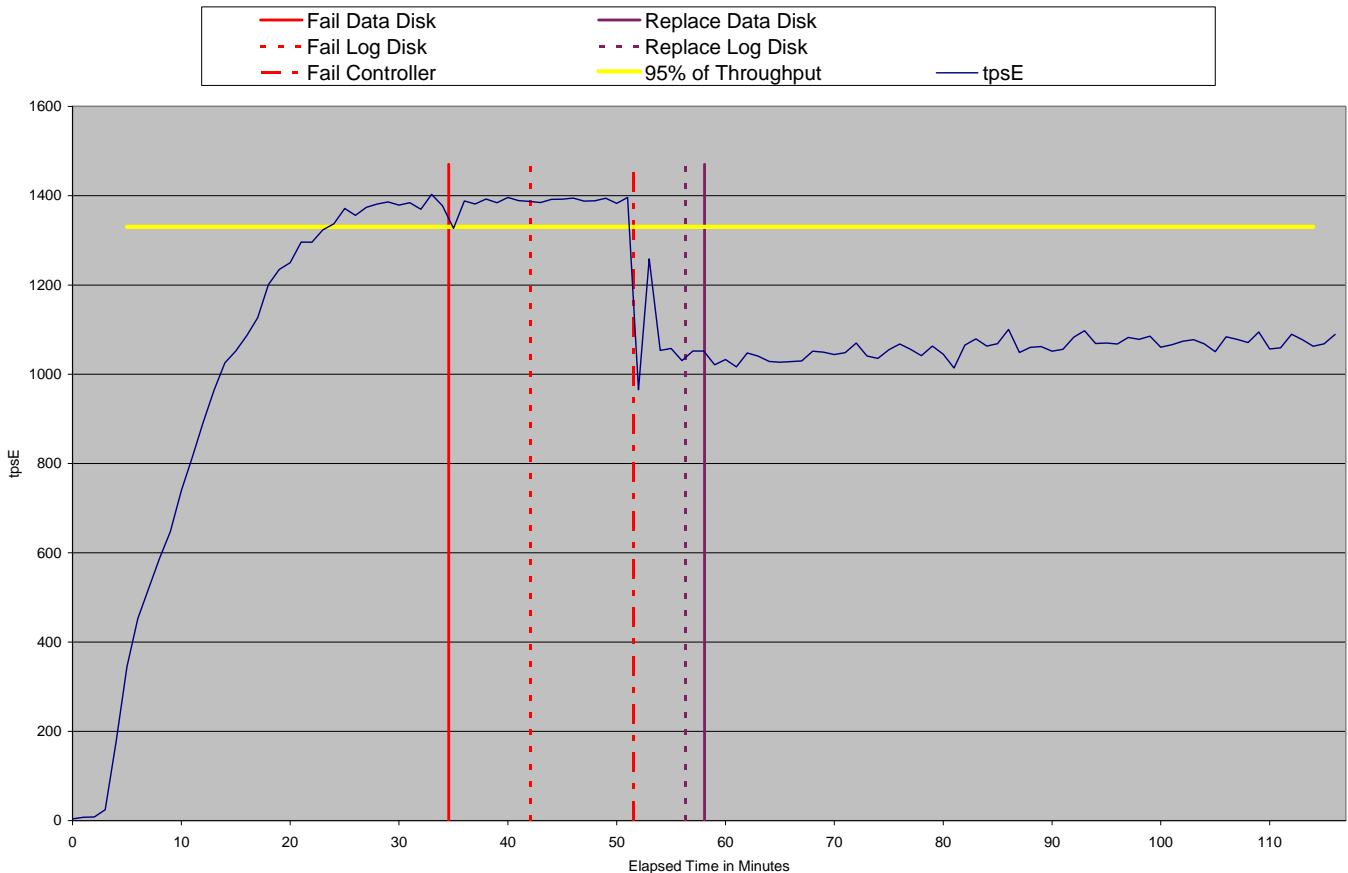
This benchmark result used Redundancy Level 1.

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 7.5.3) 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 drives in the Database Log Array and the Database Data Array. A rebuild on each replaced drive should start automatically.
6. Continue running the Driver for 1hour.
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 Procedure for Catastrophic Failures

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.

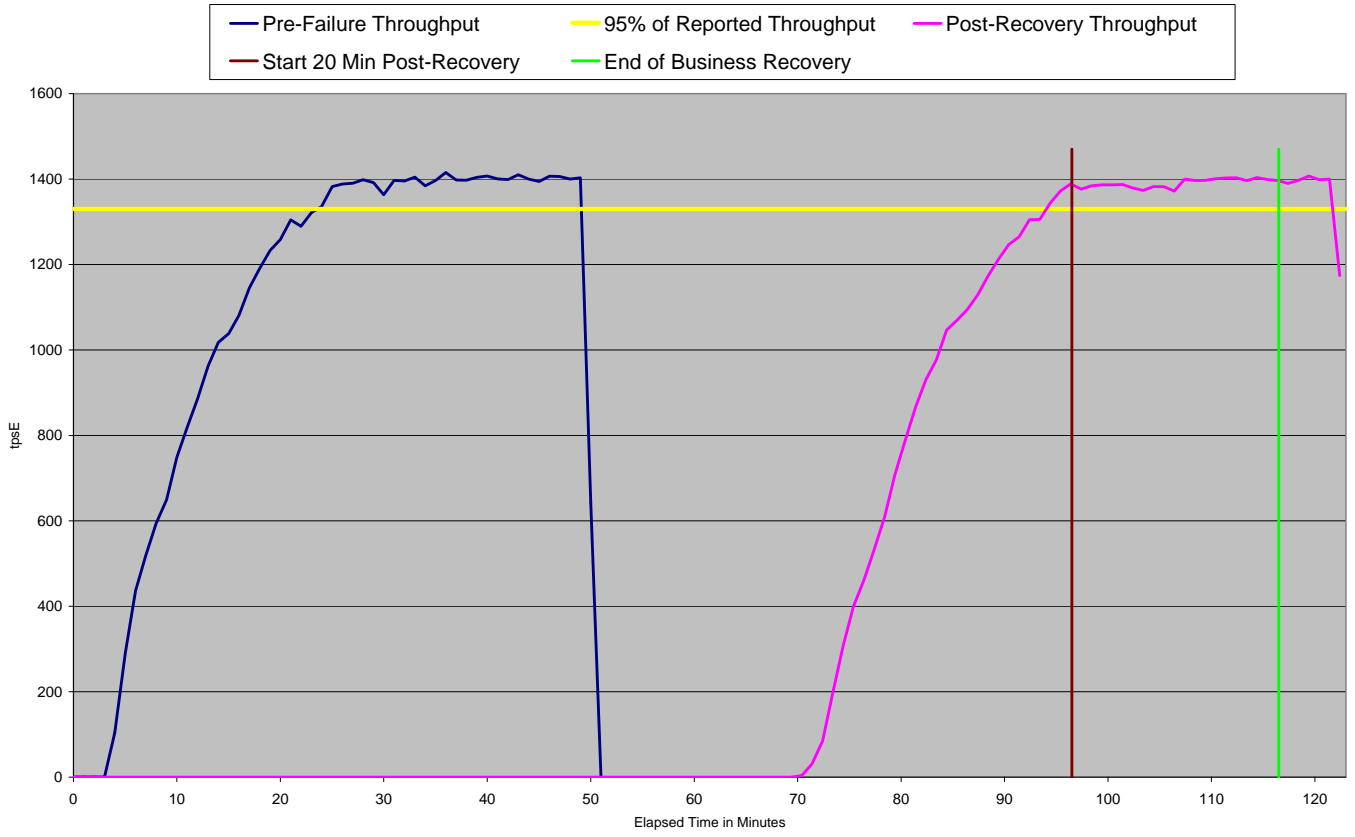
The following steps were successfully performed to meet the Durability Throughput Requirements of Clause 7.5.3:

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 7.5.3) and satisfy those requirements for at least 20 minutes.
3. Induce all of the Catastrophic failures, in Clause 7.5.2.2, 7.5.2.3 and 7.5.2.4 with following procedure simultaneously;
  - removing power cords from the database server, NEC Express5800/A1160.
  - removing each power cord from each of two clients, NEC Express5800/120Rj-2.
4. Stop the Driver.
5. Re-power and restart the database server, NEC Express5800/A1160. Re-power and restart two clients, NEC Express5800/120Rj-2.
6. On the NEC Express5800/A1160 when Windows has started, execute StartSQL.cmd to start up Microsoft® SQL Server® 2008. Then database recovery starts automatically. Microsoft® SQL Server® 2008 records timestamps out to the errorlog when the recovery procedure has begun. The timestamp defines the time when Business Recovery starts (see Clause 7.5.6.4).
7. Once the SUT will accept Transactions, start submitting Transactions and ramp up to a Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes.
8. Note this time as the end of Business Recovery (see Clause 7.5.6.7).
9. Terminate the Driver gracefully.
10. Verify that no errors were reported by the Driver during steps 7 through 9.
11. Retrieve the new number of completed trades in the database by running: *select count(\*) as count2 from SETTLEMENT*
12. 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.
13. Verify consistency conditions as specified in Clause 7.3.1.1.

The Business Recovery Time was 01:56:30.

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	700,000	Performance	1404.76	TpsE	Reported	1400.00	TpsE
<b>Broker 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>
BROKER	7,000	392	496	44	932	1,312	424
CASH_TRANSACTION	11,128,317,034	1,104,039,400	2,329,264	55,318,433	1,161,687,097	1,139,932,264	33,563,600
CHARGE	15	8	8	1	17	16	-
COMMISSION_RATE	240	16	16	2	34	32	-
SETTLEMENT	12,096,000,000	593,602,200	1,251,800	29,742,700	624,596,700	626,102,536	31,248,536
TRADE	12,096,000,000	1,343,670,288	722,690,216	103,318,025	2,169,678,529	2,095,211,504	28,851,000
TRADE_HISTORY	29,030,425,771	832,413,704	2,170,496	41,729,210	876,313,410	838,252,064	3,667,864
TRADE_REQUEST	-	-	-	-	-	32,152	32,152
TRADE_TYPE	5	8	1,032	52	1,092	1,040	-
<b>Customer File Group</b>							
ACCOUNT_PERMISSION	4,970,435	497,112	3,184	25,015	525,311	500,296	-
CUSTOMER	700,000	118,520	30,240	7,438	156,198	148,840	80
CUSTOMER_ACCOUNT	3,500,000	324,984	386,520	35,575	747,079	711,528	24
CUSTOMER_TAXRATE	1,400,000	29,152	352	1,475	30,979	29,672	168
HOLDING	619,295,975	33,192,312	24,669,352	2,893,083	60,754,747	83,110,160	25,248,496
HOLDING_HISTORY	16,210,625,558	589,477,352	307,206,432	44,834,189	941,517,973	900,690,200	4,006,416
HOLDING_SUMMARY	34,817,394	1,194,760	5,064	59,991	1,259,815	2,403,896	1,204,072
WATCH_ITEM	70,007,791	1,943,984	7,688	97,584	2,049,256	1,952,016	344
WATCH_LIST	700,000	17,400	13,896	1,565	32,861	31,296	-
<b>Market File Group</b>							
COMPANY	350,000	76,128	20,568	4,835	101,531	96,712	16
COMPANY_COMPETITOR	1,050,000	28,168	22,904	2,554	53,626	51,072	-
DAILY_MARKET	625,747,500	32,329,904	13,816,480	2,307,319	48,453,703	46,147,984	1,600
EXCHANGE	4	8	8	1	17	16	-
FINANCIAL	7,000,000	823,584	2,952	41,327	867,863	826,888	352
INDUSTRY	102	8	40	2	50	48	-
LAST_TRADE	479,500	22,416	352	1,138	23,906	45,592	22,824
NEWS_ITEM	700,000	75,893,184	1,504	3,794,734	79,689,422	75,894,720	32
NEWS_XREF	700,000	17,408	344	888	18,640	17,752	-
SECTOR	12	8	24	2	34	32	-
SECURITY	479,500	75,536	32,496	5,402	113,434	108,048	16
STATUS_TYPE	5	8	8	1	17	16	-
<b>Misc File Group</b>							
ADDRESS	1,050,004	60,528	400	3,046	63,974	61,024	96
TAXRATE	320	24	16	2	42	56	16
ZIP_CODE	14,741	488	16	25	529	504	-
<b>TOTALS (KB)</b>		<b>4,609,848,992</b>	<b>1,074,664,168</b>	<b>284,225,658</b>	<b>5,968,738,818</b>		
<b>Initial Database Size (MB)</b>		<b>5,551,282</b>	<b>5,421 GB</b>				
<b>Db/Filegroups</b>	<b>LUN Count</b>	<b>Partition Size (KB)</b>	<b>Allocated Size (MB)</b>	<b>Loaded (MB)</b>	<b>Loaded + 5% (MB)</b>	<b>After Run (MB)</b>	<b>8 Hours (MB)</b>
misc_fg	1	512,000	500	60	63	60	60
broker_fg	72	83,886,080	5,898,240	4,494,306	4,719,021	4,589,388	4,690,534
market_fg	72	5,242,880	368,640	120,277	126,291	120,302	120,327
customer_fg	72	20,971,520	1,474,560	936,639	983,471	966,385	998,028
<b>Settlements</b>	<b>19,603,284</b>						
<b>Initial Growing Space (MB)</b>	5,427,649						
<b>Final Growing Space (MB)</b>	5,552,475	<b>Data LUNS</b>	72	<b>Initial Log Size (MB)</b>	11,395	<b>Log LUNS</b>	1
<b>Delta (MB)</b>	124,826	<b>Disks per LUN</b>	12	<b>Final Log Size (MB)</b>	205,183	<b>Log Disks</b>	20
<b>Data Space per Trade (MB)</b>	0.006367622	<b>Disk Capacity (MB)</b>	136,192	<b>Log Growth (MB)</b>	193,788	<b>Disk Capacity (MB)</b>	274,624
<b>1 Day Data Growth (MB)</b>	257,615	<b>RAID10 Overhead</b>	50%	<b>Log Space per Trade (MB)</b>	0.009885488135	<b>RAID50 Overhead</b>	20%
<b>60 Day Space (MB)</b>	<b>21,008,162</b>	<b>Total Space (MB)</b>	<b>58,834,944</b>	<b>1 Day Log Space (MB)</b>	<b>399,937</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.



Keiichi Yamada  
NEC Corporation  
1-10 Nisshincho  
Fuchu-City, Tokyo 183-8501, Japan

November 5, 2008

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

Platform: NEC Express5800/A1160 (12 Processors)  
Operating system: Microsoft Windows Server 2008 Datacenter x64 Edition  
Database Manager: Microsoft SQL Server 2008 Enterprise x64 Edition

The results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
<b>Tier B, Server: NEC Express5800/A1160 (12 Processors)</b>				
12 x Intel Xeon X7460 (2.66GHz)	384 GB (16 MB L3)	2 x 73 GB SAS (int.) 864 x 147 GB 15K SAS 20 x 300 GB 15K SAS	0.16 Seconds	1,400.00
<b>Tier A, Two Clients: NEC Express5800/120Rj-2</b>				
1 x Intel Xeon E5450 (3.0GHz)	4 GB (12 MB L2)	1x 73 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 v1.5.1.
- The transactions were correctly implemented.
- The database was properly scaled and populated for 700,000 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 60 day storage requirement was correctly computed and priced.
- The system pricing was verified for major components and maintenance.

**Additional Audit Note:**

With the NEC Express5800/A1160, customer can request that one to five cores on each Intel Xeon X7460 processor be disabled. Disabling of cores, at customer's request, is done by NEC prior to customer shipment. Once disabled by NEC, the cores can only be re-enabled by NEC personnel. The measured configuration had eight of its 72 cores disabled by NEC.

Respectfully Yours,



François Raab, President

125 WEST MONROE STREET • COLORADO SPRINGS, CO 80907 • 719-473-7555 • WWW.SIZING.COM

## 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 sydiskmap_[1..10].png mount.txt mkmp.cmd StorageSetup.doc SwitchSetup.doc
	TierB(server) configuration	SupportingFiles/Introduction/Hardware/	TierB_A1160_120Rj2_setup.doc
	TierA(client) setup	SupportingFiles/Introduction/Hardware/	TierA_120Rj2_setup.doc
	Database Tunable Parameters	SupportingFiles/Introduction/Software/	sp_configure.out startSQL.cmd
	OS Tunable Parameters	SupportingFiles/Introduction/Software/	syostune.doc syhwTierB.out syhwTierA_1.out syhwTierA_2.out
Tier A Scripts	SupportingFiles/Introduction/Software/	ce1.cmd ce2.cmd ce3.cmd ce4.cmd ce5.cmd ce6.cmd ce7.cmd me1.cmd me2.cmd me3.cmd me4.cmd me5.cmd me6.cmd me7.cmd	



Clause2	Table creation scripts	SupportingFiles/Clause2/DDL/	Convert_NI_ITEM_Data.sql BulkInsert_[1..16].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_Clustered_Indexes_Fixed.sql Create_Clustered_Indexes_Growing.sql Create_Clustered_Indexes_Scaling.sql Create_NC_Indexes_Fixed.sql Create_NC_Indexes_Growing.sql Create_NC_Indexes_Scaling.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 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_Primary_Key_Check.SQL DB_Tables.sql Drop_DB_Audit_Tables.SQL Insert_Duplicates_Tests.sql Referential_Integrity_Tests.sql

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
	BaseServer	SupportingFiles/Clause3/BaseServer/	BaseServer.cpp BaseServer.h BaseServer.vcproj stdafx.cpp stdafx.h SUTServersLocals.h
	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
	TransactionsSP	SupportingFiles/Clause3/TransactionsSP/	BrokerVolumeDB_SP.cpp BrokerVolumeDB_SP.h CheckpointDB_SP.cpp CheckpointDB_SP.h CustomerPositionDB_SP.cpp CustomerPositionDB_SP.h DataMaintenanceDB_SP.cpp DataMaintenanceDB_SP.h MarketFeedDB_SP.cpp MarketFeedDB_SP.h MarketWatchDB_SP.cpp MarketWatchDB_SP.h SecurityDetailDB_SP.cpp SecurityDetailDB_SP.h stdafx.cpp stdafx.h TradeLookupDB_SP.cpp TradeLookupDB_SP.h TradeOrderDB_SP.cpp TradeOrderDB_SP.h TradeResultDB_SP.cpp TradeResultDB_SP.h TradeStatusDB_SP.cpp TradeStatusDB_SP.h TradeUpdateDB_SP.cpp TradeUpdateDB_SP.h TransactionsSP.vcproj TxnHarnessDBBase.cpp TxnHarnessDBBase.h TxnHarnessDBConn.cpp TxnHarnessDBConn.h
	TxnHarness	SupportingFiles/Clause3/TxnHarness/	TxnHarness.vcproj TxnHarness_stdafx.cpp TxnHarness_stdafx.h TxnHarnessSendToMarket.cpp TxnHarnessSendToMarket.h

Clause4			
Clause5	Egen modifications		
	EGenLoader extensions		
	EGenDriver Configuration	SupportingFiles/Clause5/	700000customes.xml
	EGenLoader Parameters	SupportingFiles/Clause5/	BuildSteps.log EGenLoaderFrom1To44000.log EGenLoaderFrom44001To88000.log EGenLoaderFrom88001To131000.log EGenLoaderFrom131001To175000.log EGenLoaderFrom175001To219000.log EGenLoaderFrom219001To263000.log EGenLoaderFrom263001To306000.log EGenLoaderFrom306001To350000.log EGenLoaderFrom350001To394000.log EGenLoaderFrom394001To438000.log EGenLoaderFrom438001To481000.log EGenLoaderFrom481001To525000.log EGenLoaderFrom525001To569000.log EGenLoaderFrom569001To613000.log EGenLoaderFrom613001To656000.log EGenLoaderFrom656001To700000.log
	EGenLogger Output	SupportingFiles/Clause5/	EGENLOG.xlt
Clause6	EGenValidate Output	SupportingFiles/Clause6/	EGenValidate.out

Clause7	ACID procedures	SupportingFiles/Clause7/AcidProcs/	AcidProc.cmd Remove_AcidProcs.cmd AcidProc.out
		SupportingFiles/Clause7/AcidProcs/Scripts/	AcidProc.vbs CustomerPosition_Iso3.sql CustomerPosition_Iso4.sql Drop_SPROC.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
		SupportingFiles/Clause7/Isolation/	Iso1_S1.out Iso1_S2.out Iso1_S3.out Iso1_S4.out Iso2_S1.out Iso2_S2.out Iso2_S3.out Iso2_S4.out Iso3_S1.out Iso3_S2.out Iso3_S3.out Iso4_S1.out Iso4_S2.out Iso4_S3.out
Isolation Output		SupportingFiles/Clause7/Isolation/	

	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery/	BusinessRecoveryTimeGraph.xls Consistency2.out count1.sql count1BR.out count2.sql count2BR.out dblgBRpart1.out dblgBRpart2.out DsymTierAoslg[1..2].out DsymTierBoslg.out Part1Step.xlt Part1TxnReport20min.xls Part1TxnReportAll.xls Part2Step.xlt Part2TxnReport20min.xls Part2TxnReportAll.xls
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/DataAccessibility/	count1.sql count1DA.out count2.sql count2DA.out DataAccessibility_wholeRun_TxnReportE.xls DataAccessibilityGraph.xls DBlgDataAccessibility.out pulledDataDisk.bmp pulledLogCont.bmp pulledLogDisk.bmp rebuildingDataDisk.bmp rebuildingLogDisk.bmp
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**

October 29, 2008

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
810-07507	<b>SQL Server 2008 Enterprise x64 Edition</b> <i>Per Processor License</i> <i>Discount Schedule: Open Program - Level C</i> <i>Unit Price reflects a 6% discount from the retail unit price of \$24,999.</i>	\$23,432	12	\$281,184
P73-01972	<b>Windows Server 2003 R2 Standard Edition</b> <i>Server License Only - No CALs</i> <i>Discount Schedule: Open Program - No Level</i> <i>Unit Price reflects a 28% discount from the retail unit price of \$999.</i>	\$719	4	\$2,876
N/A	<b>Microsoft Problem Resolution Services</b> <i>Professional Support</i> <i>(1 Incident)</i>	\$245	1	\$245

Windows Server 2008 and Windows Server 2003 are currently orderable through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found at <http://www.microsoft.com/products/info/render.aspx?view=22&type=mp&content=22/licensing>

SQL Server 2008 will be orderable and available by August 30, 2008.

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at \$245 per call.

This quote is valid for the next 90 days.

If we can be of any further assistance, please contact Jamie Reding at (425) 703-0510 or [jamiere@microsoft.com](mailto:jamiere@microsoft.com).

Reference ID: PEkeya0810290000008646.  
Please include this Reference ID in any correspondence regarding this price quote.



Prepared For:  
NEC Corporation  
Keiichi Yamada  
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10850 Gold Center Drive  
Rancho Cordova, CA 95670

Prepared By:  
Synegi, Inc.

2132 Michelson Dr.  
Irvine, CA 92612  
Tim Zimmerman

Date: 10-31-08

**Quote for Brocade Fibre Switches**

<b>Part #</b>	<b>Product Description</b>	<b>QTY</b>	<b>Cost</b>	<b>Total</b>
BR-240E-R001-A	Brocade Silkworm 200E 16 Port Fibre Switch	5	\$5,175	\$25,875
XBR-SMED4POD-0001	Brocade 4 Port License Upgrade	10	\$1,050	\$10,500
		<b>Total</b>		<b>\$36,375</b>

*Terms of Payment will be Net 30, pricing does not include tax or shipping.*

**Synegi, Inc. 2132 Michelson Drive Irvine, CA 92612 Phone- 949-222-0088 Fax- 949-222-0080**



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51	Belkin 10-meter Multimode LC/LC 62.5/125 Duplex Fiber Optic cable	405050	In Stock	\$39.99	\$2,039.49
3	Verbatim USB Floppy Drive Titanium Edition	502458	In Stock	\$28.99	\$86.97
1	Verbatim DataLife floppy disk x 10 - 1.44 MB - storage media	039031	1-3 days	\$3.99	\$3.99
48	Tripp Lite 25' Blue Cat5e or Cat5 Snapless RJ45 UTP Patch Cable 25ft	324500	In Stock	\$5.99	\$287.52
6	Tripp Lite 10' Gray Cat5e or Cat5 Snapless Crossover Cable 10ft	324527	1-3 days	\$4.99	\$29.94
4	Linksys 24-Port 10/100/1000 Gigabit Switch	1012601	In Stock	\$279.99	\$1,119.96
3	Linksys 5-Port 10/100 Switch	507611	In Stock	\$31.99	\$95.97
3	Tripp Lite 6' Null Modem Adapter Cable, DB9 Female - Female, 5ft	380490	In Stock	\$5.99	\$17.97
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