NEC

TPC Benchmark™ E
Full Disclosure Report

NEC Express5800/A1160 *(16 Processors)*

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

**First Edition
Submitted for Review
18-March-2009**

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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^{TM} 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[TM] E tests on the NEC Express5800/A1160 client/server system with version 1.7.0 of the TPC Benchmark[TM] E Standard Specification. Four 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® 2008 Standard Edition.

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

TPC Benchmark[TM] E Metrics

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

System	Software	Total System Cost	tpsE	$ USD /tpsE	Availability Date
NEC Express5800 /A1160	Microsoft® SQL Server® 2008 Enterprise x64 Edition Microsoft® Windows Server® 2008 Datacenter x64 Edition	$1,850,500 (USD)	1568.22	$1,180.01	18-March-2009

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.

NEC	NEC Express5800/A1160 (16 Processors)		TPC-E 1.7.0 TPC Pricing 1.4.0
			Report Date 18-March-2009

TPC-E Throughput **1568.22 tpsE**	Price/Performance **$1,180.01 USD per tpsE**	Availability Date **18-March-2009**	Total System Cost **$1,850,500 USD**

Database Server Configuration

Operating System **Microsoft® Windows Server® 2008 Datacenter x64 Edition**	Database Manager **Microsoft® SQL Server® 2008 Enterprise x64 Edition**	Processors/Cores/ Threads **16 / 64 / 64**	Memory **512GB**

Tier B: Server
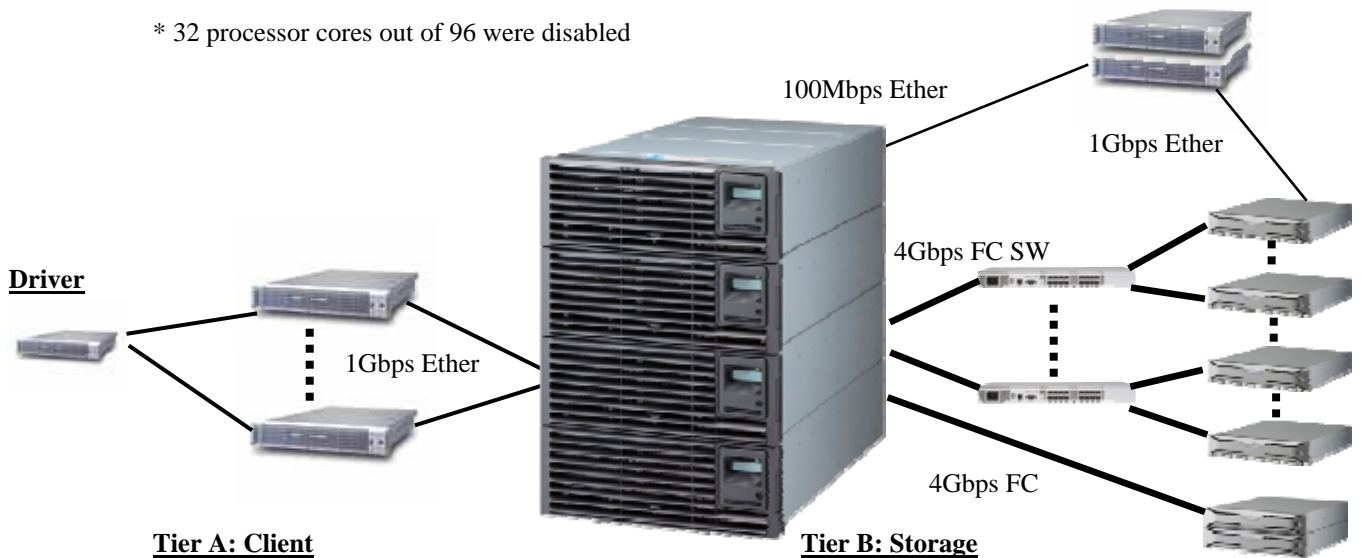NEC Express5800/A1160
16x Intel® Xeon® processor X7460 2.66GHz, 16MB L3 cache,
6 processor cores*, 6 threads
512GB Memory, 2x 73GB SAS drives
4x 2-port 4Gbps FC HBA
1x Internal SAS RAID Controller
8x Onboard 1Gbps Ether Controllers

* 32 processor cores out of 96 were disabled

Tier B: System Console
2x NEC Express5800/120Rj-2
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

100Mbps Ether

1Gbps Ether

4Gbps FC SW

Driver

1Gbps Ether

4Gbps FC

Tier A: Client
4x NEC Express5800/120Rj-2
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

Tier B: Storage
NEC Storage D3-10
41x NEC Storage D3-10 Controllers
41x NEC Storage D3-10 SAS/SATA
Disk Enclosures
960x 147GB 15k RPM SAS drives
20x 300GB 15k RPM SAS drives

Initial **6,197 GB**	Redundancy Level : 1 **RAID50 : Log / RAID10 : Data**	Storage **960 x 147GB 15K 20 x 300GB 15K**

TPC-E 1.7.0
TPC Pricing 1.4.0

NEC Express5800/A1160 (16 Processors)

Report Date
18-March-2009

Available Date
18-March-2009

Description	Part Number	Third Party Brand	Pricing	Unit Price	Qty	Extended Price	3-yr Mnt. Price
Server Hardware							
NEC Express5800/A1160							
A1160 Server Base Model w/6core Intel Xeon X7460	850200723	NEC	1	36,399	4	145,596	
- 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	56	50,344	
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	4	16,596	
HSI Cable(1)	050-03511-000	NEC	1	799	6	4,794	
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	4	47,984	
Platinum Warranty (Yr 1,2 & 3)	UPPLT-A1160-3Y	NEC	1	5,999	3		17,997
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	145	2	290	
73GB SAS HDD (3.5"), 15k rpm	062-02782-000	NEC	1	230	2	460	
Upgrade to Platinum Warranty for 3 yrs	4HR-GP-YYY	NEC	1	799	2		1,598
NEC AccuSync 73VX 17" LCD Display (+2 spares)	ASLCD73VX-BK	NEC	3	149	5	745	
				Subtotal		**285,285**	**19,595**
Disk Subsystem							
NEC Storage D3-10							
NEC Storage D3-10 Base Model	850193310	NEC	1	7,830	41	321,030	
SAS/SATA Enclosure	NF5021-SE60E	NEC	1	2,941	41	120,581	
SAS disk drive (15k rpm/147GB) (+10% spares)	NF5021-SM624E	NEC	1	406	1056	428,736	
SAS disk drive (15k rpm/300GB) (+10% spares)	NF5021-SM625E	NEC	1	606	22	13,332	
1 yr of Platinum SW Maintenance for Base SW	UFSD0M-310000AMAS	NEC	1	1,195	123		146,985
3 yrs of Platinum Warranty Upgrade	OS2X-SD4HR-YYY	NEC	1	176,736	1		176,736
UPS 3kVA	050-02424-000	NEC	1	1,799	2	3,598	
42U Rackframe	050-02378-001	NEC	1	1,799	5	8,995	
FC Cable 10M LC-LC (+10% spares)	F2F202LL-10M	Belklin	3	40	53	2,119	
				Subtotal		**898,391**	**323,721**
Server Software							
Microsoft SQL Server 2008 Enterprise x64 Edition	810-07507	Microsoft	2	23,432	16	374,912	245
				Subtotal		**374,912**	**245**

continued on the next page

TPC-E 1.7.0
TPC Pricing 1.4.0

NEC Express5800/A1160 (16 Processors)

Report Date
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18-March-2009

Client Hardware

NEC Express5800/120Rj-2

Model 120Rj-2 Base Unit, E5450, 2G DIMM, DVD-Combo	850195003	NEC	1	4,490	4	17,960	
2GB (1GB x2) DDR2 667 FB-DIMM	062-03118-000	NEC	1	145	4	580	
73GB SAS HDD (3.5"), 15k rpm	062-02782-000	NEC	1	230	4	920	
Upgrade to Platinum Warranty for 3 yrs	4HR-GP-YYY	NEC	1	799	4		3,196
NEC AccuSync 73VX 17" LCD Display (+2 spares)	ASLCD73VX-BK	NEC	3	149	6	894	
42U Rackframe	050-02378-001	NEC	1	1,799	1	1,799	
Cat5e Patch Cable 25' RJ45-RJ45 (+10% spares)	N001-025-BL	Tripp Lite	3	6	53	317	
Cat5e Crossover Cable 10' RJ45-RJ45 (+2 spares)	N010-010-GY	Tripp Lite	3	5	10	50	
					Subtotal	**22,520**	**3,196**

Client Software

Windows Server 2008 Standard Edition (x86)*	P73-04165	Microsoft	2	711	6	4,266	(Included)
					Subtotal	**4,266**	**0**

Infrastructure

Brocade Silkworm 300E 24 Port Fibre Switch (+2 spares)	BR-340-0004-A	Brocade	4	5,175	6	31,050	
Rack Mount Kit (+2 spares)	XBR-R000162	Brocade	4	99	6	594	
Advanced Replacement, 24x7 Software Support, 1 yr	300-SVC-ADVANCE-1	Brocade	4	450	18		8,100
6' Null Modem Adapter Cable (+2 spares)	P450-006	Tripp Lite	3	5	3	15	
24-Port 10/100/1000 Gigabit Switch (+2 spares)	SR2024C	Cisco	3	250	4	1,000	
5-port 10/100 switch (+2 spares)	SD205	Cisco	3	32	3	96	
					Subtotal	**32,755**	**8,100**

		TOTAL	1,618,130	354,857
NEC Large Volume Discount**		-10%	-120,207	-2,279

Notes:

Pricing: 1-NEC Contact: 1-866-632-3226, 2-Microsoft 3-CDW 4-Synegi

* Qty of Windpws Server 2008 Standard Edition includes the license of the DB server's mainetenance 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

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

3-Yr. Cost of Ownership: **$1,850,500**

tpsE Throughput: **1568.22**

$ / tpsE $1,180.01

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.

Numerical Quantities Summary				
Reported Throughput : 1568.22 tpsE		**Configured Customers : 800,000**		
Response Times (in seconds)	**Minimum**	**Average**	**90th %tile**	**Maximum**
Broker Volume	0.01	0.05	0.08	5.09
Customer Position	0.00	0.03	0.05	0.82
Market Feed	0.00	0.03	0.07	5.05
Market Watch	0.00	0.03	0.06	2.42
Security Detail	0.00	0.01	0.03	1.98
Trade Lookup	0.00	0.53	0.76	3.25
Trade Order	0.00	0.07	0.12	5.12
Trade Result	0.00	0.08	0.15	2.13
Trade Status	0.00	0.02	0.04	2.35
Trade Update	0.01	0.62	0.81	3.44
Data Maintenance	0.01	0.18		2.44
Transaction Mix		**Transaction Count**		**Mix %**
Broker Volume		5,532,312		4.900%
Customer Position		14,677,165		13.000%
Market Feed		1,129,132		1.000%
Market Watch		20,322,714		18.000%
Security Detail		15,806,601		14.000%
Trade Lookup		9,031,781		8.000%
Trade Order		11,403,618		10.100%
Trade Result		11,291,232		10.001%
Trade Status		21,451,797		19.000%
Trade Update		2,257,938		2.000%
Data Maintenance		120		
Test Duration and Timings				
Ramp-up Time		0:54:22		
Measurement Interval		2:00:00		
Business Recovery Time		0:51:23		
Total Number of Transactions Completed in Measurement Interval		112,904,290		

PREAMBLE

Introduction

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

- The simultaneous execution of multiple transaction types that span a breadth of complexity;

- Moderate system and application execution time;

- A balanced mixture of disk input/output and processor usage;

- Transaction integrity (ACID properties);

- A mixture of uniform and non-uniform data access through primary and secondary keys;

- Databases consisting of many tables with a wide variety of sizes, attributes, and relationships with realistic content;

- Contention on data access and update.

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

Goal of the TPC-E Benchmark

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

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

The benchmark defines:

- Two types of transactions to simulate Consumer-to-Business as well as Business-to-Business activities

- Several transactions for each transaction type

- Different execution profiles for each transaction type

- A specific run-time mix for all defined transactions

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

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

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

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

Restrictions and Limitations

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

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

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

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

Clause 1 : General Items

Order and Titles

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

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

Executive Summary Statement

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

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

Benchmark Sponsor

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

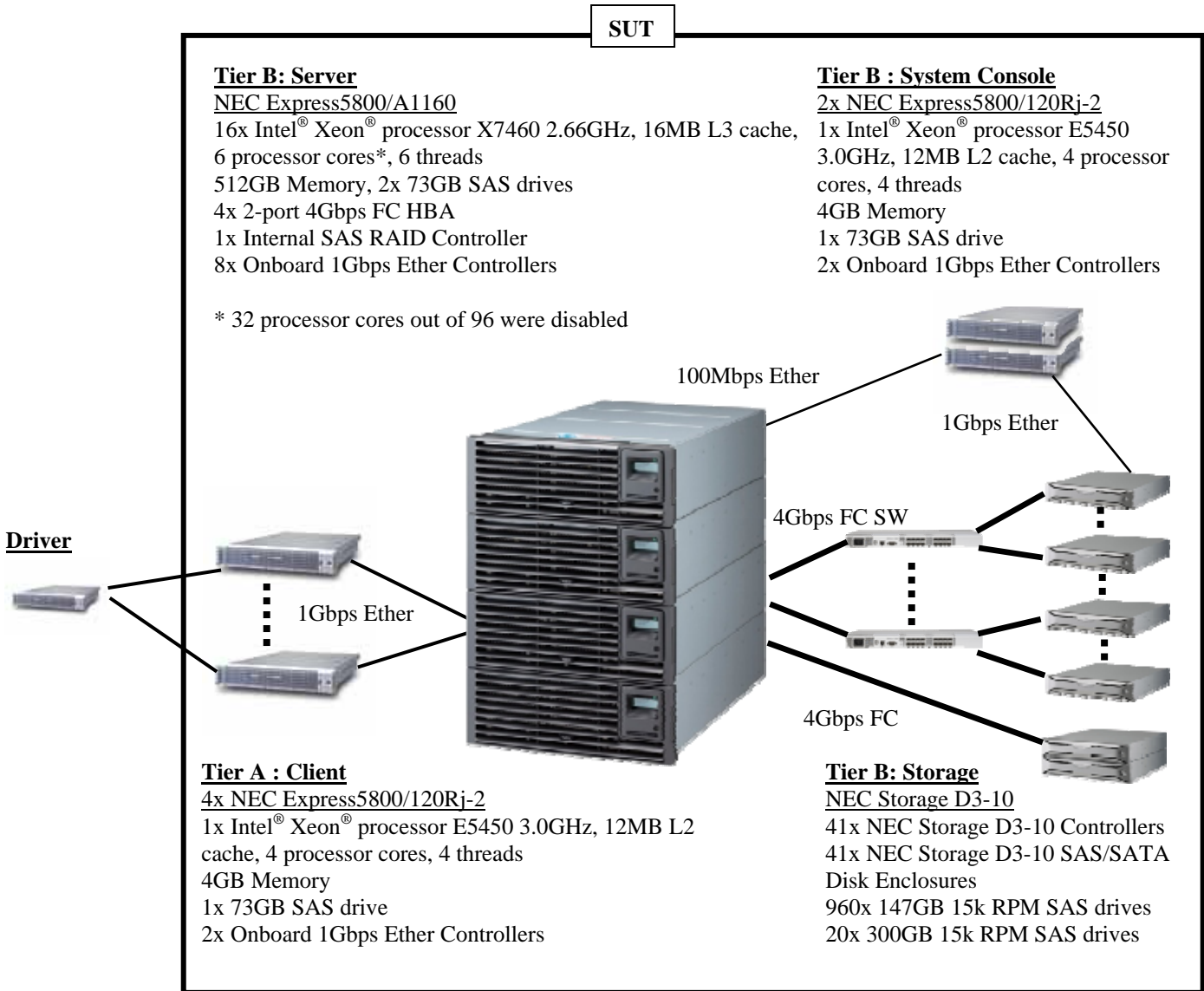This benchmark test was sponsored by NEC Corporation.

Configuration Diagrams

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

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

Measured and Priced Configuration

The following figure represents the measured and priced configuration.

Figure1.1: NEC Express5800/A1160, Measured and Priced Configuration Diagram

SUT

Tier B: Server
NEC Express5800/A1160
16x Intel® Xeon® processor X7460 2.66GHz, 16MB L3 cache, 6 processor cores*, 6 threads
512GB Memory, 2x 73GB SAS drives
4x 2-port 4Gbps FC HBA
1x Internal SAS RAID Controller
8x Onboard 1Gbps Ether Controllers

* 32 processor cores out of 96 were disabled

Tier B : System Console
2x NEC Express5800/120Rj-2
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

Driver

100Mbps Ether

1Gbps Ether

4Gbps FC SW

1Gbps Ether

4Gbps FC

Tier A : Client
4x NEC Express5800/120Rj-2
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

Tier B: Storage
NEC Storage D3-10
41x NEC Storage D3-10 Controllers
41x NEC Storage D3-10 SAS/SATA Disk Enclosures
960x 147GB 15k RPM SAS drives
20x 300GB 15k RPM SAS drives

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, 10.10.2.250, 10.10.3.250 and 10.10.4.250.

Tier-A installation / configuration

The NEC Express5800/120Rj-2 has 1x Intel® Xeon® processor E5450, 4GB of Memory, 1x 73GB SAS drive. Tier-A consists of 4x 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)
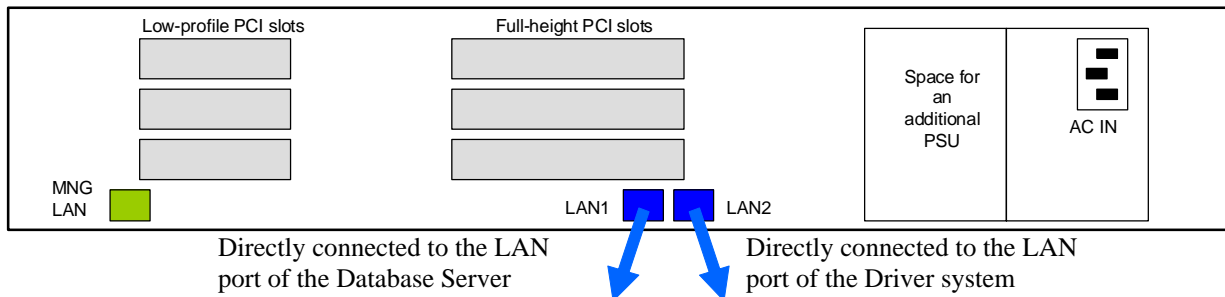
Tier-B installation / configuration

Tier-B hardware consists of four nodes of the NEC Express5800/A1160 as the database server, forty-one 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.

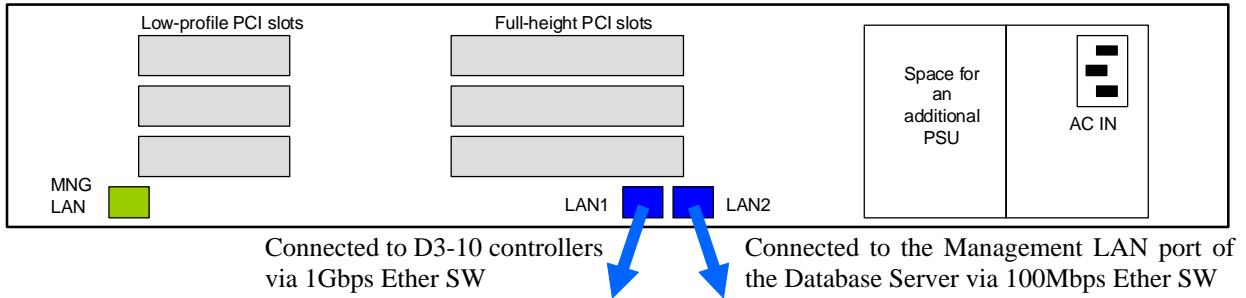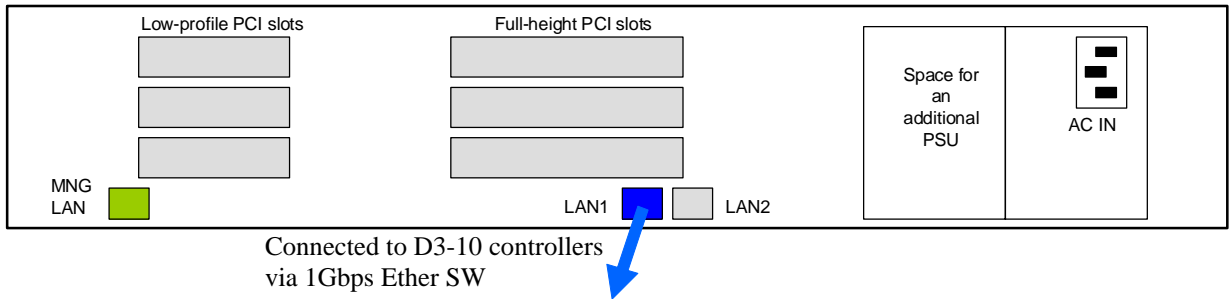**Figure1.3: Rear view of the System Console #1 (NEC Express5800/120Rj-2)**

Low-profile PCI slots   Full-height PCI slots

Space for an additional PSU

AC IN

MNG LAN

LAN1   LAN2

Connected to D3-10 controllers via 1Gbps Ether SW

Connected to the Management LAN port of the Database Server via 100Mbps Ether SW

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

Low-profile PCI slots   Full-height PCI slots

Space for an additional PSU

AC IN

MNG LAN

LAN1   LAN2

Connected to D3-10 controllers via 1Gbps Ether SW

The NEC Express5800/A1160 was configured to four 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® processor X7460 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 thirty-two processor cores out of 96 were disabled on the four nodes of the NEC Express5800/A1160 as follows:

Node#0	Socket#0	Core#3
	Socket#0	Core#4
	Socket#1	Core#3
	Socket#1	Core#4
	Socket#2	Core#3
	Socket#2	Core#4
	Socket#3	Core#3
	Socket#3	Core#4
Node#1	Socket#0	Core#3
	Socket#0	Core#4
	Socket#1	Core#3
	Socket#1	Core#4
	Socket#2	Core#3

	Socket#2	Core#4
	Socket#3	Core#3
	Socket#3	Core#4
Node#2	Socket#0	Core#3
	Socket#0	Core#4
	Socket#1	Core#3
	Socket#1	Core#4
	Socket#2	Core#3
	Socket#2	Core#4
	Socket#3	Core#3
	Socket#3	Core#4
Node#3	Socket#0	Core#3
	Socket#0	Core#4
	Socket#1	Core#3
	Socket#1	Core#4
	Socket#2	Core#3
	Socket#2	Core#4
	Socket#3	Core#3
	Socket#3	Core#4

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

Figure1.5: Connection diagram for the NEC Express5800/A1160 four nodes
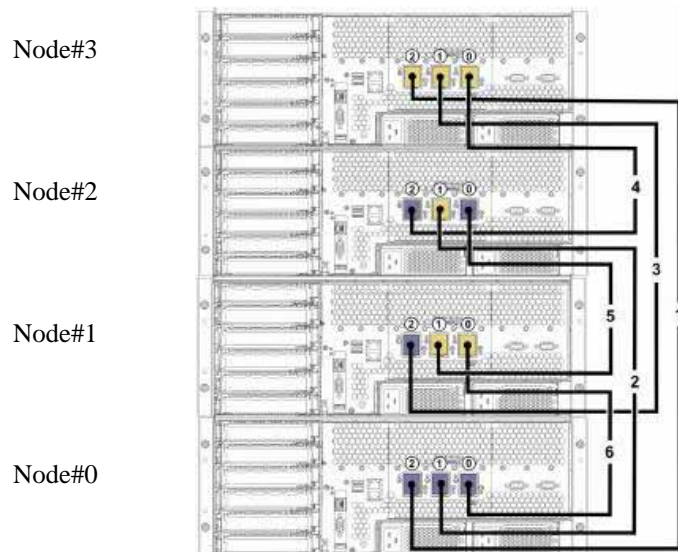
The 2x 2-port 4Gbps FC HBAs were installed to the PCI-Express slots of two nodes of the NEC Express5800/A1160. They were connected to the Database Array via 16-port 4Gbps FC switches as follows:

---- 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
Onboard LAN#0	to GbE NIC of client #3
Onboard LAN#1	to GbE NIC of client #4
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

---- Node#3 ----

Management LAN	to the system console #1 via 100Mbps Ether switch

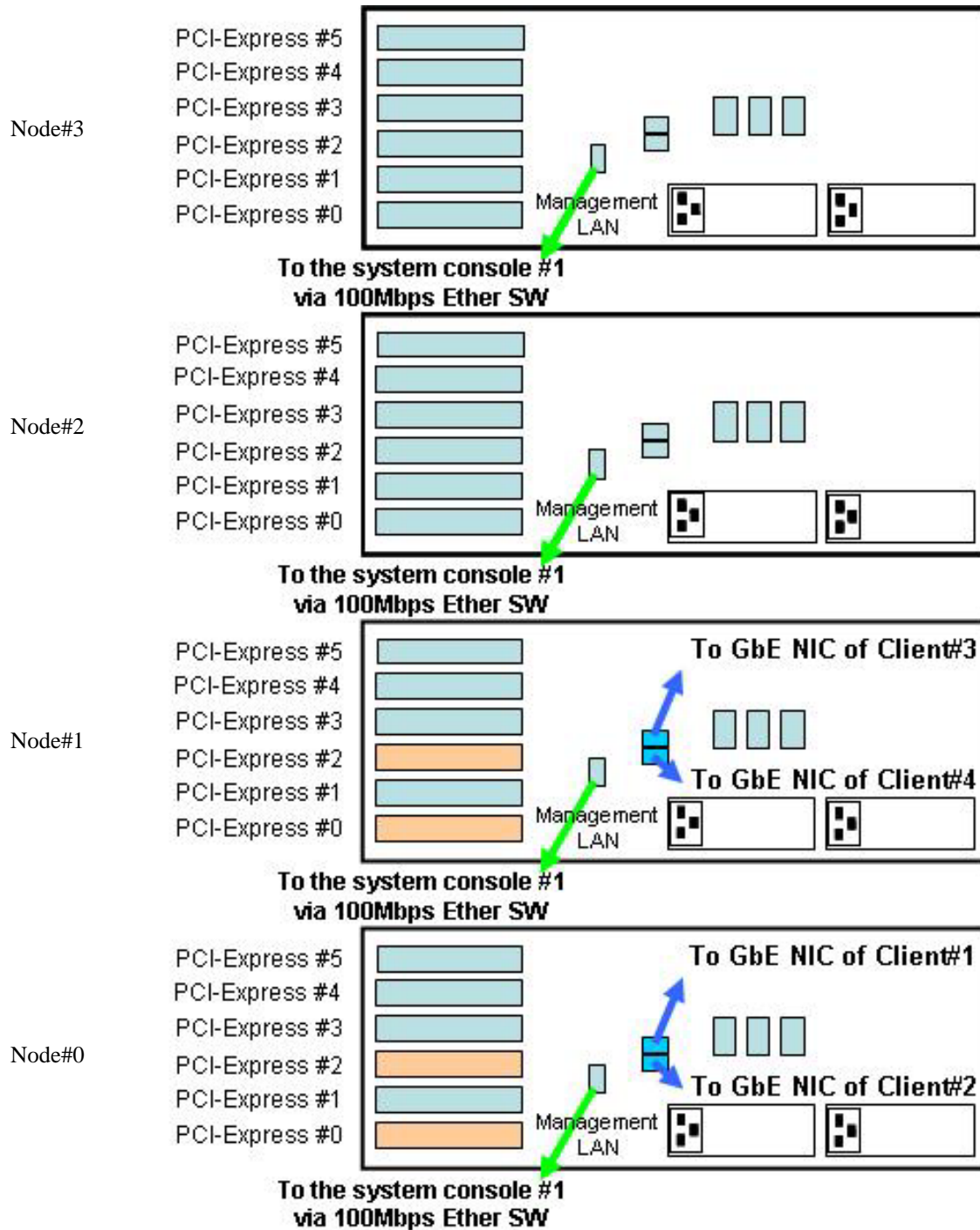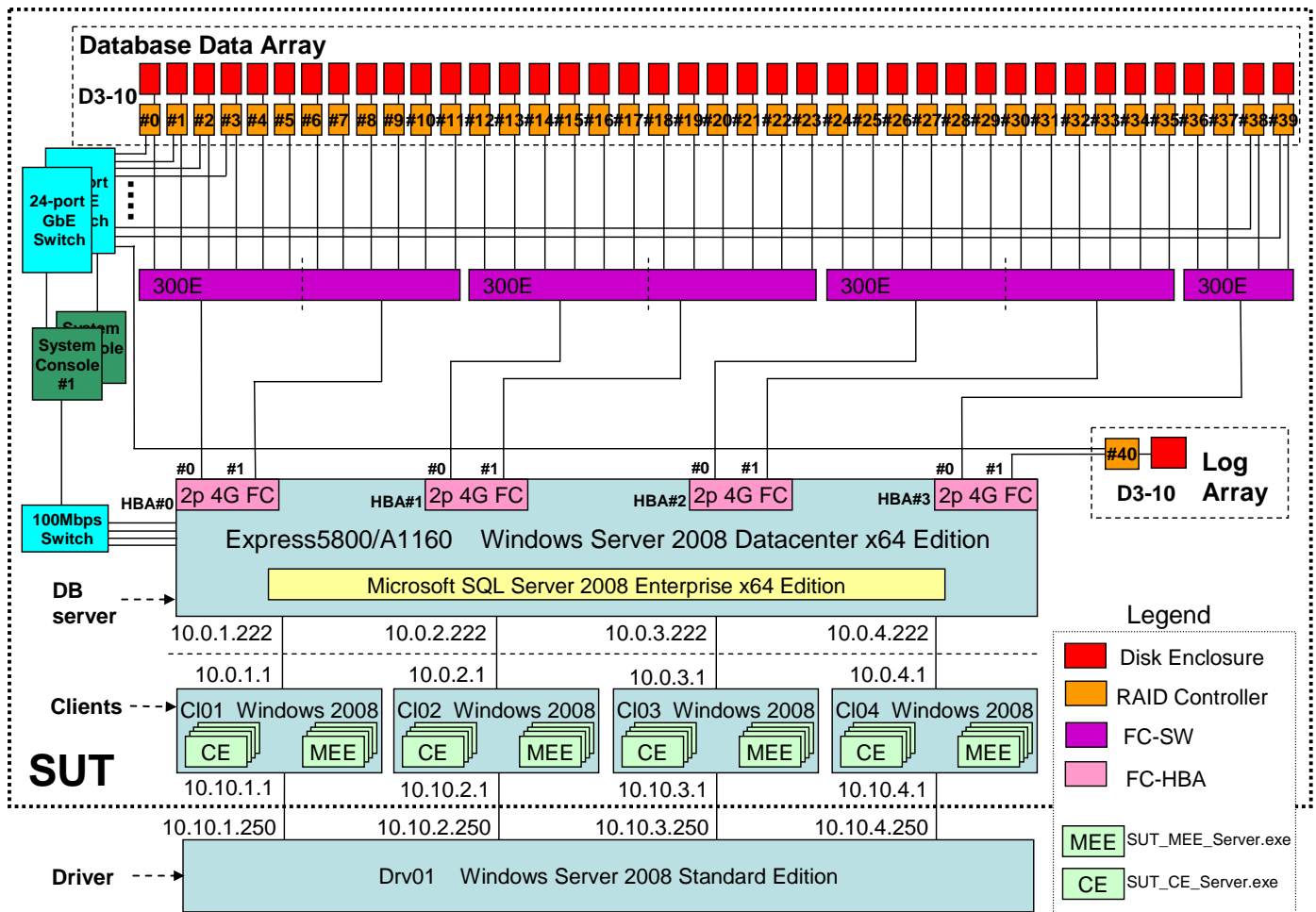**Figure1.6: Rear view of the Server (NEC Express5800/A1160)**

Figure1.7: Overview of the whole system connections

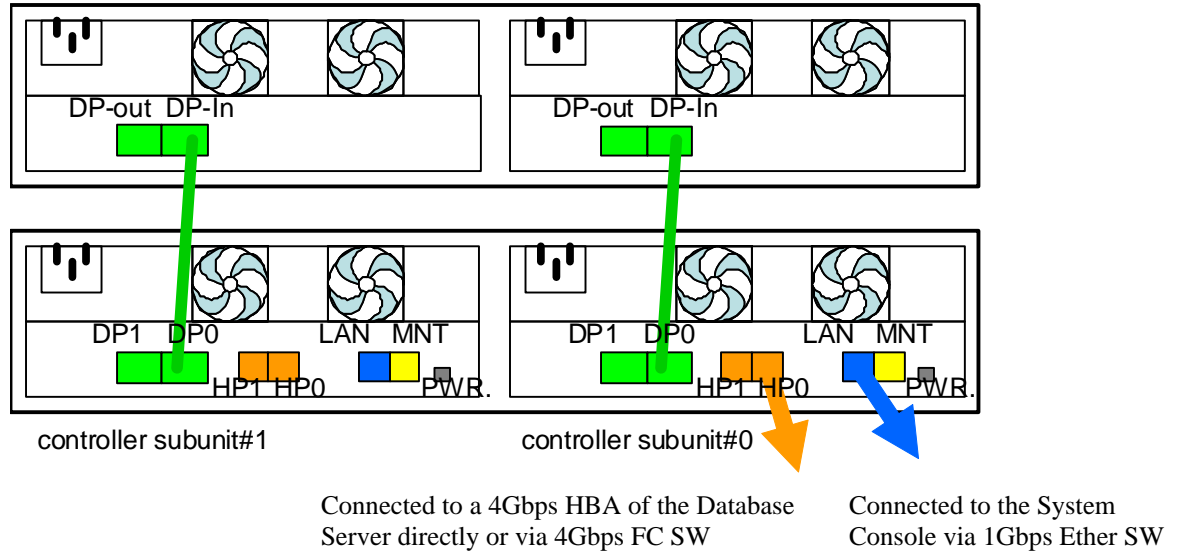## Connect NEC Storage D3-10 controllers to disk enclosures

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 forty NEC Storage D3-10 controllers and forty 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

DP-out DP-In   DP-out DP-In

DP1   DP0   LAN   MNT   DP1   DP0   LAN   MNT
           HP1 HP0   PWR.   HP1 HP0   PWR.

controller subunit#1   controller subunit#0

Connected to a 4Gbps HBA of the Database   Connected to the System
Server directly or via 4Gbps FC SW   Console via 1Gbps Ether SW

Software Configuration

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

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

Driver

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

Tier-A

OS Installation

Step.1: Install "Windows Server® 2008"

1. Put an OS install medium into the DVD drive of the NEC Express5800/120Rj-2.

2. Power on the NEC Express5800/120Rj-2 with a DVD Drive, then "Windows Setup" boots from the OS install medium.

3. Continue normal Windows installation.

Step.2: Install driver

1. After Windows installation completes, put the EXPRESSBUILDER DVD medium into the DVD drive of the NEC Express5800/120Rj-2.

2. A dialog below is displayed.
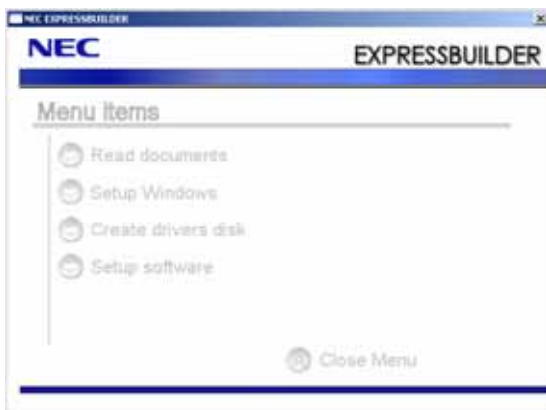
3. Select "Setup Windows" -> "Update the system".
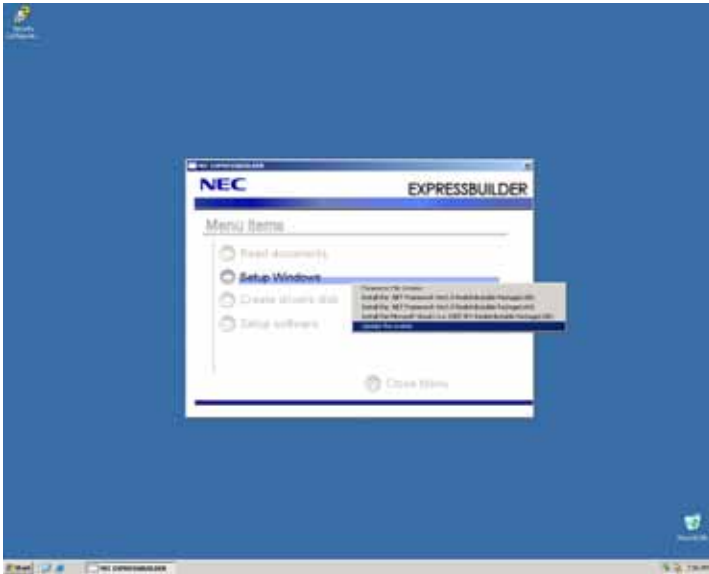
4. When "Update the system" is finished, remove the EXPRESSBUILDER DVD medium from the DVD drive and reboot the NEC Express5800/120Rj-2.

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 is installed, install the vc2008SP1redist_x86.exe, SUT_CE_Server.exe and SUT_MEE_Server.exe.

Tier-B

Tier-B hardware consists of four nodes of the NEC Express5800/A1160 as the database server, forty-one 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".
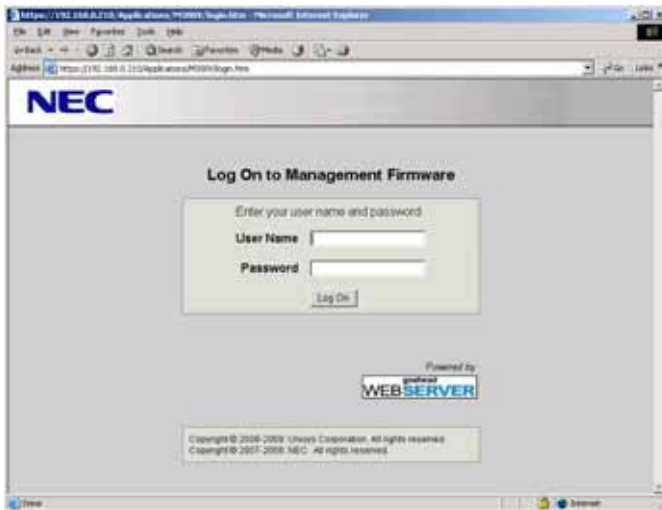
Tier-B : The Database Server

Power up the database server, NEC 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.

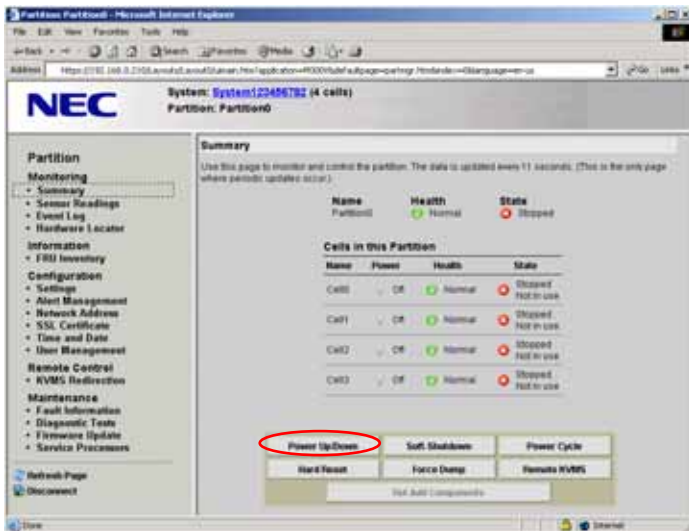*Step.1:* Start up "Internet Explorer".

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.
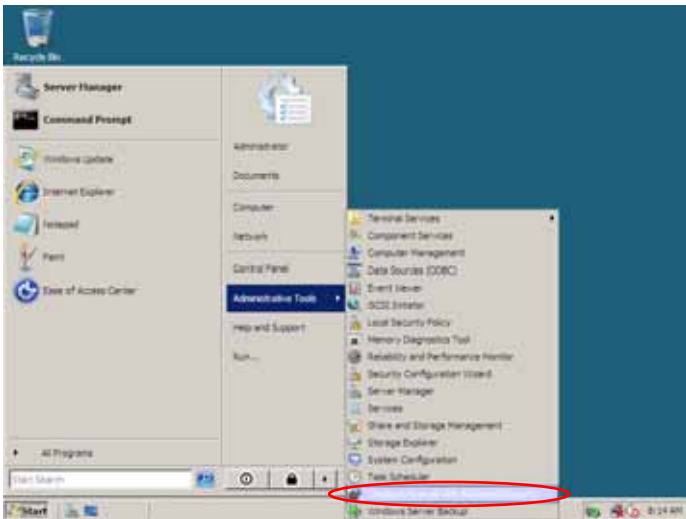

OS Configuration

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

Disable "Windows Firewall"

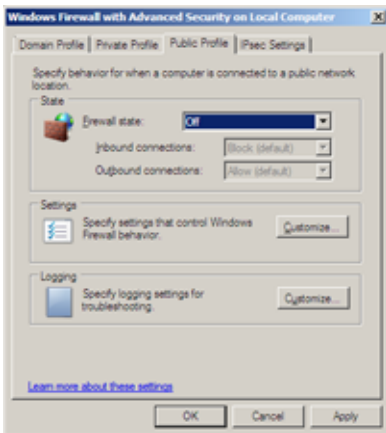To connect the Database Server to the Clients, disable "Windows Firewall".

    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.
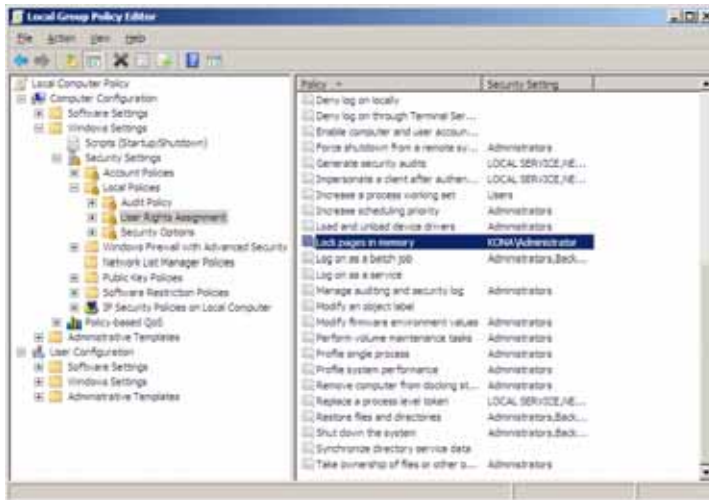
3. Double-click "Lock pages in memory" in the right window to open dialog, then add Administrator into this policy.

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.
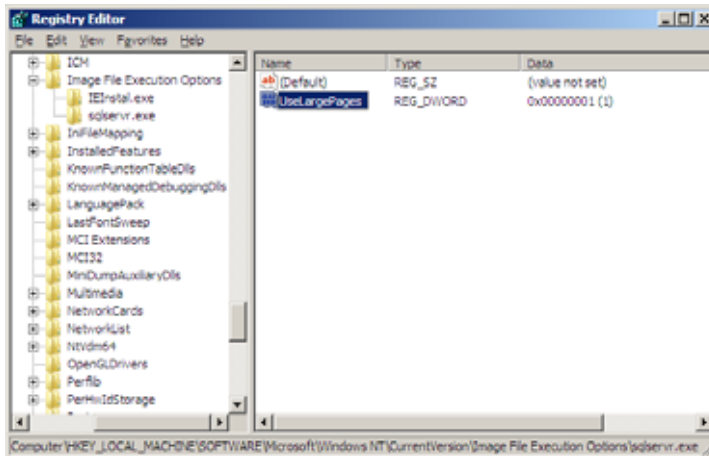
1. Start "regedit.exe" from "Run…" of the Start Menu.

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.

Configure "Visual Effects"

1. To configure "Visual Effects", select "Control Panel" -> "System"->"Advanced System Settings".

2. Selecting "Advanced" tab -> [Settings…] of "Performance" –> "Visual Effects" tab, check the radio button for "Adjust for best performance"

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 sydskmap_[1..11].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.
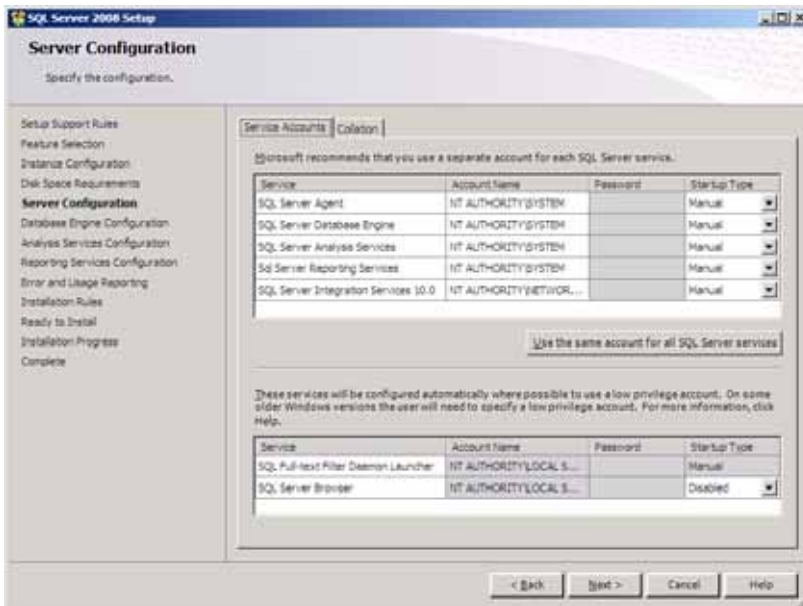
Step.1: **"Feature Selection"**

Select all Features.
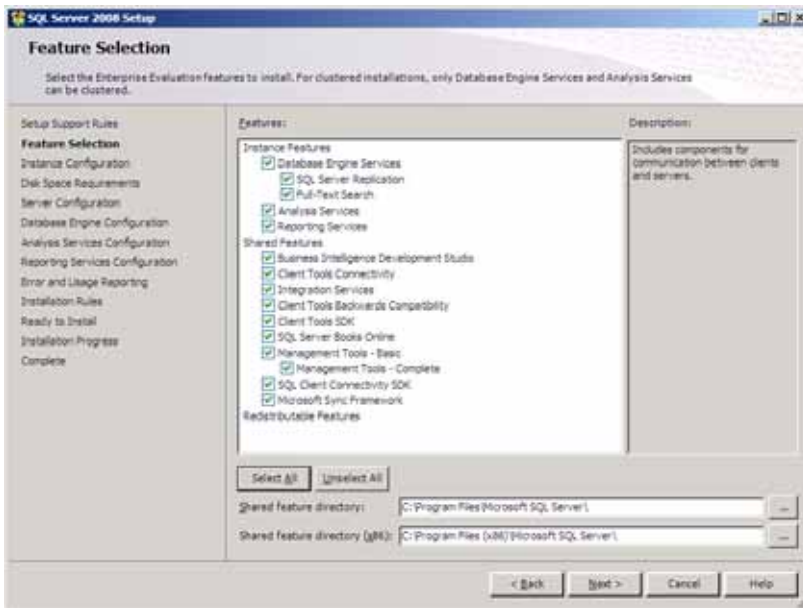
Step.2: **"Server Configuration"**

Change the "Startup Type" from Automatic to Manual.

Select "Collation" tab.

Change the "Database Engine Collation" to Laten1_General_BIN.
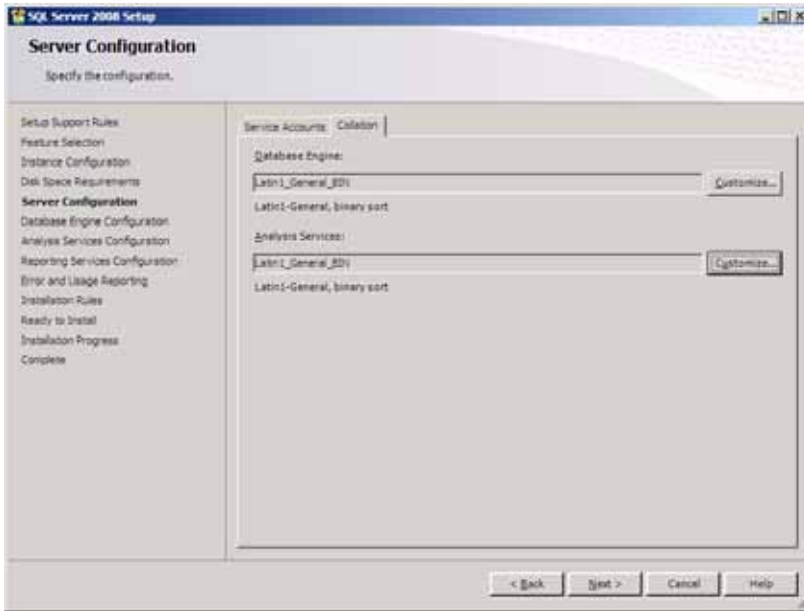
SQL Server® Configuration

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
max server memory (MB)	16	2147483647	480256	480256
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	480256	480256
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).

Step.4: **Configure softNUMA node**

1. Run "SoftNUMA-node-cpumask.reg" to add node keys and configure CPUmask for each node (the reg file "SoftNUMA-node-cpumask.reg" is included in the Supporting Files).

2. Run "SoftNUMA-ports.reg" to configure TCP/IP ports for eache softNUMA nodes "SoftNUMA-ports.reg" is included in the Supporting Files).

Clause 2 : Database Design, Scaling & Population Related Items

Database Creation

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

The database has been created for 800,000 customers. The SQL Server® 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 User-Defined Objects, within the database, must be reported in the Report.

Physical space was allocated to Microsoft® SQL Server® 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 800,000 customers.

Table 2.1 Number of Rows for Server

Table Name	Rows Loaded
Scaling Tables	
ACCOUNT PERMISSION	5,679,775
ADDRESS	1,200,004
BROKER	8,000

COMPANY	400,000
COMPANY COMPETITOR	1,200,000
CUSTOMER	800,000
CUSTOMER ACCOUNT	4,000,000
CUSTOMER TAXRATE	1,600,000
DAILY MARKET	715,140,000
FINANCIAL	8,000,000
LAST TRADE	548,000
NEWS ITEM	800,000
NEWS XREF	800,000
SECURITY	548,000
WATCH ITEM	80,054,495
WATCH LIST	800,000
Growing Tables	
CASH TRANSACTION	12,718,084,996
HOLDING	707,739,258
HOLDING HISTORY	18,526,540,227
HOLDING SUMMARY	39,788,095
SETTLEMENT	13,824,000,000
TRADE	13,824,000,000
TRADE HISTORY	33,177,541,373
TRADE REQUEST	0
Fixed Tables	
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_27\ (RAW) Z:\Device\Market_27 (RAW) Z:\Device\Customer_27\ (RAW)	90GB 5GB 40GB	Broker_27 Market_27 Customer_27
2	0		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_28\ (RAW) Z:\Device\Market_28\ (RAW) Z:\Device\Customer_28\ (RAW)	90GB 5GB 40GB	Broker_28 Market_28 Customer_28
3	1		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_25\ (RAW) Z:\Device\Market_25\ (RAW) Z:\Device\Customer_25\ (RAW)	90GB 5GB 40GB	Broker_25 Market_25 Customer_25
4	1		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_26\ (RAW) Z:\Device\Market_26\ (RAW) Z:\Device\Customer_26\ (RAW)	90GB 5GB 40GB	Broker_26 Market_26 Customer_26
5	2		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_31\ (RAW) Z:\Device\Market_31\ (RAW) Z:\Device\Customer_31\ (RAW)	90GB 5GB 40GB	Broker_31 Market_31 Customer_31
6	2		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_32\ (RAW) Z:\Device\Market_32\ (RAW) Z:\Device\Customer_32\ (RAW)	90GB 5GB 40GB	Broker_32 Market_32 Customer_32
7	3		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_35\ (RAW) Z:\Device\Market_35\ (RAW) Z:\Device\Customer_35\ (RAW)	90GB 5GB 40GB	Broker_35 Market_35 Customer_35
8	3		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_36\ (RAW) Z:\Device\Market_36\ (RAW) Z:\Device\Customer_36\ (RAW)	90GB 5GB 40GB	Broker_36 Market_36 Customer_36
9	4		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_33\ (RAW) Z:\Device\Market_33\ (RAW) Z:\Device\Customer_33\ (RAW)	90GB 5GB 40GB	Broker_33 Market_33 Customer_33
10	4		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_34\ (RAW) Z:\Device\Market_34\ (RAW) Z:\Device\Customer_34\ (RAW)	90GB 5GB 40GB	Broker_34 Market_34 Customer_34
11	5		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_29\ (RAW) Z:\Device\Market_29\ (RAW) Z:\Device\Customer_29\ (RAW)	90GB 5GB 40GB	Broker_29 Market_29 Customer_29
12	5		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_30\ (RAW) Z:\Device\Market_30\ (RAW) Z:\Device\Customer_30\ (RAW)	90GB 5GB 40GB	Broker_30 Market_30 Customer_30

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

13	6		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_11\ (RAW) Z:\Device\Market_11\ (RAW) Z:\Device\Customer_11\ (RAW) -> **alias** Z:\Device\TPCE_TempDB\ (NTFS)	90GB 5GB 40GB (693GB)	Broker_11 Market_11 Customer_11 tempdb.mdf
14	6		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_12\ (RAW) Z:\Device\Market_12\ (RAW) Z:\Device\Customer_12\ (RAW)	90GB 5GB 40GB	Broker_12 Market_12 Customer_12
15	7		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_05\ (RAW) Z:\Device\Market_05\ (RAW) Z:\Device\Customer_05\ (RAW)	90GB 5GB 40GB	Broker_05 Market_05 Customer_05
16	7		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_06\ (RAW) Z:\Device\Market_06\ (RAW) Z:\Device\Customer_06\ (RAW)	90GB 5GB 40GB	Broker_06 Market_06 Customer_06
17	8		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_01\ (RAW) Z:\Device\Market_01\ (RAW) Z:\Device\Customer_01\ (RAW) -> **alias** Z:\Device\Data_01\ (NTFS)	90GB 5GB 40GB (693GB)	Broker_01 Market_01 Customer_01 TPCE_Misc.ndf
18	8	0-1	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_02\ (RAW) Z:\Device\Market_02\ (RAW) Z:\Device\Customer_02\ (RAW)	90GB 5GB 40GB	Broker_02 Market_02 Customer_02
19	9		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_07\ (RAW) Z:\Device\Market_07\ (RAW) Z:\Device\Customer_07\ (RAW)	90GB 5GB 40GB	Broker_07 Market_07 Customer_07
20	9		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_08\ (RAW) Z:\Device\Market_08\ (RAW) Z:\Device\Customer_08\ (RAW)	90GB 5GB 40GB	Broker_08 Market_08 Customer_08
21	10		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_03\ (RAW) Z:\Device\Market_03\ (RAW) Z:\Device\Customer_03\ (RAW)	90GB 5GB 40GB	Broker_03 Market_03 Customer_03
22	10		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_04\ (RAW) Z:\Device\Market_04\ (RAW) Z:\Device\Customer_04\ (RAW)	90GB 5GB 40GB	Broker_04 Market_04 Customer_04
23	11		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_09\ (RAW) Z:\Device\Market_09\ (RAW) Z:\Device\Customer_09\ (RAW)	90GB 5GB 40GB	Broker_09 Market_09 Customer_09
24	11		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_10\ (RAW) Z:\Device\Market_10\ (RAW) Z:\Device\Customer_10\ (RAW)	90GB 5GB 40GB	Broker_10 Market_10 Customer_10
25	12		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_13\ (RAW) Z:\Device\Market_13\ (RAW) Z:\Device\Customer_13\ (RAW)	90GB 5GB 40GB	Broker_13 Market_13 Customer_13
26	12		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_14\ (RAW) Z:\Device\Market_14\ (RAW) Z:\Device\Customer_14\ (RAW)	90GB 5GB 40GB	Broker_14 Market_14 Customer_14
27	13		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_15\ (RAW) Z:\Device\Market_15\ (RAW) Z:\Device\Customer_15\ (RAW)	90GB 5GB 40GB	Broker_15 Market_15 Customer_15
28	13		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_16\ (RAW) Z:\Device\Market_16\ (RAW) Z:\Device\Customer_16\ (RAW)	90GB 5GB 40GB	Broker_16 Market_16 Customer_16
29	14		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_21\ (RAW) Z:\Device\Market_21\ (RAW) Z:\Device\Customer_21\ (RAW) -> **alias** Z:\Device\TPCE_TempLog\ (NTFS)	90GB 5GB 40GB (693GB)	Broker_21 Market_21 Customer_21 templog.ldf
30	14	1-0	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_22\ (RAW) Z:\Device\Market_22\ (RAW) Z:\Device\Customer_22\ (RAW)	90GB 5GB 40GB	Broker_22 Market_22 Customer_22
31	15		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_17\ (RAW) Z:\Device\Market_17\ (RAW) Z:\Device\Customer_17\ (RAW)	90GB 5GB 40GB	Broker_17 Market_17 Customer_17
32	15		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_18\ (RAW) Z:\Device\Market_18\ (RAW) Z:\Device\Customer_18\ (RAW)	90GB 5GB 40GB	Broker_18 Market_18 Customer_18
33	16		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_19\ (RAW) Z:\Device\Market_19\ (RAW) Z:\Device\Customer_19\ (RAW)	90GB 5GB 40GB	Broker_19 Market_19 Customer_19
34	16		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_20\ (RAW) Z:\Device\Market_20\ (RAW) Z:\Device\Customer_20\ (RAW)	90GB 5GB 40GB	Broker_20 Market_20 Customer_20
35	17		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_23\ (RAW) Z:\Device\Market_23\ (RAW) Z:\Device\Customer_23\ (RAW)	90GB 5GB 40GB	Broker_23 Market_23 Customer_23
36	17		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_24\ (RAW) Z:\Device\Market_24\ (RAW) Z:\Device\Customer_24\ (RAW)	90GB 5GB 40GB	Broker_24 Market_24 Customer_24

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

37	18		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_57\ (RAW) Z:\Device\Market_57\ (RAW) Z:\Device\Customer_57\ (RAW) Z:\Device\Backup_57\ (NTFS)	90GB 5GB 40GB 663GB	Broker_57 Market_57 Customer_57 Backup_57
38	18		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_58\ (RAW) Z:\Device\Market_58\ (RAW) Z:\Device\Customer_58\ (RAW) Z:\Device\Backup_58\ (NTFS)	90GB 5GB 40GB 663GB	Broker_58 Market_58 Customer_58 Backup_58
39	19		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_63\ (RAW) Z:\Device\Market_63\ (RAW) Z:\Device\Customer_63\ (RAW) Z:\Device\Backup_63\ (NTFS)	90GB 5GB 40GB 663GB	Broker_63 Market_63 Customer_63 Backup_63
40	19		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_64\ (RAW) Z:\Device\Market_64\ (RAW) Z:\Device\Customer_64\ (RAW) Z:\Device\Backup_64\ (NTFS)	90GB 5GB 40GB 663GB	Broker_64 Market_64 Customer_64 Backup_64
41	20		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_67\ (RAW) Z:\Device\Market_67\ (RAW) Z:\Device\Customer_67\ (RAW) Z:\Device\Backup_67\ (NTFS)	90GB 5GB 40GB 663GB	Broker_67 Market_67 Customer_67 Backup_67
42	20	1-1	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_68\ (RAW) Z:\Device\Market_68\ (RAW) Z:\Device\Customer_68\ (RAW) Z:\Device\Backup_68\ (NTFS)	90GB 5GB 40GB 663GB	Broker_68 Market_68 Customer_68 Backup_68
43	21		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_59\ (RAW) Z:\Device\Market_59\ (RAW) Z:\Device\Customer_59\ (RAW) Z:\Device\Backup_59\ (NTFS)	90GB 5GB 40GB 663GB	Broker_59 Market_59 Customer_59 Backup_59
44	21		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_60\ (RAW) Z:\Device\Market_60\ (RAW) Z:\Device\Customer_60\ (RAW) Z:\Device\Backup_60\ (NTFS)	90GB 5GB 40GB 663GB	Broker_60 Market_60 Customer_60 Backup_60
45	22		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_65\ (RAW) Z:\Device\Market_65\ (RAW) Z:\Device\Customer_65\ (RAW) Z:\Device\Backup_65\ (NTFS)	90GB 5GB 40GB 663GB	Broker_65 Market_65 Customer_65 Backup_65
46	22		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_66\ (RAW) Z:\Device\Market_66\ (RAW) Z:\Device\Customer_66\ (RAW) Z:\Device\Backup_66\ (NTFS)	90GB 5GB 40GB 663GB	Broker_66 Market_66 Customer_66 Backup_66
47	23		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_61\ (RAW) Z:\Device\Market_61\ (RAW) Z:\Device\Customer_61\ (RAW) Z:\Device\Backup_61\ (NTFS)	90GB 5GB 40GB 663GB	Broker_61 Market_61 Customer_61 Backup_61
48	23		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_62\ (RAW) Z:\Device\Market_62\ (RAW) Z:\Device\Customer_62\ (RAW) Z:\Device\Backup_62\ (NTFS)	90GB 5GB 40GB 663GB	Broker_62 Market_62 Customer_62 Backup_62

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

49	24		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_69\ (RAW) Z:\Device\Market_69\ (RAW) Z:\Device\Customer_69\ (RAW) Z:\Device\Backup_69\ (NTFS)	90GB 5GB 40GB 663GB	Broker_69 Market_69 Customer_69 Backup_69
50	24		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_70\ (RAW) Z:\Device\Market_70\ (RAW) Z:\Device\Customer_70\ (RAW) Z:\Device\Backup_70\ (NTFS)	90GB 5GB 40GB 663GB	Broker_70 Market_70 Customer_70 Backup_70
51	25		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_71\ (RAW) Z:\Device\Market_71\ (RAW) Z:\Device\Customer_71\ (RAW) Z:\Device\Backup_71\ (NTFS)	90GB 5GB 40GB 663GB	Broker_71 Market_71 Customer_71 Backup_71
52	25		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_72\ (RAW) Z:\Device\Market_72\ (RAW) Z:\Device\Customer_72\ (RAW) Z:\Device\Backup_72\ (NTFS)	90GB 5GB 40GB 663GB	Broker_72 Market_72 Customer_72 Backup_72
53	26		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_77\ (RAW) Z:\Device\Market_77\ (RAW) Z:\Device\Customer_77\ (RAW) Z:\Device\Backup_77\ (NTFS)	90GB 5GB 40GB 663GB	Broker_77 Market_77 Customer_77 Backup_77
54	26	2-0	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_78\ (RAW) Z:\Device\Market_78\ (RAW) Z:\Device\Customer_78\ (RAW) Z:\Device\Backup_78\ (NTFS)	90GB 5GB 40GB 663GB	Broker_78 Market_78 Customer_78 Backup_78
55	27		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_79\ (RAW) Z:\Device\Market_79\ (RAW) Z:\Device\Customer_79\ (RAW) Z:\Device\Backup_79\ (NTFS)	90GB 5GB 40GB 663GB	Broker_79 Market_79 Customer_79 Backup_79
56	27		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_80\ (RAW) Z:\Device\Market_80\ (RAW) Z:\Device\Customer_80\ (RAW) Z:\Device\Backup_80\ (NTFS)	90GB 5GB 40GB 663GB	Broker_80 Market_80 Customer_80 Backup_80
57	28		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_73\ (RAW) Z:\Device\Market_73\ (RAW) Z:\Device\Customer_73\ (RAW) Z:\Device\Backup_73\ (NTFS)	90GB 5GB 40GB 663GB	Broker_73 Market_73 Customer_73 Backup_73
58	28		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_74\ (RAW) Z:\Device\Market_74\ (RAW) Z:\Device\Customer_74\ (RAW) Z:\Device\Backup_74\ (NTFS)	90GB 5GB 40GB 663GB	Broker_74 Market_74 Customer_74 Backup_74
59	29		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_75\ (RAW) Z:\Device\Market_75\ (RAW) Z:\Device\Customer_75\ (RAW) Z:\Device\Backup_75\ (NTFS)	90GB 5GB 40GB 663GB	Broker_75 Market_75 Customer_75 Backup_75
60	29		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_76\ (RAW) Z:\Device\Market_76\ (RAW) Z:\Device\Customer_76\ (RAW) Z:\Device\Backup_76\ (NTFS)	90GB 5GB 40GB 663GB	Broker_76 Market_76 Customer_76 Backup_76

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

61	30		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_43\ (RAW) Z:\Device\Market_43\ (RAW) Z:\Device\Customer_43\ (RAW) Z:\Device\Backup_43\ (NTFS)	90GB 5GB 40GB 663GB	Broker_43 Market_43 Customer_43 Backup_43
62	30		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_44\ (RAW) Z:\Device\Market_44\ (RAW) Z:\Device\Customer_44\ (RAW) Z:\Device\Backup_44\ (NTFS)	90GB 5GB 40GB 663GB	Broker_44 Market_44 Customer_44 Backup_44
63	31		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_47\ (RAW) Z:\Device\Market_47\ (RAW) Z:\Device\Customer_47\ (RAW) Z:\Device\Backup_47\ (NTFS)	90GB 5GB 40GB 663GB	Broker_47 Market_47 Customer_47 Backup_47
64	31		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_48\ (RAW) Z:\Device\Market_48\ (RAW) Z:\Device\Customer_48\ (RAW) Z:\Device\Backup_48\ (NTFS)	90GB 5GB 40GB 663GB	Broker_48 Market_48 Customer_48 Backup_48
65	32		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_37\ (RAW) Z:\Device\Market_37\ (RAW) Z:\Device\Customer_37\ (RAW)	90GB 5GB 40GB	Broker_37 Market_37 Customer_37
66	32	2-1	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_38\ (RAW) Z:\Device\Market_38\ (RAW) Z:\Device\Customer_38\ (RAW)	90GB 5GB 40GB	Broker_38 Market_38 Customer_38
67	33		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_39\ (RAW) Z:\Device\Market_39\ (RAW) Z:\Device\Customer_39\ (RAW)	90GB 5GB 40GB	Broker_39 Market_39 Customer_39
68	33		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_40\ (RAW) Z:\Device\Market_40\ (RAW) Z:\Device\Customer_40\ (RAW)	90GB 5GB 40GB	Broker_40 Market_40 Customer_40
69	34		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_41\ (RAW) Z:\Device\Market_41\ (RAW) Z:\Device\Customer_41\ (RAW) Z:\Device\Backup_41\ (NTFS)	90GB 5GB 40GB 663GB	Broker_41 Market_41 Customer_41 Backup_41
70	34		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_42\ (RAW) Z:\Device\Market_42\ (RAW) Z:\Device\Customer_42\ (RAW) Z:\Device\Backup_42\ (NTFS)	90GB 5GB 40GB 663GB	Broker_42 Market_42 Customer_42 Backup_42
71	35		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_45\ (RAW) Z:\Device\Market_45\ (RAW) Z:\Device\Customer_45\ (RAW) Z:\Device\Backup_45\ (NTFS)	90GB 5GB 40GB 663GB	Broker_45 Market_45 Customer_45 Backup_45
72	35		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_46\ (RAW) Z:\Device\Market_46\ (RAW) Z:\Device\Customer_46\ (RAW) Z:\Device\Backup_46\ (NTFS)	90GB 5GB 40GB 663GB	Broker_46 Market_46 Customer_46 Backup_46

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

73	36		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_49\ (RAW) Z:\Device\Market_49\ (RAW) Z:\Device\Customer_49\ (RAW) Z:\Device\Backup_49\ (NTFS)	90GB 5GB 40GB 663GB	Broker_49 Market_49 Customer_49 Backup_49
74	36		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_50\ (RAW) Z:\Device\Market_50\ (RAW) Z:\Device\Customer_50\ (RAW) Z:\Device\Backup_50\ (NTFS)	90GB 5GB 40GB 663GB	Broker_50 Market_50 Customer_50 Backup_50
75	37		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_53\ (RAW) Z:\Device\Market_53\ (RAW) Z:\Device\Customer_53\ (RAW) Z:\Device\Backup_53\ (NTFS)	90GB 5GB 40GB 663GB	Broker_53 Market_53 Customer_53 Backup_53
76	37	3-0	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_54\ (RAW) Z:\Device\Market_54\ (RAW) Z:\Device\Customer_54\ (RAW) Z:\Device\Backup_54\ (NTFS)	90GB 5GB 40GB 663GB	Broker_54 Market_54 Customer_54 Backup_54
77	38		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_51\ (RAW) Z:\Device\Market_51\ (RAW) Z:\Device\Customer_51\ (RAW) Z:\Device\Backup_51\ (NTFS)	90GB 5GB 40GB 663GB	Broker_51 Market_51 Customer_51 Backup_51
78	38		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_52\ (RAW) Z:\Device\Market_52\ (RAW) Z:\Device\Customer_52\ (RAW) Z:\Device\Backup_52\ (NTFS)	90GB 5GB 40GB 663GB	Broker_52 Market_52 Customer_52 Backup_52
79	39		12x147GB, 15K, SAS D3-10 Base model RAID10	Z:\Device\Broker_55\ (RAW) Z:\Device\Market_55\ (RAW) Z:\Device\Customer_55\ (RAW) Z:\Device\Backup_55\ (NTFS)	90GB 5GB 40GB 663GB	Broker_55 Market_55 Customer_55 Backup_55
80	39		12x147GB, 15K, SAS D3-10 Disk Enclosure RAID10	Z:\Device\Broker_56\ (RAW) Z:\Device\Market_56\ (RAW) Z:\Device\Customer_56\ (RAW) Z:\Device\Backup_56\ (NTFS)	90GB 5GB 40GB 663GB	Broker_56 Market_56 Customer_56 Backup_56
81	40	3-1	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).*
- *· The methodology used to load the database must be reported.*

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.

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

Clause 3 : Transaction Related Items

Vendor-Supplied Code

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

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

Database Footprint Requirements

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

The database footprint requirements were met.

Clause 4: SUT, Driver, and Network Related Items

Network configurations and Driver system

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

There is no difference between the measured and priced configurations in the network configuration. The network configuration of the measured configuration is provided as Figure 1.1 and 1.7.

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).

EGen v1.7.0 was used in this benchmark.

EGen Code

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

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

EGen Modifications

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

EGen has not been modified in this benchmark.

EGenLoader 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).

No extensions were made to the EGenLoader for this benchmark.

Clause 6 : Performance Metrics and Response Time Related Items

EGenDriver Items

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

The number of EGenDriverMEE instances is seventeen. The number of EGenDriverCE instances is seventeen.

Measured Throughput

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

<div align="center">

Measured tpsE

1,568.22 tpsE

</div>

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
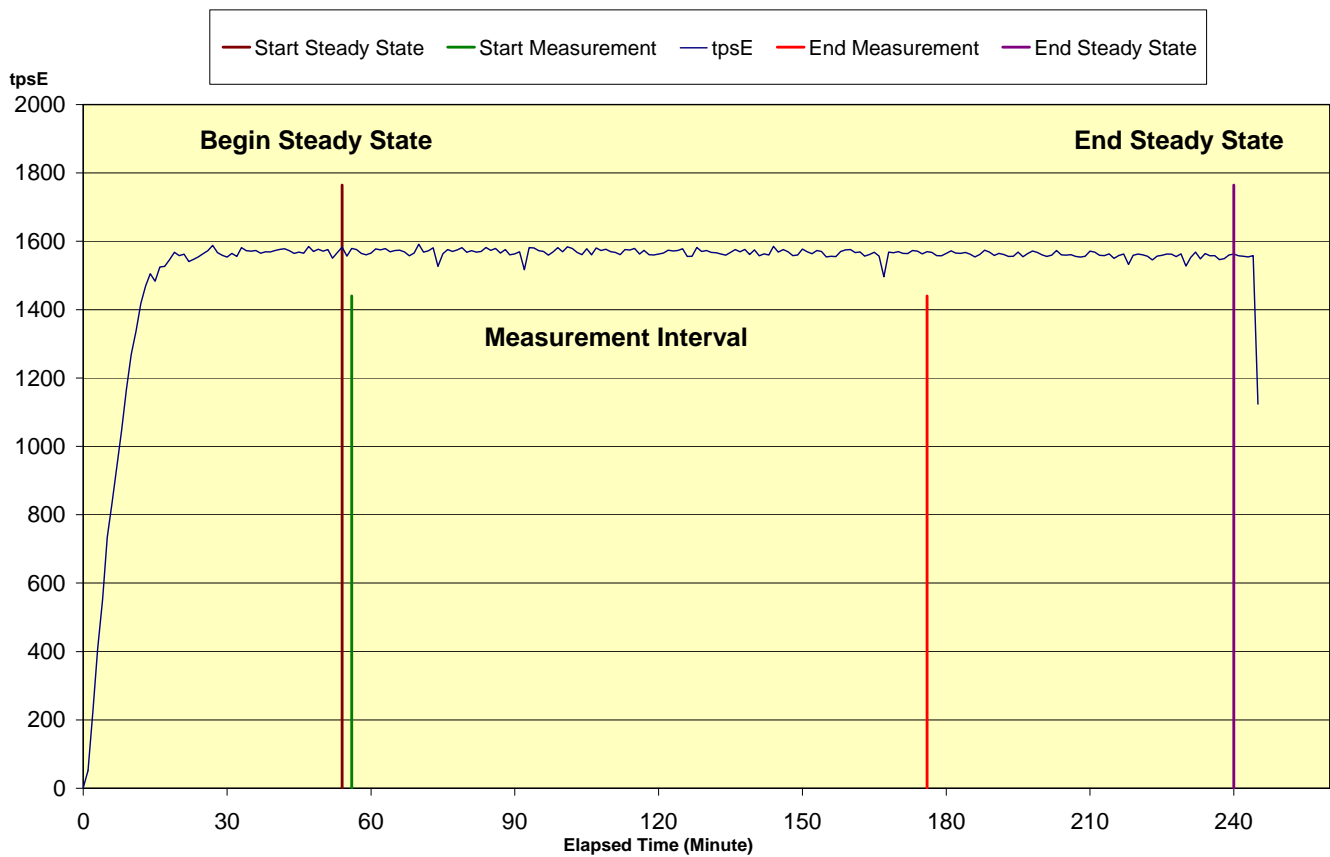
Steady State

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
Customer-Position			
by_tax_id	1	50.00%	48% to 52%
get_history	1	50.01%	48% to 52%
Market-Watch			
Securities chosen by	Watch list	60.02%	57% to 63%
	Account ID	34.98%	33% to 37%
	Industry	5.00%	4.5% to 5.5%
Security-Detail			
access_lob	1	1.00%	0.9% to 1.1%
Trade-Lookup			
frame_to_execute	1	30.00%	28.5% to 31.5%
	2	29.99%	28.5% to 31.5%
	3	30.01%	28.5% to 31.5%
	4	9.99%	9.5% to 10.5%
Trade-Order			
Transactions requested by a third party		9.99%	9.5% to 10.5%
Security chosen by company name and issue		40.00%	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	34.99%	33% to 37%
trade_qty	100	25.03%	24% to 26%
	200	25.01%	24% to 26%
	400	24.99%	24% to 26%
	800	24.98%	24% to 26%
trade_type	TMB	29.99%	29.7% to 30.3%
	TMS	30.02%	29.7% to 30.3%
	TLB	20.00%	19.8% to 20.2%
	TLS	9.99%	9.9% to 10.1%
	TSL	9.99%	9.9% to 10.1%
Trade-Update			
frame_to_execute	1	32.99%	31% to 35%
	2	33.00%	31% to 35%
	3	34.01%	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.1.7.0-1013\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. 1.7.0-1013\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® Management Studio. You are required to copy values from one sessionto 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® Management Studio.
2. Open MSTPCE.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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® Management Studio.
2. Open MSTPCE.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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® Management Studio.
2. Open MSTPCE.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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.1.7.0-1013\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 is 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 Database Log Array controller, the failed drives in the Database Log Array and the Database Data Array. A rebuild on each replaced drive and a recovery on replaced controller should start automatically.
6. Continue running the Driver for 20 minutes.
7. Terminate the run gracefully from the Driver.
8. Retrieve the new number of completed trades in the database by running: *select count(*) as count2 from SETTLEMENT*
9. Compare the number of executed Trade-Result Transactions on the Driver to (count2 – count1). Verify that (count2 - count1) is equal to the number of successful Trade-Result Transaction records in the Driver log file.
10. Allow recovery process to complete as needed.

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

Figure 7.1 Data Accessibility Graph
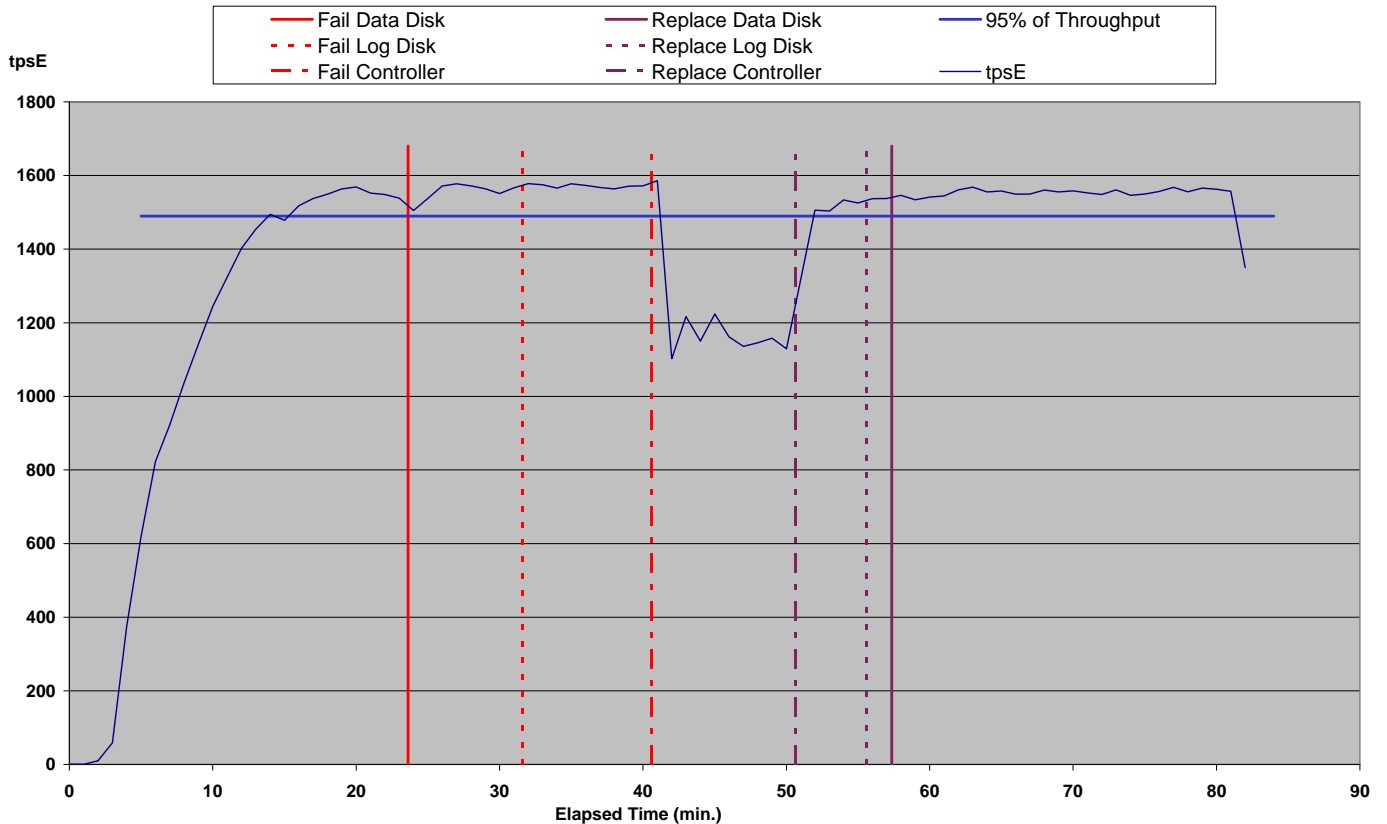
Durability Test Procedure for Catastrophic Failures

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 four clients, NEC Express5800/120Rj-2.
4. Stop the Driver.
5. Re-power and restart the database server, NEC Express5800/A1160. Re-power and restart four 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 0:51:23.

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
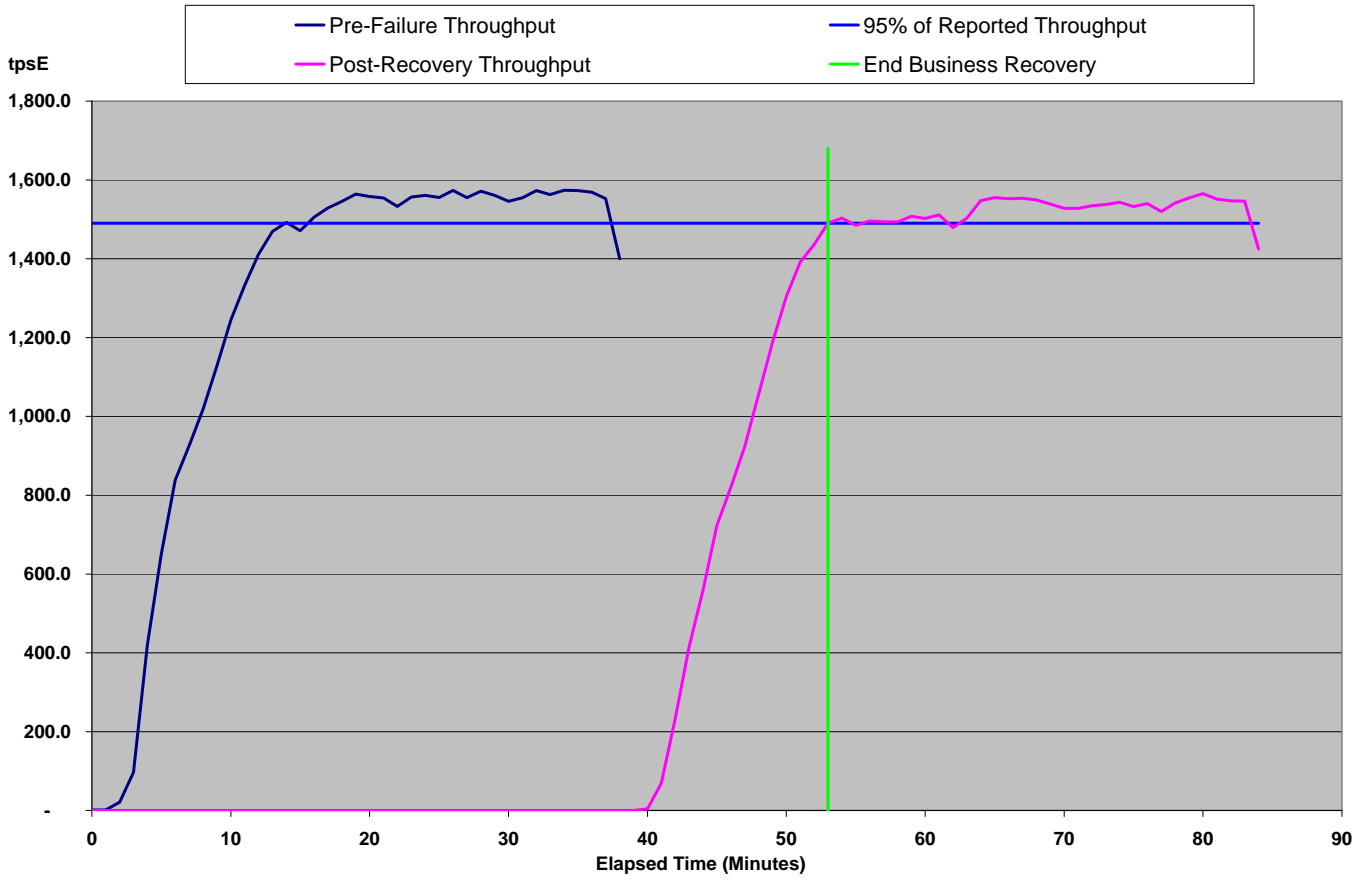
Clause 8 : Pricing Related Items

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	800,000	Performance	1568.22	TpsE		
Broker File Group	**Initial Rows**	**Data (KB)**	**Index size (KB)**	**Extra 5% (KB)**	**Total + 5% (KB)**	**After run (KB)**	**Growth (KB)**
BROKER	8,000	448	768	61	1,277	1,712	496
CASH_TRANSACTION	12,718,084,996	1,262,118,392	2,660,672	63,238,953	1,328,018,017	1,303,148,256	38,369,192
CHARGE	15	8	8	1	17	16	-
COMMISSION_RATE	240	16	16	2	34	32	-
SETTLEMENT	13,824,000,000	678,402,448	1,430,528	33,991,649	713,824,625	715,497,552	35,664,576
TRADE	13,824,000,000	1,535,831,528	826,672,960	118,125,224	2,480,629,712	2,396,265,160	33,760,672
TRADE_HISTORY	33,177,541,373	951,327,432	2,480,360	47,690,390	1,001,498,182	957,962,232	4,154,440
TRADE_REQUEST	-	-	-	-	-	30,952	30,952
TRADE_TYPE	5	8	1,032	52	1,092	1,040	-
Customer File Group							
ACCOUNT_PERMISSION	5,679,775	483,448	3,176	24,331	510,955	486,968	344
CUSTOMER	800,000	135,464	35,704	8,558	179,726	171,176	8
CUSTOMER_ACCOUNT	4,000,000	371,432	442,152	40,679	854,263	813,608	24
CUSTOMER_TAXRATE	1,600,000	33,304	904	1,710	35,918	34,376	168
HOLDING	707,739,258	37,968,192	28,230,504	3,309,935	69,508,631	94,311,488	28,112,792
HOLDING_HISTORY	18,526,540,227	673,692,456	351,092,984	51,239,272	1,076,024,712	1,029,336,968	4,551,528
HOLDING_SUMMARY	39,788,095	1,367,456	5,752	68,660	1,441,868	2,750,720	1,377,512
WATCH_ITEM	80,054,495	2,227,104	8,736	111,792	2,347,632	2,236,200	360
WATCH_LIST	800,000	19,880	16,904	1,839	38,623	36,784	-
Market File Group							
COMPANY	400,000	87,016	24,816	5,592	117,424	111,848	16
COMPANY_COMPETITOR	1,200,000	32,184	26,784	2,948	61,916	58,968	-
DAILY_MARKET	715,140,000	36,983,536	15,827,552	2,640,554	55,451,642	52,812,728	1,640
EXCHANGE	4	8	8	1	17	16	-
FINANCIAL	8,000,000	941,232	3,296	47,226	991,754	944,912	384
INDUSTRY	102	8	40	2	50	48	-
LAST_TRADE	548,000	25,640	904	1,327	27,871	52,136	25,592
NEWS_ITEM	800,000	86,734,992	1,680	4,336,834	91,073,506	86,736,704	32
NEWS_XREF	800,000	19,872	904	1,039	21,815	20,776	-
SECTOR	12	8	24	2	34	32	-
SECURITY	548,000	86,384	38,504	6,244	131,132	124,928	40
STATUS_TYPE	5	8	8	1	17	16	-
Misc File Group							
ADDRESS	1,200,004	69,176	512	3,484	73,172	69,776	88
TAXRATE	320	24	16	2	42	56	16
ZIP_CODE	14,741	488	16	25	529	504	-
TOTALS (KB)		5,268,959,592	1,229,008,224	324,898,391	6,822,866,207		
Initial Database Size (MB)		6,345,672	6,197 GB				

Db/Filegroups	LUN Count	Partition Size (KB)	Allocated Size (MB)	Loaded (MB)	Loaded + 5% (MB)	After Run (MB)	8 Hours (MB)
misc_fg	1	512,000	500	69	72	69	69
broker_fg	80	83,886,080	6,553,600	5,137,624	5,394,505	5,246,979	5,358,204
market_fg	80	5,242,880	409,600	137,535	144,411	137,562	137,589
customer_fg	80	20,971,520	1,638,400	1,070,445	1,123,967	1,103,690	1,137,503
Settlements	22,391,016						

Initial Growing Space (MB)	6,204,377						
Final Growing Space (MB)	6,346,976	**Data LUNS**	80	**Initial Log Size (MB)**	22,003	**Log LUNS**	1
Delta (MB)	142,599	**Disks per LUN**	12	**Final Log Size (MB)**	241,801	**Log Disks**	20
Data Space per Trade (MB)	0.006368594	**Disk Capacity (MB)**	136,192	**Log Growth (MB)**	219,797	**Disk Capacity (MB)**	274,624
1 Day Data Growth (MB)	287,636	**RAID10 Overhead**	50%	**Log Space per Trade (MB)**	0.009816322486	**RAID50 Overhead**	20%
60 Day Space (MB)	23,603,823	**Total Space (MB)**	65,372,160	**1 Day Log Space (MB)**	443,352	**Log Space (MB)**	4,393,984

Auditor's Attestation Letter

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

INFO SIZING

TPC CERTIFIED AUDITOR

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

March 16, 2008

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

Platform: NEC Express5800/A1160 (16 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
Tier B, Server: NEC Express5800/A1160 (16 Processors)				
16 x Intel Xeon X7460 (2.66GHz)	512 GB (16 MB L3)	2 x 73 GB SAS (int.) 960 x 147 GB 15K SAS 20 x 300 GB 15K SAS	0.15 Seconds	1,568.22
Tier A, Four Clients: NEC Express5800/120Rj-2				
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 v1.7.0.

- The transactions were correctly implemented.

- The database was properly scaled and populated for 800,000 customers.

- The mandatory network between the driver and the SUT was configured.

- The ACID properties were met.

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- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.
- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 00:51.23 was correctly measured.
- The 60 day storage requirement was correctly computed and configured.
- The system pricing was verified for major components and maintenance.

Additional Audit Note:

With the NEC Express5800/A1160, a customer can request that one to five cores on each Intel Xeon X7460 processor be disabled. Disabling of cores, at the 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. The measured configuration had 32 of its 96 cores disabled by NEC.

Respectfully Yours,

François Raab, President

Clause 9 : Supporting Files

Supporting Files Index Table

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

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

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

Clause	Description	path	filename
Introduction	Disk Configuration	SupportingFiles/Introduction/Hardware/	D3-10diagram.doc sydskmap_[1..11].png mount.txt mkmp.cmd StorageSetup.doc SwitchSetup.doc
	TierB(server) cofiguration	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 SoftNUMA-node-cpumask.reg SoftNUMA-ports.reg
	OS Tunable Parameters	SupportingFiles/Introduction/Software/	syostune.doc syhwTierB.out syhwTierA_[1..4].out
	Tier A Scripts	SupportingFiles/Introduction/Software/	ce[0..16].cmd me[0..16].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 Output_TPCE_VERSIONS_Table.SQL Remove_Database.sql Restore_Database.sql SQL_Server_Configuration.sql tempdb.sql Trade_Cleanup.sql Version.sql
	Database Space Scripts	SupportingFiles/Clause2/Audit_Scripts/Space/	SPFiles.sql SPLog.sql SPUsed.sql
	Database Audit Scripts	SupportingFiles/Clause2/Audit_Scripts/Database/	Create_DB_Audit_Tables.SQL DB_Check.sql DB_FK_Constraints.sql DB_Primary_Key_Check.SQL DB_Tables.sql Drop_DB_Audit_Tables.SQL Insert_Duplicates_Tests.sql Referential_Integrity_Tests.sql

	Output	SupportingFiles/Clause2/Outputs	800000Customers_Load_Timer.log
			BrokerVolume.log
			BuildSteps.log
			BulkInsert_1.out
			BulkInsert_10.out
			BulkInsert_11.out
			BulkInsert_12.out
			BulkInsert_13.out
			BulkInsert_14.out
			BulkInsert_15.out
			BulkInsert_16.out
			BulkInsert_2.out
			BulkInsert_3.out
			BulkInsert_4.out
			BulkInsert_5.out
			BulkInsert_6.out
			BulkInsert_7.out
			BulkInsert_8.out
			BulkInsert_9.out
			Check_Constraints_Fixed.log
			Check_Constraints_Growing.log
			Check_Constraints_Scaling.log
			Convert_NI_ITEM_Data.log
			Create_Clustered_Indexes_Fixed.log
			Create_Clustered_Indexes_Growing.log
			Create_Clustered_Indexes_Scaling.log
			Create_DM_Audit_Table.log
			Create_TID_Ranges_Table.log
			Create_TPCE_VERSIONS_Table.log
			CreateDB.log
			CustomerPosition.log
			Database_Options_1.log
			Database_Options_2.log
			DataMaintenance.log
			Drop_Fixed_Tables.log
			Drop_FK_Constraints.log
			Drop_Growing_Tables.log
			Drop_Scaling_Tables.log
			FK_Constraints.log
			Get_Next_T_ID.log
			Load_Timer.log
			Load_Timer_Proc.log
			Load_TPCE_Info.log
			MarketFeed.log
			MarketWatch.log
			NC_Indexes_Fixed.log
			NC_Indexes_Growing.log
			NC_Indexes_Scaling.log
			RemoveDB.log
			SecurityDetail.log
			SQL_Server_Configuration.log
			Tables_Fixed.log
			Tables_Growing.log
			Tables_Scaling.log
			TPCE_Types.log
			TPCE_VERSIONS.log
			TradeLookup.log
			TradeOrder.log
			TradeResult.log
			TradeStatus.log
			TradeUpdate.log
			Version.log

Clause3	Transaction Frames	SupportingFiles/Clause3/	BrokerVolume.sql CustomerPosition.sql DataMaintenance.sql MarketFeed.sql MarketWatch.sql SecurityDetail.sql Trade_Cleanup.sql TradeLookup.sql TradeOrder.sql TradeResult.sql TradeStatus.sql TradeUpdate.sql
	SUT_CE_Server	SupportingFiles/Clause3/SUT_CE_Server/	CEServer.cpp CEServer.h CEServerMain.cpp PortDefinitions.h stdafx.cpp stdafx.h SUT_CE_Server.vcproj SUT_CE_Server.vcproj.user 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 SUT_MEE_Server.vcproj.user
Clause4			
Clause5	EGen modifications		
	EGenLoader extensions		
	EGenDriver Configuration	SupportingFiles/Clause5/	4client800000cust.xml
	EGenLoader Parameters	SupportingFiles/Clause5/	BuildSteps.log EGenLoaderFrom1To50000.log EGenLoaderFrom50001To100000.log EGenLoaderFrom100001To150000.log EGenLoaderFrom150001To200000.log EGenLoaderFrom200001To250000.log EGenLoaderFrom250001To300000.log EGenLoaderFrom300001To350000.log EGenLoaderFrom350001To400000.log EGenLoaderFrom400001To450000.log EGenLoaderFrom450001To500000.log EGenLoaderFrom500001To550000.log EGenLoaderFrom550001To600000.log EGenLoaderFrom600001To650000.log EGenLoaderFrom650001To700000.log EGenLoaderFrom700001To750000.log EGenLoaderFrom750001To800000.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
	Isolation Output	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

	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery	BusinessRecoveryTimeGraph.xls Consistency2.out count1.sql count1BR.out count2.sql count2BR.out dblgBRpart1.out dblgBRpart2.out dblgRecovery.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.png pulledLogCont.png pulledLogDisk.png rebuildingDataDisk.png rebuildingLogDisk.png replacingLogCnt.png
Clause8	60-Day Space Calculations	SupportingFiles/Clause8/	tpce_space.xls

Appendix A : Price Quotation

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

March 4, 2009

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	**SQL Server 2008 Enterprise x64 Edition** *Per Processor License* *Discount Schedule: Open Program - Level C* *Unit Price reflects a 6% discount from the retail unit price of $24,999.*	$23,432	16	$374,912
P73-04165	**Windows Server 2008 Standard Edition (x86)** *Server License with 5 CALs* *Discount Schedule: Open Program - Level C* *Unit Price reflects a 29% discount from the retail unit price of $999.*	$711	6	$4,266
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident)*	$245	1	$245

A list of Microsoft's resellers can be found at
http://www.microsoft.com/products/info/render.aspx?view=22&ty
pe=mnp&content=22/licensing

All products listed above are currently orderable and available.

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.

Reference ID: PEkeya0903040000009570.

SYNEGI

Prepared For:
NEC Corporation
Keiichi Yamada
c/o NEC Coproration of America
10850 Gold Center Drive
Rancho Cordova, CA 95670

Prepared By:
Synegi, Inc.
2132 Michelson Dr.
Irvine, CA 92612
Tim Zimmerman

Date: 3-9-09

Quote for Brocade Fibre Switches

Part #	Product Description	QTY	Cost	Total
BR-340-0004-A	Brocade Silkworm 300E, 8Gbit 24 Port Fibre Switch w/16 Ports Enabled & Includes 16 SFP's.	6	$5,175	$31,050
XBR-R000162	Rack Mount Kit	6	$99	$594
Hardware Support (mandatory)				
300-SVC-ADVANCE-1	Advanced Replacement, 24x7 Software Support, 1 yr	18	$450	$8,100
	Total Cost			**$39,744**

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

CDW   **800.750.4239**

Shopping Cart _____

Use Standard Checkout ▶
Use Express Checkout ▶ ⓘ

Quantity	Product		CDW	Availability	Price	Ext. Price
11		NEC AccuSync 73VX 17" LCD Display	1372835	In Stock	$148.99	$1,638.89
53		Belkin 10 meter Multimode LC/LC 62.5/125 Duplex Fiber Optic cable	405050	In Stock	$39.99	$2,119.47
53		Tripp Lite 25' Blue Cat5e or Cat5 Snagless RJ45 UTP Patch Cable 25ft	324500	In Stock	$5.99	$317.47
10		Tripp Lite 10' Gray Cat5e or Cat5 Snagless Crossover Cable 10ft	324527	1-3 days	$4.99	$49.90
3		Tripp Lite 6' Null Modem Adapter Cable, DB9 Female - Female, 6ft	380490	In Stock	$4.99	$14.97
4		Cisco SR2024C Compact 24-port 10/100/1000 Gigabit Switch	1012601	In Stock	$249.99	$999.96
3		Cisco SD205 5-port 10/100 Switch	507611	1-3 days	$31.99	$95.97
					Sub-Total	$5,236.63

Related Top Sellers For: **Cisco SD205 5-port 10/100 Switch**

Recommended Accessories

Belkin 8 Outlet, 6' Cord Surge
$18.99

Tripp Lite 3' Black Cat5e or Cat5 Snagless RJ45 UTP Patch Cable 3ft
$2.99

Tripp Lite 100' Gray Cat5e or Cat5 Snagless RJ45 UTP Patch Cable 100ft
$25.99

Tripp Lite 10' Blue Cat5e or Cat5 RJ45 Molded 350mhz UTP Patch Cable
$4.99

Tripp Lite 7' Blue Cat5e or Cat5 RJ45 Molded 350mhz UTP Patch Cable
$3.99

http://www.cdw.com/shop/cart/default.aspx?cm_re=CRT-_-SZ-_-QC+Quick+Cart+Button...   3/6/2009