NEC

TPC Benchmark™ E
Full Disclosure Report

NEC Express5800/A1080a-E

with Microsoft® SQL Server® 2012 Enterprise Edition
and
Microsoft® Windows Server® 2008 R2 Enterprise Edition
with Service Pack 1

First Edition
28-Mar-2012

Abstract

This report documents the compliance of NEC Corporation's TPC Benchmark[TM] E tests on the NEC Express5800/A1080a-E client/server system with version 1.12.0 of the TPC Benchmark[TM] E Standard Specification. Two clients (NEC Express5800/R120b-2) were used as the Tier-A clients.

The operating system and the DBMS used on the server were Microsoft® Windows Server® 2008 R2 Enterprise Edition with Service Pack 1 and Microsoft® SQL Server® 2012 Enterprise 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 Doug Johnson 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.
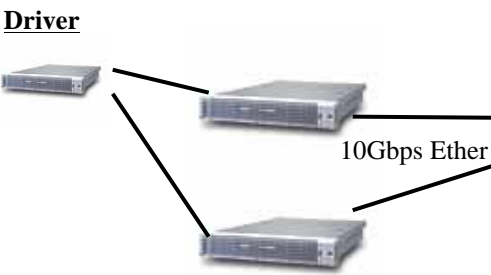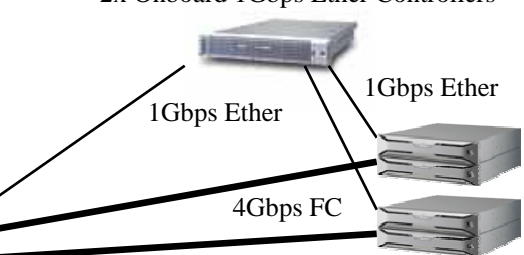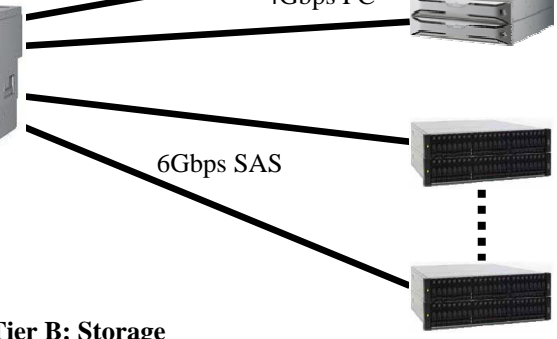
System	Software	Total System Cost	tpsE	$ USD /tpsE	Availability Date
NEC Express5800 /A1080a-E	Microsoft® SQL Server® 2012 Enterprise Edition Microsoft® Windows Server® 2008 R2 Enterpirse Edition with Service Pack 1	$2,077,196 (USD)	4,614.22	$450.18	2-Apr-2012

Executive Summary

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

Auditor

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

NEC	**NEC Express5800/A1080a-E**	**TPC-E 1.12.0** **TPC Pricing 1.7.0**
		Report Date 28-Mar-2012

TPC-E Throughput **4,614.22 tpsE**	Price/Performance **$450.18 USD per tpsE**	Availability Date **2-Apr-2012**	Total System Cost **$2,077,196USD**

Database Server Configuration

Operating System **Microsoft® Windows Server® 2008 R2 Enterprise Edition with Service Pack 1**	Database Manager **Microsoft® SQL Server® 2012 Enterprise Edition**	Processors/Cores/Threads **8 / 80 / 160**	Memory **2048GB**

Tier B: System Console
1x NEC Express5800/R120b-2
2x Intel® Xeon® processor X5675
3.06GHz, 12MB L3 cache,
6 processor cores, 12 threads
8GB Memory
1x 300GB SAS drive
2x Onboard 1Gbps Ether Controllers

Tier B: Server
NEC Express5800/A1080a-E
8x Intel® Xeon® processor E7-8870 2.40GHz,
 30MB L3 cache, 10 processor cores, 20 threads
2048GB Memory, 2x 300GB SAS drives
1x 2port 8Gbps FC HBA
1x Internal SAS RAID Controller
11x External SAS RAID Controllers
2x Onboard 1Gbps Ether Controllers
1x 2port 10Gbps Ether Controller

Driver

1Gbps Ether

1Gbps Ether

4Gbps FC

6Gbps SAS

10Gbps Ether

Tier A: Client
2x NEC Express5800/R120b-2
2x Intel® Xeon® processor X5675 3.06GHz,
12MB L3 cache, 6 processor cores, 12 threads
8GB Memory
1x 300GB SAS drive
2x Onboard 1Gbps Ether Controllers
1x 2port 10Gbps Ether Controller

Tier B: Storage
NEC Storage D3-10
2x NEC Storage D3-10 Controllers
5x NEC Storage D3-10 SAS/SATA Disk Enclosures
76x 147GB 15k rpm SAS drives
Dot Hill Systems Storage
22x Dot Hill 3120 JBODs
396x 150GB SSD SAS drives

Initial Database Size **19,267 GB**	Redundancy Level : 1 **RAID10 : Log / RAID5 : Data**	Storage **76 x 147GB 15K HDD** **396 x 150GB SSD**

Description	Part Number	Third Party Brand	Pricing	Unit Price	Qty	Extended Price	3-yr Mnt. Price
Server Hardware							
NEC Express5800/A1080a-E							
A1080a-E Base Unit (1x MGM card, 2x power module included)	NE3100-101H	NEC	1	12,499	1	12,499	
Processor Memory Module (PMM) Xeon E7-8870 All Cores Activated	NE3102-011	NEC	1	9,499	8	75,992	
32GB Memory (1067MHz 16GB DIMM x 2)	NE3103-014	NEC	1	2,599	64	166,336	
6Gbps SAS RAID Controller for Embedded HDD/SSD	NE3104-001	NEC	1	499	1	499	
300GB 10krpm 6Gbps SAS HDD	NE3105-104	NEC	1	399	2	798	
2Port 8G FC HBA	NE3108-104	NEC	1	2,499	1	2,499	
MegaRAID SAS 9285-8e	Q24-FR000000011373	NEC	1	1,000	11	11,000	
2port 10GBASE	NE3108-004	NEC	1	999	1	999	
Optical Module for 10G SR	NE3108-005	NEC	1	159	2	318	
Embedded DVD-ROM	NE3100-201	NEC	1	99	1	99	
Power Module	NE3100-301	NEC	1	799	2	1,598	
Power Cable for 200V	NE3107-001	NEC	1	69	4	276	
PDU L6-30P	NE3107-101	NEC	1	599	2	1,198	
Installation	SP-GX00-STIN001	NEC	1	5,000	1	5,000	
Microsoft Windows Server 2008 R2 Enterprise Edition w/25 CALs	062-03622-000	NEC	1	3,999	1	3,999	
Platinum Warranty (Yr 1,2 & 3)	UPPLT-A1080a8-3Y	NEC	1	6,799	1		6,799
NEC Express5800/R120b-2 (for System Maintenance)							
Model R120b-2 (1x X5675, MEM less, ODD/HDD less)	N8100-1712F	NEC	1	4,850	1	4,850	
CPU kit (X5675)	N8101-487F	NEC	1	2,720	1	2,720	
Additional 4GB Memory Module	N8102-373F	NEC	1	195	2	390	
RAID Controller (256MB, RAID0/1)	N8103-129	NEC	1	410	1	410	
300GB HDD (SAS 10k rpm, 2.5")	N8150-301	NEC	1	365	1	365	
External DVD-ROM (USB)	N8160-85	NEC	1	215	1	215	
3 Years of Upgraded Platinum Warranty for the Express 5800/100 Series	UPPLT-GP100-2U-3Y	NEC	1	840	1		840
AccuSync AS171-BK 17" LCD Display (+2 spares)	AS171-BK	NEC	3	139	4	556	
					Subtotal	**292,616**	**7,639**
Disk Subsystem							
NEC Storage D3-10							
NEC Storage D3-10 Base Model	850193310	NEC	1	6,834	2	13,668	
3 Years of Platinum Warranty Upgrade for D3-10 Base Model	UPPT850193310	NEC	1	1,025	2		2,050
SAS/SATA Disk Enclosure w/NEC logo	NF5021-SE60E-000	NEC	1	2,749	5	13,745	
3 Years of Platinum Warranty Upgrade for 3Gbps Disk Enclosure	UPPTNF5021SE60E	NEC	1	412	5		2,060
SAS disk drive (15k rpm/147GB) (+10% spares)	NF5021-SM624E	NEC	1	311	84	26,124	
3 Years Platinum Warranty Upgrade SAS Disk Drive(15krpm/147GB/3Gbps	UPPTNF5021SM624E	NEC	1	51	84		4,284
1 yr of Platinum SW Maintenance for Base SW	UFSD0M-310000AMAS	NEC	1	520	6		3,120
Dot Hill Systems Storage							
3120,2RM,NO DRIVES,AC	D3120X000000DA	DotHill	4	3,467	22	76,274	
DRIVE, 150GB, SLC, SAS, (+10% spares)	PFRUKF73-01	DotHill	4	2,323	436	1,012,828	
DD,AMS SFF BLANK, 48 BULK PACK	PFRUKF31-48	DotHill	4	864	2	1,728	
DD,AMS SFF BLANK,FRU,PKG	PFRUKF31-01	DotHill	4	18	36	648	
RACK MOUNT KIT	FHDW018-02	DotHill	4	120	22	2,640	
3120 JBOD, 7x24x4 Onsite	DS3120XPA4D1SW0	DotHill	4	2,046	22		45,012
2m External SAS Cable 4 Channel SFF-8088 to SFF-8088 (+2 spares)	S524-02M	Tripp Lite	3	124	13	1,612	
UPS 3kVA	050-02424-000	NEC	1	1,799	24	43,176	
42U Rackframe	050-02378-001	NEC	1	1,799	3	5,397	
10 meter Multimode LC/LC 62.5/125 Duplex Fiber Optic cable (+2 spares)	F2F202LL-10M	Belklin	3	30	4	120	
					Subtotal	**1,197,960**	**56,526**
Server Software							
Microsoft SQL Server 2012 Enterprise Edition 2 core License	TBD	Microsoft	2	13,473	40	538,900	259
					Subtotal	**538,900**	**259**

continued on the next page

Client Hardware

NEC Express5800/R120b-2

Model R120b-2 (1x X5675, MEM less, ODD/HDD less)	N8100-1712F	NEC	1	4,850	2	9,700	
CPU kit (X5675)	N8101-487F	NEC	1	2,720	2	5,440	
Additional 4GB Memory Module	N8102-373F	NEC	1	195	4	780	
300GB HDD (SAS 10k rpm, 2.5")	N8150-301	NEC	1	365	2	730	
RAID Controller (256MB, RAID0/1)	N8103-129	NEC	1	410	2	820	
10GBASE Adapter (SFP+/2ch)	N8104-128	NEC	1	710	2	1,420	
SFP+ Module (10G-SR)	N8104-129	NEC	1	155	2	310	
3 Years of Upgraded Platinum Warranty for the Express 5800/100 Series	UPPLT-GP100-2U-3Y	NEC	1	840	2		1,680
AccuSync AS171-BK 17" LCD Display (+2 spares)	AS171-BK	NEC	3	139	4	556	
42U Rackframe	050-02378-001	NEC	1	1,799	1	1,799	
Cat5 Snagless RJ45 UTP Patch Cable 25 ft (+2 spares)	N001-025-BL	Tripp Lite	3	7	5	35	
Cat5 Snagless Crossover Cable 7 ft cross over (+2 spares)	N010-007-GY	Tripp Lite	3	5	5	25	
					Subtotal	**21,615**	**1,680**

Client Software

Windows Server 2008 R2 Standard Edition w/10 CALs	P73-04980	Microsoft	2	711	3	2,133	(Included)
					Subtotal	**2,133**	**0**

Infrastructure

3 Meter OM3 10Gb Aqua 50/125 Multimode Fiber Cable, LC/LC, 10ft (+2 spare	N820-03M	Tripp Lite	3	38	4	152	
SD2005 5-port 10/100/1000 Gigabit Switch (+2 spares)	SD2005	Cisco	3	55	3	165	
					Subtotal	**317**	**0**

			TOTAL	2,053,541	66,104
NEC Large Volume Discount***		-10%		-41,517	-932

Notes:

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

** 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 Doug Johnson of InfoSizing, Inc. (www.sizing.com)

3-Yr. Cost of Ownership:	**$2,077,196**
tpsE Throughput:	**4,614.22**
$ / tpsE	**$450.18**

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 : 4,614.22 tpsE		**Configured Customers : 2,400,000**		
Response Times (in seconds)	**Minimum**	**Average**	**90th %tile**	**Maximum**
Broker Volume	0.00	0.05	0.09	2.79
Customer Position	0.00	0.04	0.06	5.52
Market Feed	0.00	0.03	0.05	5.63
Market Watch	0.00	0.03	0.05	5.46
Security Detail	0.00	0.02	0.04	4.52
Trade Lookup	0.00	0.10	0.18	5.58
Trade Order	0.00	0.08	0.12	5.84
Trade Result	0.00	0.10	0.16	5.76
Trade Status	0.00	0.02	0.04	4.51
Trade Update	0.01	0.12	0.20	5.78
Data Maintenance	0.00	0.02		0.17
Transaction Mix		**Transaction Count**		**Mix %**
Broker Volume		16,275,912		4.900%
Customer Position		43,181,132		13.000%
Market Feed		3,322,268		1.000%
Market Watch		59,789,369		18.000%
Security Detail		46,503,062		14.000%
Trade Lookup		26,572,694		8.000%
Trade Order		33,548,390		10.100%
Trade Result		33,222,410		10.002%
Trade Status		63,110,406		18.999%
Trade Update		6,643,249		2.000%
Data Maintenance		120		
Test Duration and Timings				
Ramp-up Time				1:01:39
Measurement Interval				2:00:00
Business Recovery Time				1:08:53
Total Number of Transactions Completed in Measurement Interval				332,168,892

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 Configuration

The following figure represents the measured configuration.

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

Tier B: System Console
1x NEC Express5800/R120b-2
2x Intel® Xeon® processor X5675
3.06GHz, 12MB L3 cache,
6 processor cores, 12 threads
8GB Memory,
1x 300GB SAS drive
2x Onboard 1Gbps Ether Controllers

Tier B: Server
NEC Express5800/A1080a-E
8x Intel® Xeon® processor E7-8870 2.40GHz,
 30MB L3 cache, 10 processor cores, 20 threads
2048GB Memory, 2x 300GB SAS drives
1x 2port 8Gbps FC HBA
1x Internal SAS RAID Controller
11x External SAS RAID Controllers
2x Onboard 1Gbps Ether Controllers
1x 2port 10Gbps Ether Controller

Driver

1Gbps Ether

1Gbps Ether

4Gbps FC

6Gbps SAS

6Gbps SAS

10Gbps Ether

Tier A: Client
2x NEC Express5800/R120b-2
2x Intel® Xeon® processor X5675 3.06GHz,
12MB L3 cache, 6 processor cores, 12 threads
8GB Memory
1x 300GB SAS drive
2x Onboard 1Gbps Ether Controllers
1x 2port 10Gbps Ether Controller

Tier B: Storage
NEC Storage D3-10
2x NEC Storage D3-10 Controllers
7x NEC Storage D3-10 SAS/SATA Disk Enclosures
100x 147GB 15k rpm SAS drives
Dot Hill Systems Storage
22x Dot Hill 3120 JBODs
18x 150GB SSD SAS drives
378x 64GB SSD SATA drives
NEC Disk Expansion Unit
10x NEC Disk Expansion Units
120x 147GB 15k rpm SAS drives

Priced Configuration

The following figure represents the priced configuration.

Figure1.2: NEC Express5800/A1080a-E, Priced Configuration Diagram

Tier B: System Console
1x NEC Express5800/R120b-2
2x Intel® Xeon® processor X5675
3.06GHz, 12MB L3 cache,
6 processor cores, 12 threads
8GB Memory
1x 300GB SAS drive
2x Onboard 1Gbps Ether Controllers

Tier B: Server
NEC Express5800/A1080a-E
8x Intel® Xeon® processor E7-8870 2.40GHz,
 30MB L3 cache, 10 processor cores, 20 threads
2048GB Memory, 2x 300GB SAS drives
1x 2port 8Gbps FC HBA
1x Internal SAS RAID Controller
11x External SAS RAID Controllers
2x Onboard 1Gbps Ether Controllers
1x 2port 10Gbps Ether Controller

Driver

1Gbps Ether

1Gbps Ether

1Gbps Ether

4Gbps FC

10Gbps Ether

6Gbps SAS

Tier A: Client
2x NEC Express5800/R120b-2
2x Intel® Xeon® processor X5675 3.06GHz,
12MB L3 cache, 6 processor cores, 12 threads
8GB Memory
1x 300GB SAS drive
2x Onboard 1Gbps Ether Controllers
1x 2port 10Gbps Ether Controller

Tier B: Storage
NEC Storage D3-10
2x NEC Storage D3-10 Controllers
5x NEC Storage D3-10 SAS/SATA Disk Enclosures
76x 147GB 15k rpm SAS drives
Dot Hill Systems Storage
22x Dot Hill 3120 JBODs
396x 150GB SSD 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). 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, two NEC Express5800/R120b-2 were used.

Tier-A installation / configuration

The NEC Express5800/R120b-2 has 2x Intel® Xeon® processor X5675, 8GB of Memory, 1x 300GB SAS drive. The 1x 2port 10Gbps Ether Controller is installed to the PCI-Express slot of the NEC Express5800/R120b-2. Tier-A consists of 2x NEC Express5800/R120b-2, all of which have the same hardware configuration. Each Tier-A machine is connected to the database server with a 10GbE cable and to the driver system with a GbE cable.

Figure1.3: Rear view of each Client (NEC Express5800/R120b-2)
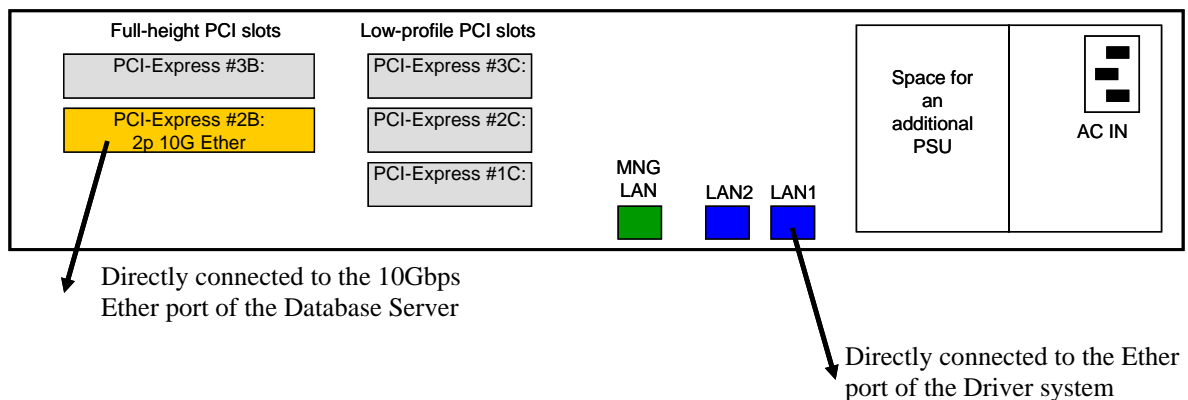
Tier-B installation / configuration

Tier-B hardware consists of one NEC Express5800/A1080a-E as the database server, two NEC Storage D3-10 and twenty-two Dot Hill 3120 as the Database Array and one NEC Express5800/R120b-2 as the System Console of the NEC Express5800/A1080a-E and the NEC Storage D3-10.

The System Console (NEC Express5800/R120b-2) has 2x Intel® Xeon® processor X5675, 8GB of Memory, 1x 300GB SAS drive. The machine is directly connected to the Management LAN port of the Database Server, and connected to D3-10 controllers via 1Gbps Ether switch.

Figure1.4: Rear view of the System Console (NEC Express5800/R120b-2)

Full-height PCI slots
PCI-Express #3B:
PCI-Express #2B:

Low-profile PCI slots
PCI-Express #3C:
PCI-Express #2C:
PCI-Express #1C:

MNG
LAN

LAN2   LAN1

Space for
an
additional
PSU

AC IN

Directly connected to the Management LAN
port of the Database Server

Connected to D3-10 controllers
via 1Gbps Ether SW
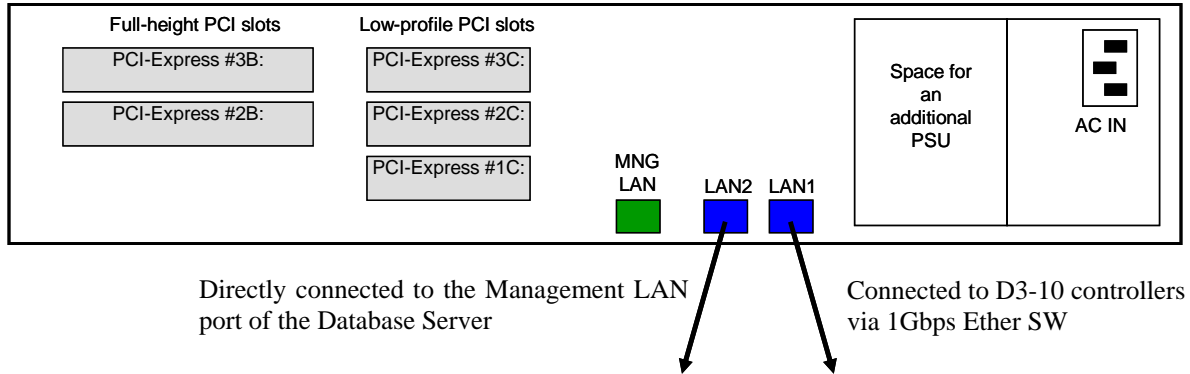
The NEC Express5800/A1080a-E has 8x Intel® Xeon® processor E7-8870 2.40GHz, 30MB L3 cache, 128x 16GB DIMMs, 2x Onboard 1Gbps Ether Controllers, 1x Internal SAS RAID Controller and 2x 300GB SAS drive with Microsoft® Windows Server® 2008 R2 Enterprise Edition with Service Pack 1.

1x 2port 8Gbps FC HBA, 11x External SAS RAID Controllers and 1x 2port 10Gbps Ether Controller are installed to the PCI-Express slots of the NEC Express5800/A1080a-E. The FC HBA and External SAS RAID Controllers are connected to the Database Array as follows:

Management LAN	to the system console
PCI-Express #2: External SAS RAID Controller	to 3120 JBOD
PCI-Express #3: External SAS RAID Controller	to 3120 JBOD
PCI-Express #4: External SAS RAID Controller	to 3120 JBOD
PCI-Express #5: External SAS RAID Controller	to 3120 JBOD
PCI-Express #6: External SAS RAID Controller	to 3120 JBOD
PCI-Express #7: 2port 10Gbps Ether Controller	#0 to 10Gbps Ether port of client #1
	#1 to 10Gbps Ether port of client #2
PCI-Express #8: External SAS RAID Controller	to 3120 JBOD
PCI-Express #9: External SAS RAID Controller	to 3120 JBOD
PCI-Express #10: External SAS RAID Controller	to 3120 JBOD
PCI-Express #11: 2port 8Gbps FC HBA	#0 to D3-10 Controller
	#1 to D3-10 Controller
PCI-Express #12: External SAS RAID Controller	to 3120 JBOD
PCI-Express #13: External SAS RAID Controller	to 3120 JBOD
PCI-Express #14: External SAS RAID Controller	to 3120 JBOD

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

Directly connected to
the Ether port of the System Console

PCI-Express #1 : Int SAS RAID

MNG LAN

LAN2 LAN1

PCI-Express #2 : Ext SAS RAID

PCI-Express #3 : Ext SAS RAID

PCI-Express #4 : Ext SAS RAID

PCI-Express #5 : Ext SAS RAID

PCI-Express #6 : Ext SAS RAID

PCI-Express #7 : 2p 10G Ether

PCI-Express #8 : Ext SAS RAID

PCI-Express #9 : Ext SAS RAID

PCI-Express #10: Ext SAS RAID

PCI-Express #11: 2p 8G FC

PCI-Express #12: Ext SAS RAID

PCI-Express #13: Ext SAS RAID

PCI-Express #14: Ext SAS RAID

AC IN

AC IN

AC IN

AC IN

Directly connected to
the 10Gbps Ether port
of Client#1

Directly connected to
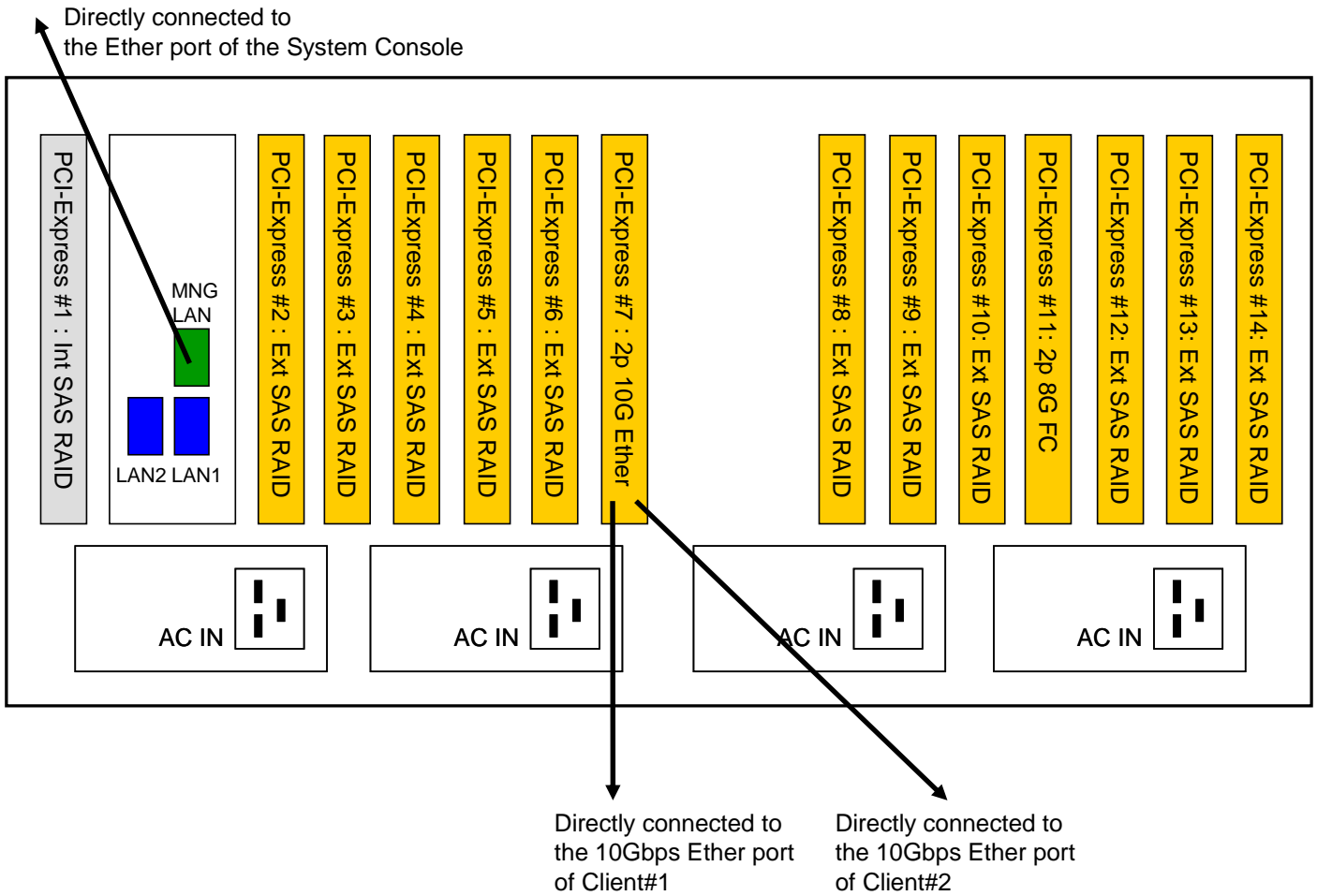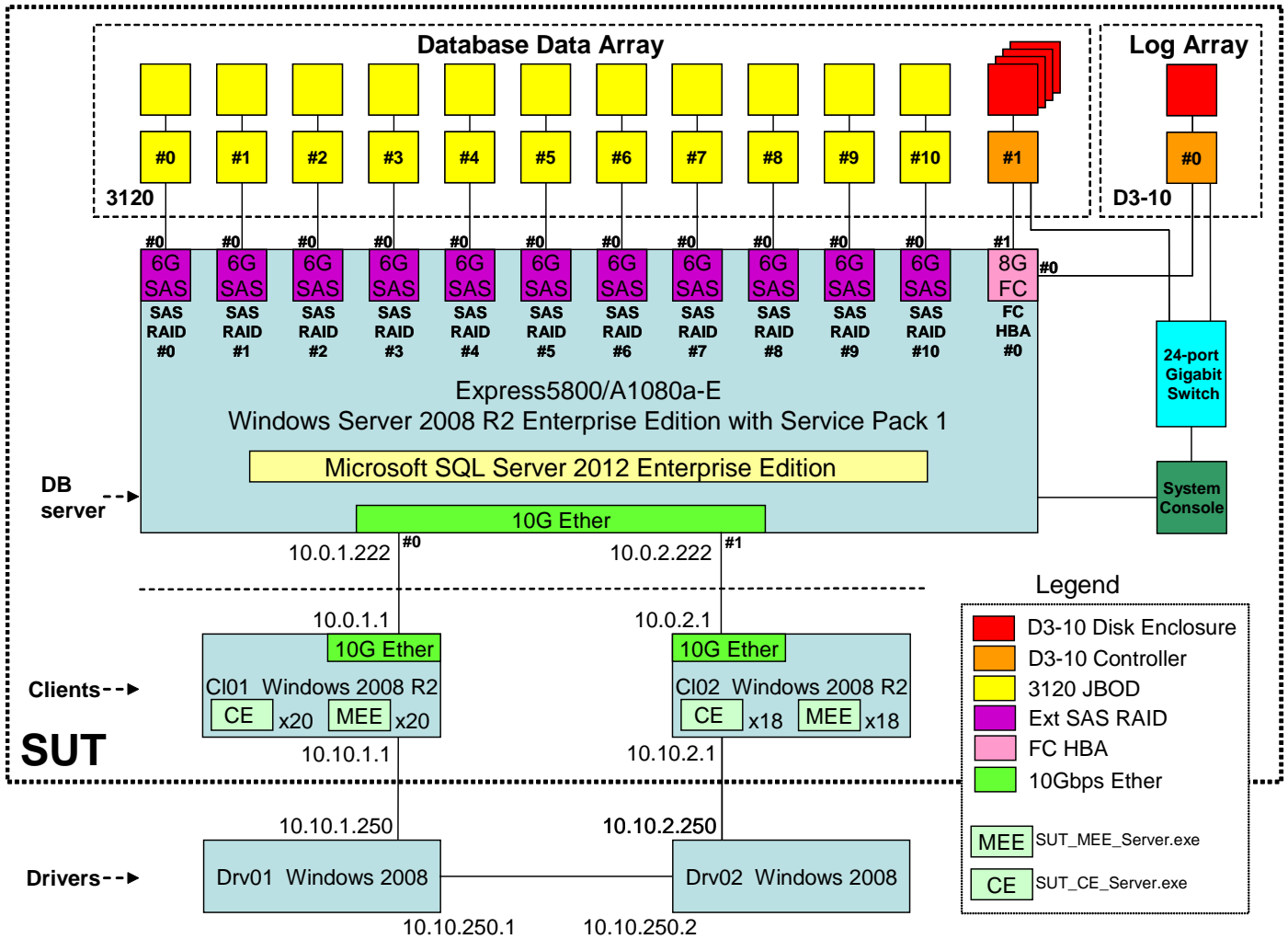the 10Gbps Ether port
of Client#2

Figure1.6: Overview of the whole system connections

Connect NEC Storage D3-10 controllers to disk enclosures and Dot Hill 3120 JBODs

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 one NEC Storage D3-10 controller, four NEC Storage D3-10 disk enclosures and twenty-two Dot Hill 3120 JBODs. The D3-10 controller is connected to the 8Gbps FC HBA of the Database Server. The 3120 JBODs are connected to the 6Gbps SAS of the Database Server.

Log Array has one NEC Storage D3-10 controller and one NEC Storage D3-10 disk enclosure. The controller is connected to the 8Gbps FC HBA of the Database Server.

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

Figure1.7: Connection diagram of the NEC Storage D3-10 for Log Array

controller subunit#1   controller subunit#0

Directly connected to the 8Gbps HBA   Connected to the System
of the Database Server directly   Console via 1Gbps Ether SW
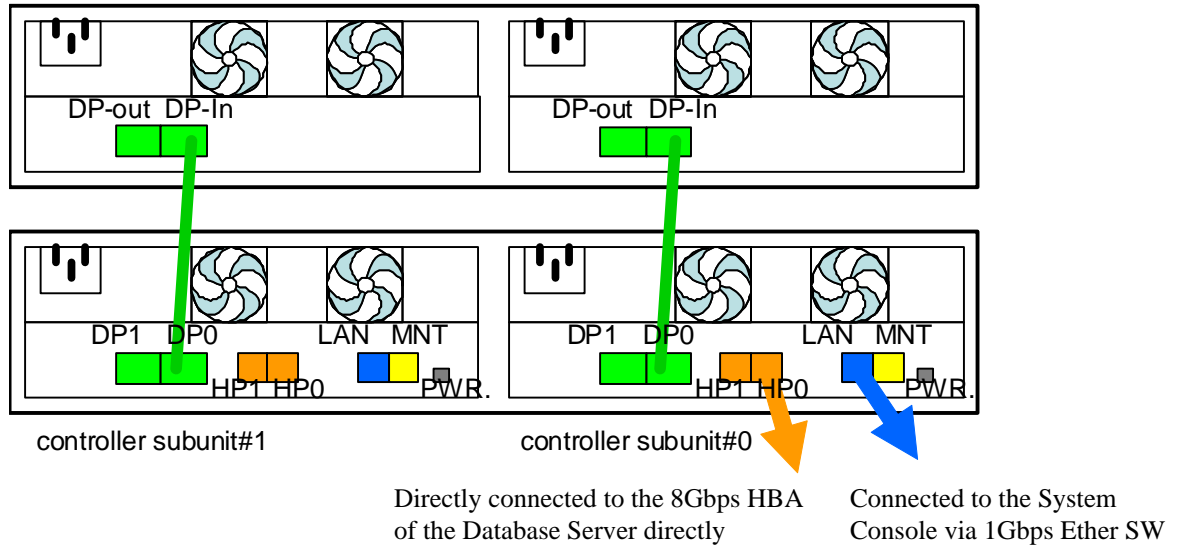
See Figure 1.8 to check the connection diagram of the NEC Storage D3-10 controller and the disk enclosures for Database Data Array.

Figure1.8: Connection diagram of the NEC Storage D3-10 for Database Data Array

controller subunit#1   controller subunit#0

Directly connected to the 8Gbps HBA   Connected to the System
of the Database Server   Console via 1Gbps Ether SW
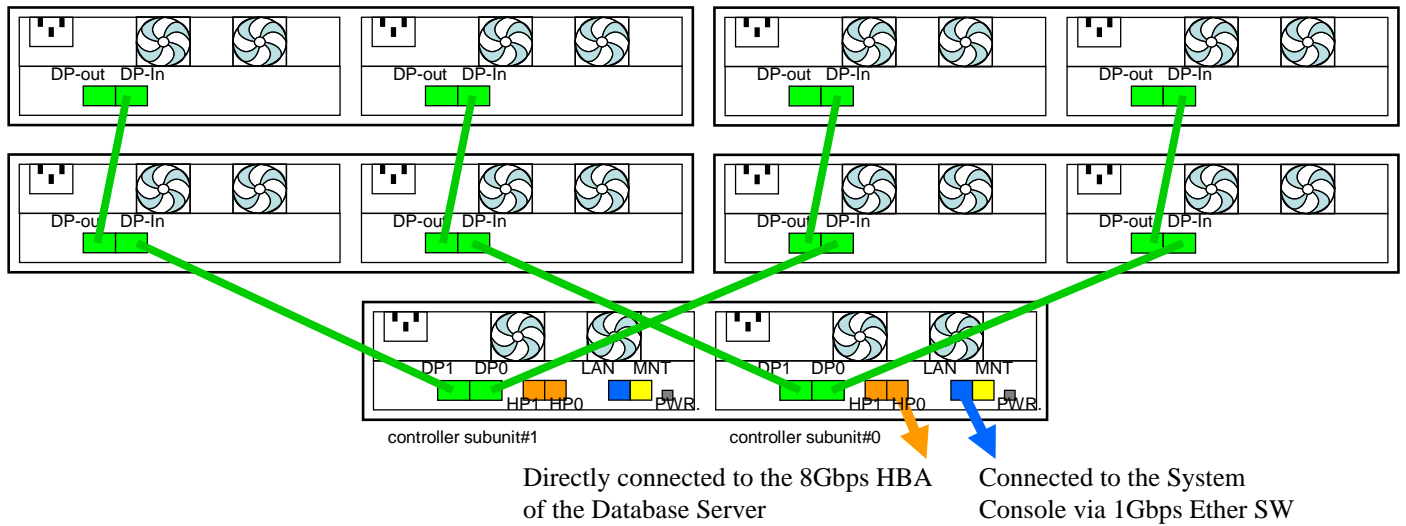
See Figure 1.9 to check the connection diagram of the Dot Hill 3120 JBODs for Database Data Array.

Figure1.9: Connection diagram of the Dot Hill 3120 for Database Data Array
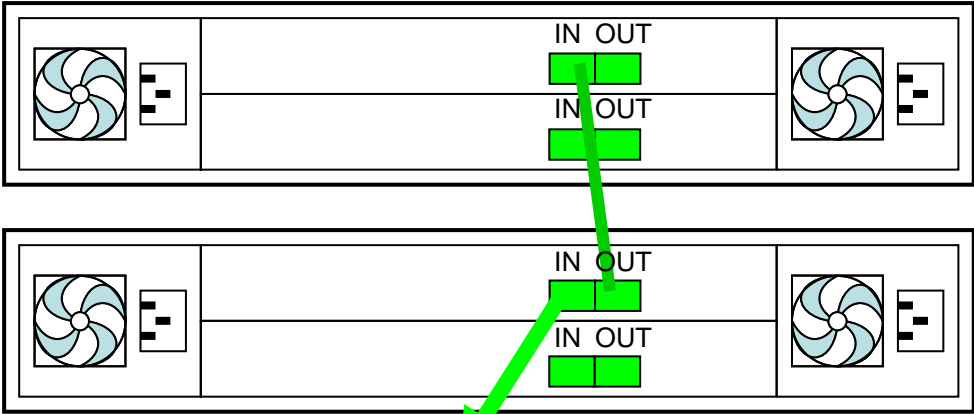
Directly connected to the 6Gbps SAS
of the Database Server

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 R2"

1. Put an OS install medium into the DVD drive of the NEC Express5800/R120b-2.

2. Power on the NEC Express5800/R120b-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/R120b-2.

2. A dialog below is displayed.
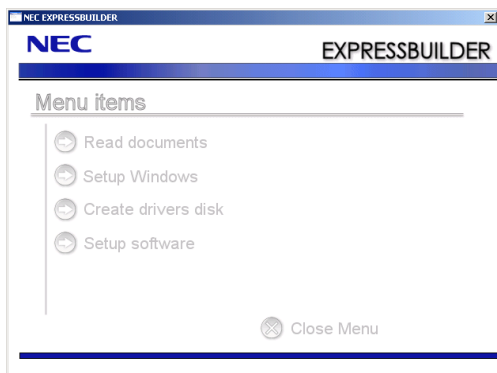
3. Select "Setup Windows" -> "Update the system".
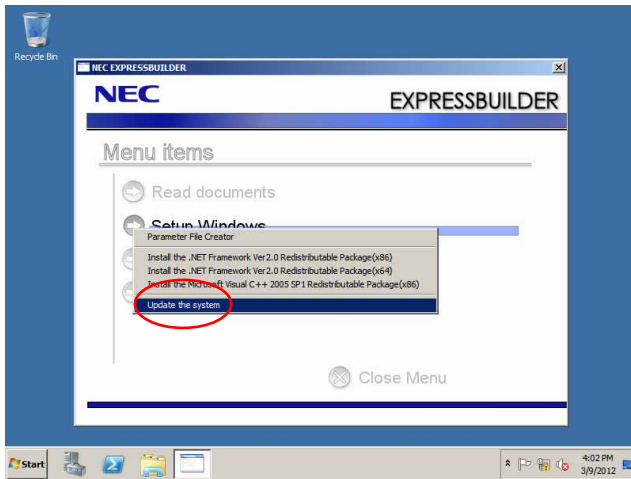
4. When "Update the system" is finished, remove the EXPRESSBUILDER DVD medium from the DVD drive and reboot the NEC Express5800/R120b-2.

OS Configuration

Assign IP addresses to Ethernet cards.

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

    "Local Area Connection 3" is used for this connection. Assign IP address "10.0.x.1".

    "x" represents the Client number.

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

    "Local Area Connection" 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® 2012 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 vcredist_x86.exe, SUT_CE_Server.exe and SUT_MEE_Server.exe.

Tier-B

Tier-B hardware consists of one NEC Express5800/A1080a-E as the database server, two NEC Storage D3-10 controller, seven NEC Storage D3-10 enclosures and twenty-two Dot Hill 3120 JBODs as the Database Array and one NEC Express5800/R120b-2 as the System Console of the NEC Express5800/A1080a-E and the NEC Storage D3-10.

Tier-B : The System Console

OS Installation

The OS installation procedure on the System Console, NEC Express5800/R120b-2, is the same as described in Tier-A portion of this clause.

OS Configuration

Assign IP addresses to Ethernet connections.

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

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

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

　"Local Area Connection 2" is used for this. Assign IP address "192.168.1.7".

Tier-B : The Database Server

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

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

Step.1: Start "Internet Explorer" and enter "http://192.168.1.100/" as Address .

Step.2: Enter the User Name and Password, then click "Login".
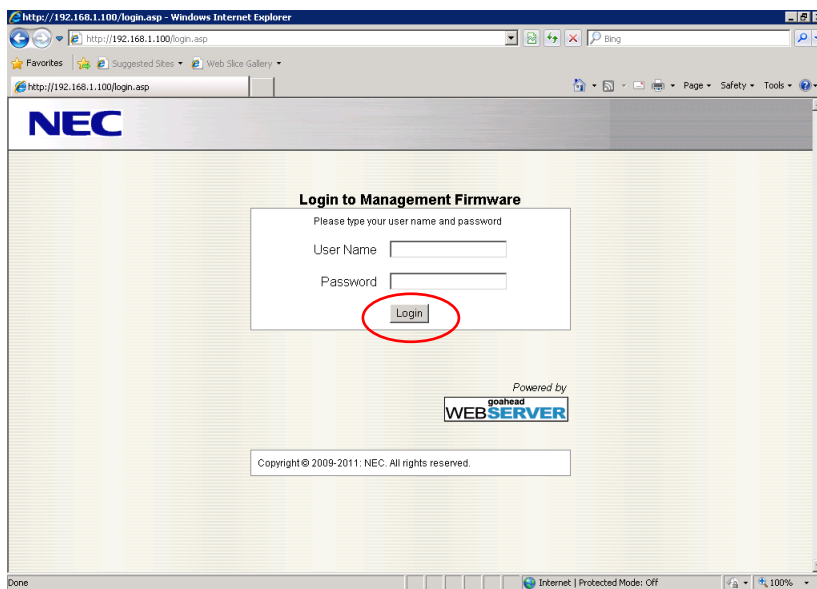
(The IP address, User Name and Password of Management Firmware are to be provided by NEC.)

Step.3: Click "Power On".
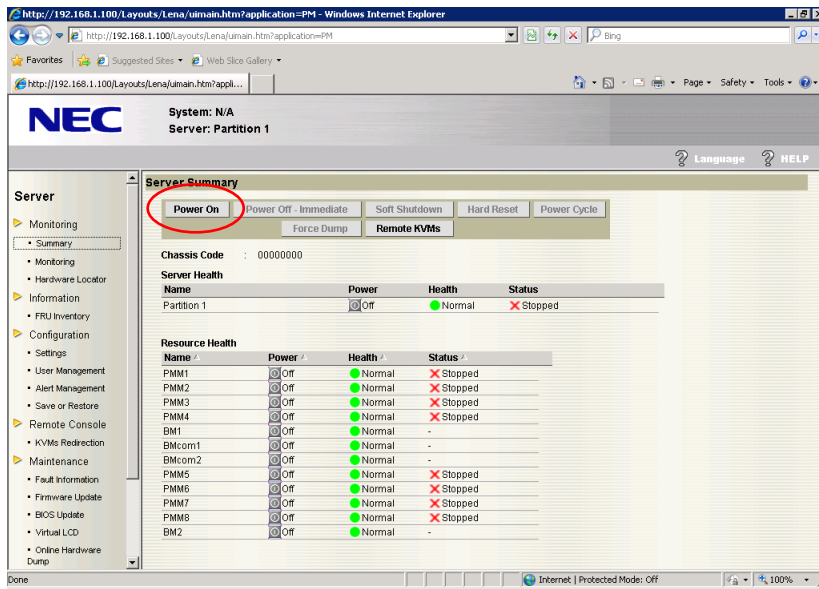
Step.4: Then the database server is booting up OS automatically.

OS Installation

The database server has already had its OS, Microsoft® Windows Server® 2008 R2 Enterprise Edition with Service Pack 1 installed.

OS Configuration

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

Disable "Windows Firewall"

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

1. Run configuration tool "WF.msc" from "Run" of the Start menu.
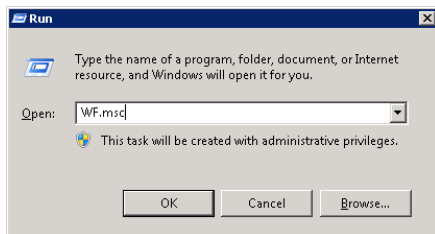
2. Click "Properties".
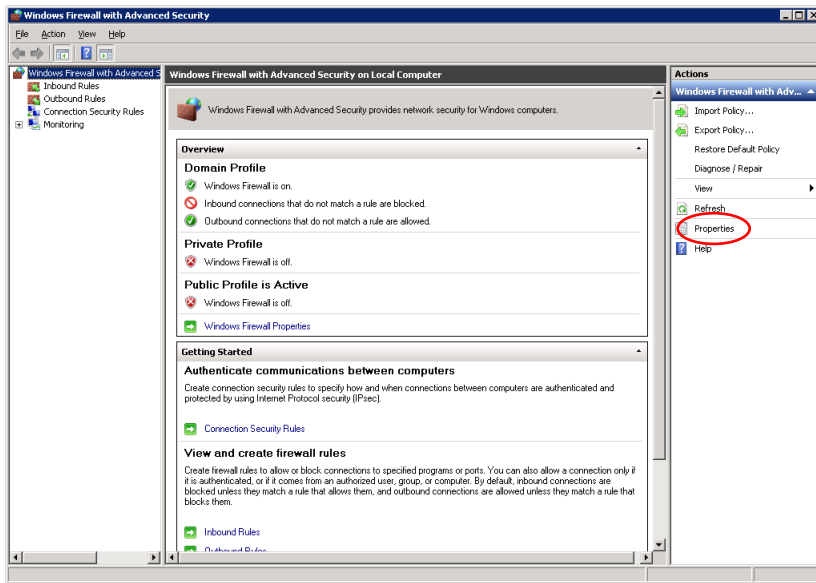
3. Select "Off" as Firewall state and click "OK".
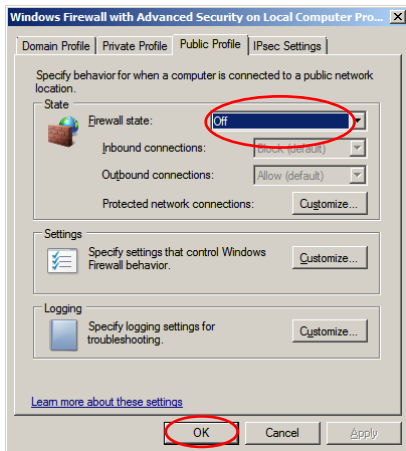
Configure "Lock pages in memory"

1. Run configuration tool "gpedit.msc" from "Run" of the Start menu.
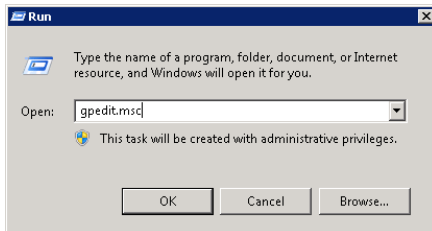
2. Select "Local Computer Policy" -> "Computer Configuration" -> "Windows Settings" -> "Security Settings" -> "Local Policies" -> "User Rights Assignment" in the left window. Then double-click "Lock pages in memory" in the right windows.
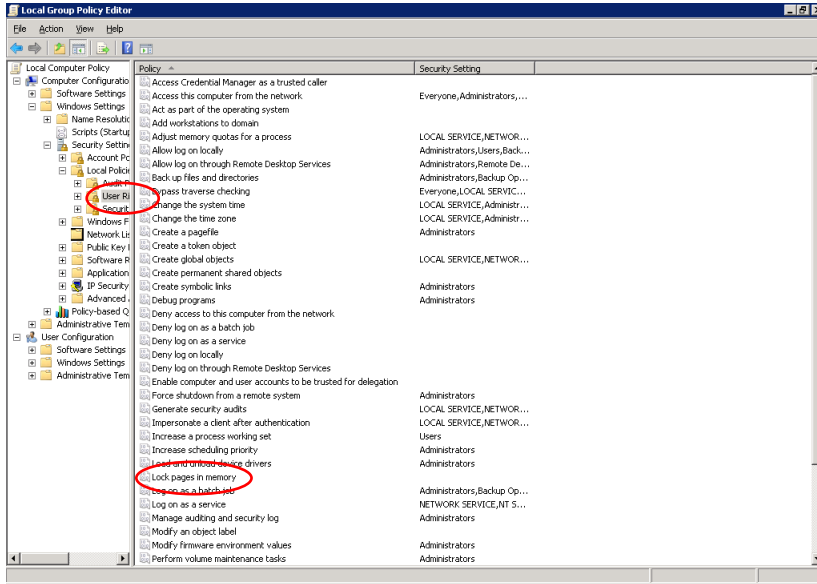
3. Click "Add User or Group".
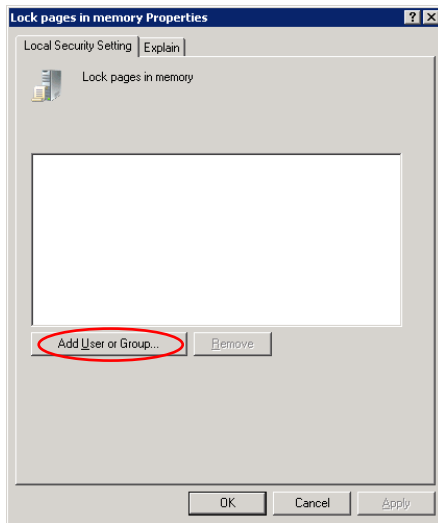
4. Enter "Administrator" and click "OK".
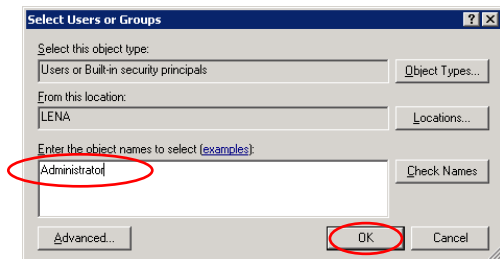
5. Click "OK".
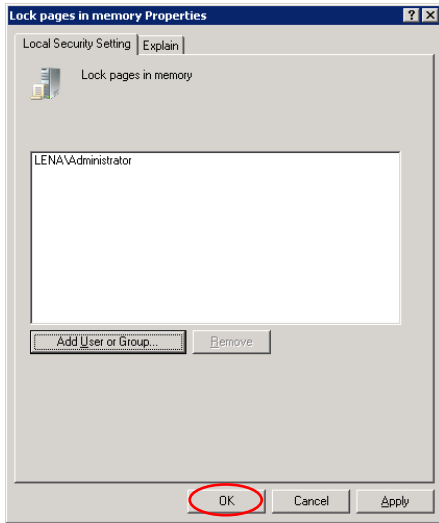
6. Logoff to reflect new configuration.

Configure "Registry"

1. Run "largepages.reg" to enable "code in large page" configuration controlled by the OS (the reg file "largepages.reg" in included in the Supporting Files).
2. Reboot OS to reflect new configuration.

RAID Configuration for the Database Array

Step by Step instruction is shown in D3-10StorageSetup.doc and 3120StorageSetup.doc (included in the Supporting Files).

Configure Partitions for Database Server

Step.1: Create Partitions

Use "Disk Management" to create partitions as shown sydskmap_[01..07].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® 2012 Enterprise Edition. Here are the notes for the installation.

Step.1: **Install .NET Framework 3.5.1**

1. Run configuration tool "ServerManager.msc" from "Run" of the Start menu.
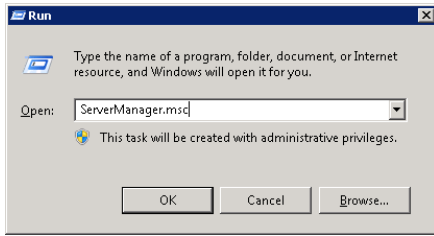
2. Select "Features" in the left window. Then click "Add Features" in the right windows.
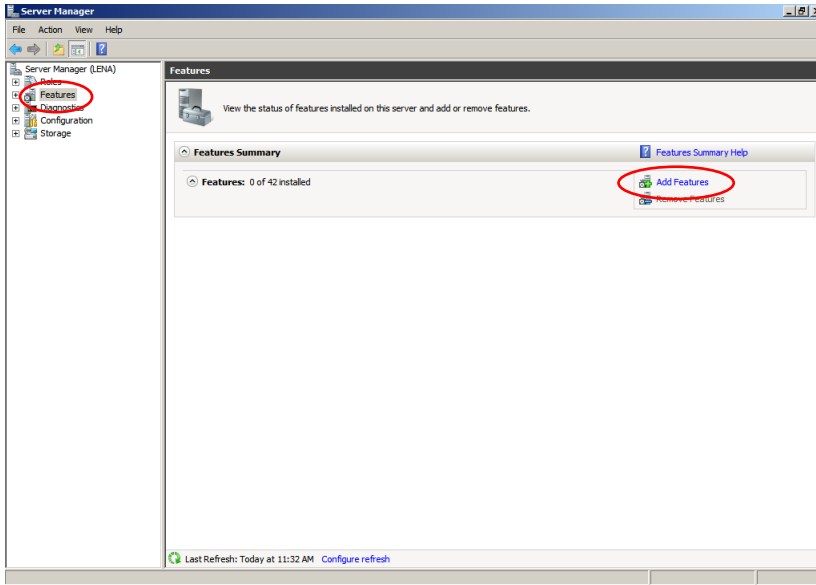
3. Select ".NET Framework 3.5.1" and click "Next".
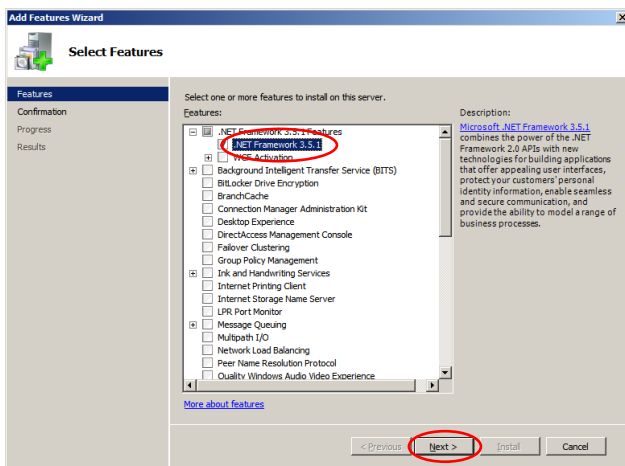
4. Click "Install".
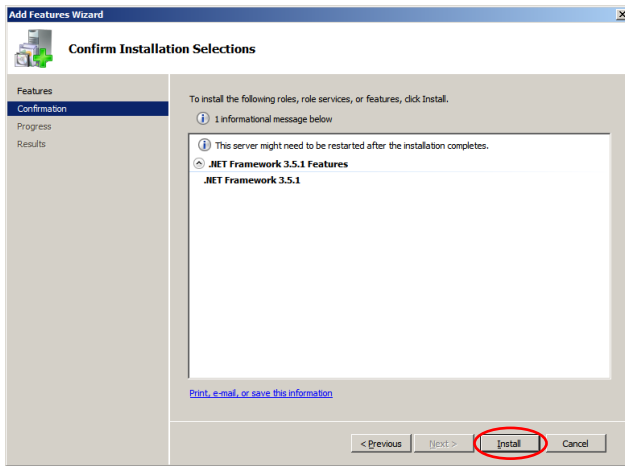
5. Click "Close".
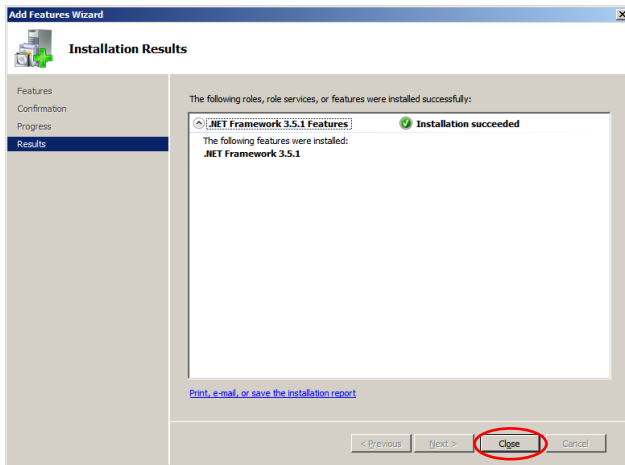
Step.2: **Server Configuration**

Change the "Startup Type" from Automatic to Manual.
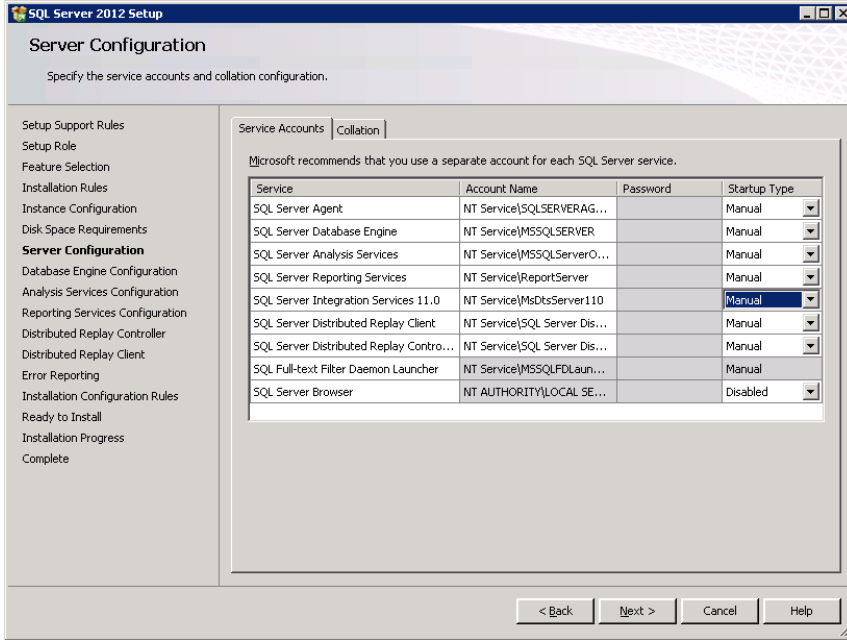
Select "Collation" tab.

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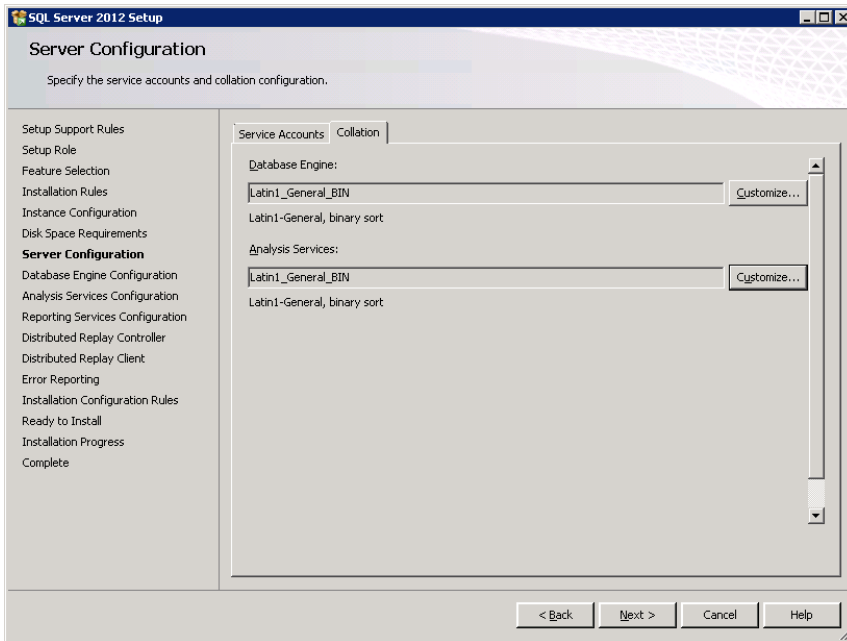
SQL Server® Configuration

Step.1: **Startup Parameter**

Start Microsoft® SQL Server® 2012 from the command line using startSQL.cmd (included in the Supporting Files).

Step.2: **sp_configure**

name	minimum	maximum	config_value	run_value
access check cache bucket count	0	65536	0	0
access check cache quota	0	2147483647	0	0
Ad Hoc Distributed Queries	0	1	0	0
affinity I/O mask	-2147483648	2147483647	0	0
affinity mask	-2147483648	2147483647	-1	-1
affinity64 I/O mask	-2147483648	2147483647	0	0
affinity64 mask	-2147483648	2147483647	268435455	268435455
Agent XPs	0	1	0	0
allow updates	0	1	0	0
backup compression default	0	1	1	1
blocked process threshold (s)	0	86400	0	0
c2 audit mode	0	1	0	0
clr enabled	0	1	0	0
common criteria compliance enabled	0	1	0	0
contained database authentication	0	1	0	0
cost threshold for parallelism	0	32767	5	5
cross db ownership chaining	0	1	0	0
cursor threshold	-1	2147483647	-1	-1
Database Mail XPs	0	1	0	0
default full-text language	0	2147483647	1033	1033
default language	0	9999	0	0
default trace enabled	0	1	0	0
disallow results from triggers	0	1	0	0
EKM provider enabled	0	1	0	0
filestream access level	0	2	0	0
fill factor (%)	0	100	0	0
ft crawl bandwidth (max)	0	32767	100	100
ft crawl bandwidth (min)	0	32767	0	0
ft notify bandwidth (max)	0	32767	100	100
ft notify bandwidth (min)	0	32767	0	0
in-doubt xact resolution	0	2	0	0
index create memory (KB)	704	2147483647	0	0
lightweight pooling	0	1	1	1
locks	5000	2147483647	0	0
max degree of parallelism	0	32767	1	1
max full-text crawl range	0	256	4	4
max server memory (MB)	128	2147483647	1920000	1920000

max text repl size (B)	-1	2147483647	65536	65536
max worker threads	128	65535	4096	4096
media retention	0	365	0	0
min memory per query (KB)	512	2147483647	1024	1024
min server memory (MB)	0	2147483647	0	16
nested triggers	0	1	1	1
network packet size (B)	512	32767	4096	4096
Ole Automation Procedures	0	1	0	0
open objects	0	2147483647	0	0
optimize for ad hoc workloads	0	1	0	0
PH timeout (s)	1	3600	60	60
precompute rank	0	1	0	0
priority boost	0	1	1	1
query governor cost limit	0	2147483647	0	0
query wait (s)	-1	2147483647	-1	-1
recovery interval (min)	0	32767	32767	32767
remote access	0	1	1	1
remote admin connections	0	1	0	0
remote login timeout (s)	0	2147483647	0	0
remote proc trans	0	1	0	0
remote query timeout (s)	0	2147483647	0	0
Replication XPs	0	1	0	0
scan for startup procs	0	1	0	0
server trigger recursion	0	1	1	1
set working set size	0	1	0	0
show advanced options	0	1	1	1
SMO and DMO XPs	0	1	1	1
transform noise words	0	1	0	0
two digit year cutoff	1753	9999	2049	2049
user connections	0	32767	0	0
user options	0	32767	0	0
xp_cmdshell	0	1	0	0

Step.3: **Configure cpu affinity**

Run 160cpu-affinity.sql to configure the affinity of cpu (the sql file "160cpu-affinity.sql" is included in the Supporting Files).

Step.4: **Configure tempdb**

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

Step.5: **Configure softNUMA node**

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

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

3. Reboot OS to reflect new configuration.

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 2,400,000 customers. The SQL Server® scripts and setup command files are included in the Supporting Files\Clause2 folder. One file group called "tpce_fg" is used for all tables and indices. "tpce_fg" uses all the V:\Device\tpce_* disk partitions. The database log uses the V:\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® 2012 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 2,400,000 customers.

Table 2.1: Number of Rows for Server

Table Name	Rows Loaded
Scaling Tables	
ACCOUNT PERMISSION	17,040,108
ADDRESS	3,600,004
BROKER	24,000
COMPANY	1,200,000
COMPANY COMPETITOR	3,600,000
CUSTOMER	2,400,000

CUSTOMER ACCOUNT	12,000,000
CUSTOMER TAXRATE	4,800,000
DAILY MARKET	2,145,420,000
FINANCIAL	24,000,000
LAST TRADE	1,644,000
NEWS ITEM	2,400,000
NEWS XREF	2,400,000
SECURITY	1,644,000
WATCH ITEM	239,964,184
WATCH LIST	2,400,000
Growing Tables	
CASH TRANSACTION	38,154,316,860
HOLDING	2,123,445,459
HOLDING HISTORY	55,579,497,927
HOLDING SUMMARY	119,360,046
SETTLEMENT	41,472,000,000
TRADE	41,472,000,000
TRADE HISTORY	99,532,602,851
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 and 2.3 depict the distribution of the database over the disks of the measured and priced system.
Figure 1.1 and 1.2 show the disk configuration for measured and priced systems.

Table 2.2: Data Distribution for the Measured Configuration

Disk#	Controller#	Card#	Card Type	Drives Enclosure model RAID level	Partition Filesystem	Size	Use
0		Internal	SAS RAID	2x300GB, 10K, SAS Internal RAID1	System Reserved C: (NTFS)	100MB 278.78GB	OS
1	0	0-0	FC HBA	8x147GB, 15K, SAS D3-10 Base model RAID10	V: (NTFS) V:\Device\TPCE_Log\ (RAW) V:\Device\TPCE_TempLog (NTFS) V:\Device\TPCE_TempDB (NTFS)	10GB 1000GB 55GB	Log TPCE_TempLog TPCE_TempDB
				8x147GB, 15K, SAS D3-10 Disk Enclosure RAID10			
2	1	0-1	FC HBA	12x147GB, 15K, SAS D3-10 Base model RAID6	(NTFS)	1274GB	
3				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	
4				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	
5				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	
6				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	
7				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	
8				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	
9		1-0	SAS RAID	12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_06 (NTFS)	1498.40GB	Backup_06
10				12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_05 (NTFS)	1498.40GB	Backup_05
11		1-1		18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_01\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_01
12				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_02\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_02
13		2-0	SAS RAID	12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_04 (NTFS)	1498.40GB	Backup_04
14				12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_03 (NTFS)	1498.40GB	Backup_03
15		2-1		18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_04\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_04
16				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_03\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_03

17		3-0	SAS RAID	12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_02 (NTFS)	1498.40GB	Backup_02
18				12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_01 (NTFS)	1498.40GB	Backup_01
19		3-1		18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_05\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_05
20				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_06\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_06
21		4-0	SAS RAID	18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_07\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_07
22				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_08\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_08
23		5-0	SAS RAID	12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_10 (NTFS)	1498.40GB	Backup_10
24				12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_09 (NTFS)	1498.40GB	Backup_09
25		5-1		18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_09\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_09
26				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_10\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_10
27		6-0	SAS RAID	18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_21\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_21
28				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_22\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_22
29		7-0	SAS RAID	12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_08 (NTFS)	1498.40GB	Backup_08
30				12x147GB, 15K, SAS Disk Expansion Unit RAID5	V:\Device\Backup_07 (NTFS)	1498.40GB	Backup_07
31		7-1		18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_11\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_11
32				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_12\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_12
33		8-0	SAS RAID	18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_13\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_13
34				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_14\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_14

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

35		9-0	SAS RAID	18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_15\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_15
36				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_16\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_16
37		10-0	SAS RAID	18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_17\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_17
38				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_18\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_18
39		11-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_19\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_19
40				18x64GB, SSD, SATA 3120 JBOD RAID5	V:\Device\TPCE_20\ (RAW) (NTFS)	1004.98GB 145MB	TPCE_20

Table 2.3: Data Distribution for the Priced Configuration

Disk#	Controller#	Card#	Card Type	Drives Enclosure model RAID level	Partition Filesystem	Size	Use
0		Internal	SAS RAID	2x300GB, 10K, SAS Internal RAID1	System Reserved C: (NTFS)	100MB 278.78GB	OS
1	0	0-0	FC HBA	8x147GB, 15K, SAS D3-10 Base model RAID10	V: (NTFS) V:\Device\TPCE_Log\ (RAW) V:\Device\TPCE_TempLog (NTFS) V:\Device\TPCE_TempDB (NTFS)	10GB 1000GB 55GB	Log TPCE_TempLog TPCE_TempDB
				8x147GB, 15K, SAS D3-10 Disk Enclosure RAID10			
2				12x147GB, 15K, SAS D3-10 Base model RAID6	(NTFS)	1274GB	60days Space
3				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	60days Space
4	1	0-1	FC HBA	12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	60days Space
5				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	60days Space
6				12x147GB, 15K, SAS D3-10 Disk Enclosure RAID6	(NTFS)	1274GB	60days Space
11		1-1	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_01\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_01
12				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_02\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_02
15		2-1	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_04\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_04
16				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_03\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_03
19		3-1	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_05\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_05
20				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_06\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_06
21		4-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_07\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_07
22				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_08\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_08
25		5-1	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_09\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_09
26				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_10\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_10

27		6-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_21\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_21
28				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_22\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_22
31		7-1	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_11\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_11
32				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_12\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_12
33		8-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_13\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_13
34				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_14\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_14
35		9-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_15\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_15
36				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_16\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_16
37		10-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_17\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_17
38				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_18\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_18
39		11-0	SAS RAID	18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_19\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_19
40				18x150GB, SSD, SAS 3120 JBOD RAID5	V:\Device\TPCE_20\ (RAW) (NTFS)	1004.98GB 1361.08GB	TPCE_20

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 in the Report.*

Microsoft® SQL Server® 2012, a relational database, was used in this benchmark. Microsoft® SQL Server® 2012 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, 1.2 and 1.6.

Clause 5: EGen Related Items

EGen Version

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

EGen v1.12.0 was used in this benchmark.

EGen Code

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

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

EGen Modifications

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

EGen has not been modified in this benchmark.

EGenLoader Extensions

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

No extensions were made to the EGenLoader for this benchmark.

Clause 6 : Performance Metrics and Response Time Related Items

EGenDriver Items

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

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

Measured Throughput

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

Measured tpsE
4,614.22 tpsE

Trade-Result Throughput vs. Elapsed Wall Clock Time

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

Figure 6.1: Test Run Graph
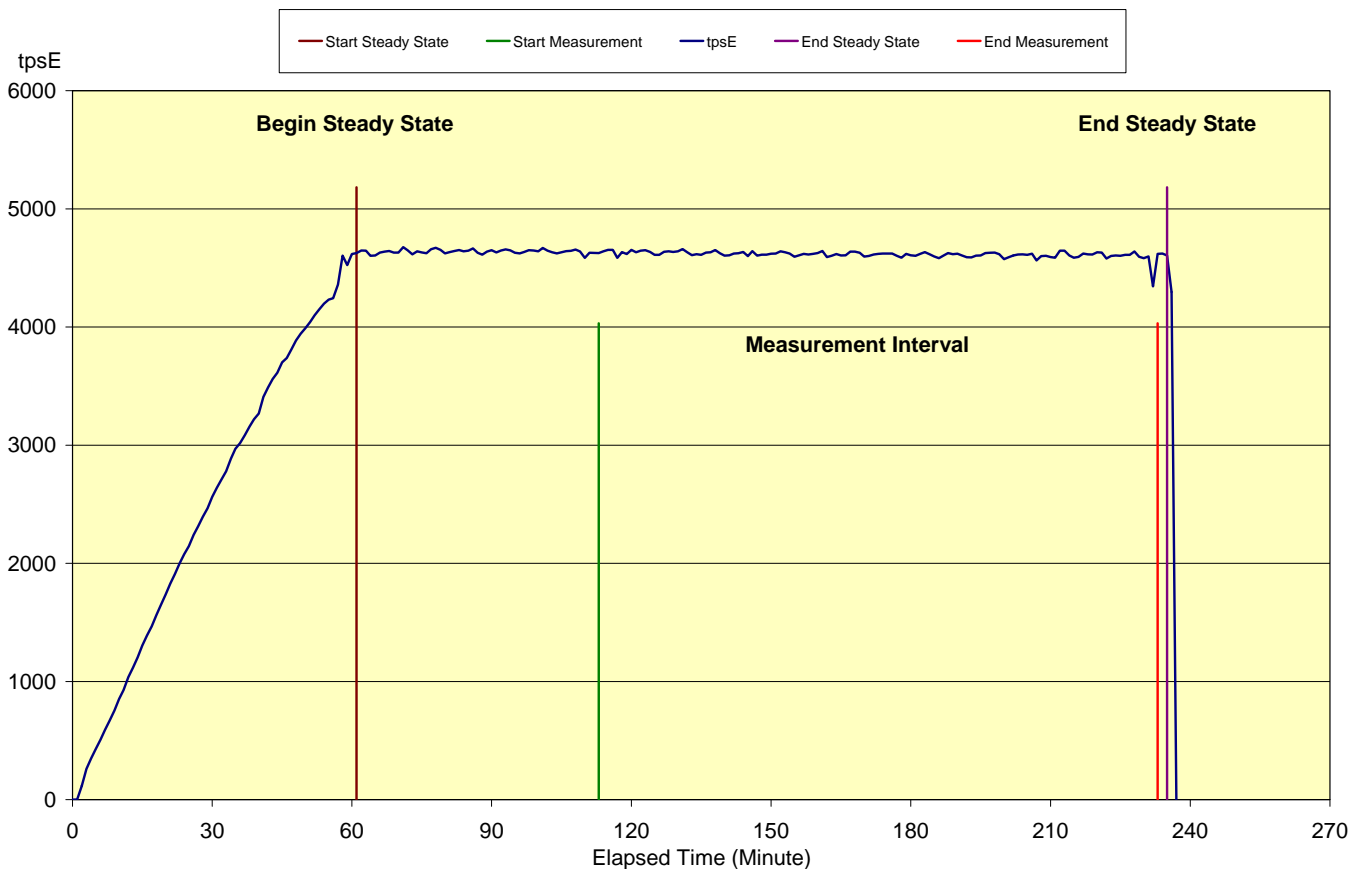
Steady State

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

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

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

Work Performed During Steady State

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

A checkpoint in Microsoft® SQL Server® 2012 wrote to disk all updated memory pages that had not been yet actually written to disk. SQL Server® 2012 recovery interval parameter was set to the maximum allowable value to perform checkpoint at specific intervals. Checkpoints were issued at specified duration (420 seconds) and specified intervals (448 seconds).

Transaction Averages

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

Table 6.1: Transaction Averages

Input Parameter	Value	Actual Pct	Required Range
Customer-Position			
by_tax_id	1	50.01%	48% to 52%
get_history	1	50.00%	48% to 52%
Market-Watch			
Securities chosen by	Watch list	60.00%	57% to 63%
	Account ID	35.00%	33% to 37%
	Industry	5.00%	4.5% to 5.5%
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	10.00%	9.5% to 10.5%
Trade-Order			
Transactions requested by a third party		10.00%	9.5% to 10.5%
Security chosen by company name and issue		39.99%	38% to 42%
type_is_margin	1	8.00%	7.5% to 8.5%
roll_it_back	1	0.99%	0.94% to 1.04%
is_lifo	1	35.00%	33% to 37%
trade_qty	100	25.00%	24% to 26%
	200	24.98%	24% to 26%
	400	25.02%	24% to 26%
	800	25.00%	24% to 26%
trade_type	TMB	30.00%	29.7% to 30.3%
	TMS	29.99%	29.7% to 30.3%
	TLB	20.00%	19.8% to 20.2%
	TLS	10.01%	9.9% to 10.1%
	TSL	10.00%	9.9% to 10.1%
Trade-Update			
frame_to_execute	1	33.00%	31% to 35%
	2	33.00%	31% to 35%
	3	34.00%	32% to 36%

TPC Benchmark^{TM} E Full Disclosure Report

Clause 7 : Transaction and System Properties Related Items

Transaction System Properties (ACID)

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

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

Redundancy Level

The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.6.3.4) and describe the Data Accessibility test(s) used to demonstrate compliance.

Redundancy Level 1 was used for the Database Array.

Durability Test for Data Accessibility

A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.6.4.2).

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

1. Determine the current number of completed trades in the database by running: *select count(*) as count1 from SETTLEMENT*
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.6.2) 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 RAID10, the Database Data Array uses RAID5 and the Database Log Array controller has a mirrored cache module.
5. Begin the necessary recovery process, with replacing the failed Database Log Array controller, the failed drives in the Database Log Array and the Database Data Array.
6. Continue running the Driver for 20 minutes.
7. Terminate the run gracefully from the Driver.
8. Retrieve the new number of completed trades in the database by running: *select count(*) as count2 from SETTLEMENT*
9. Compare the number of executed Trade-Result Transactions on the Driver to (count2 – count1). Verify that (count2 - count1) is equal to the number of successful Trade-Result Transaction records in the Driver log file.
10. Allow recovery process to complete as needed.

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

Figure 7.1: Data Accessibility Graph
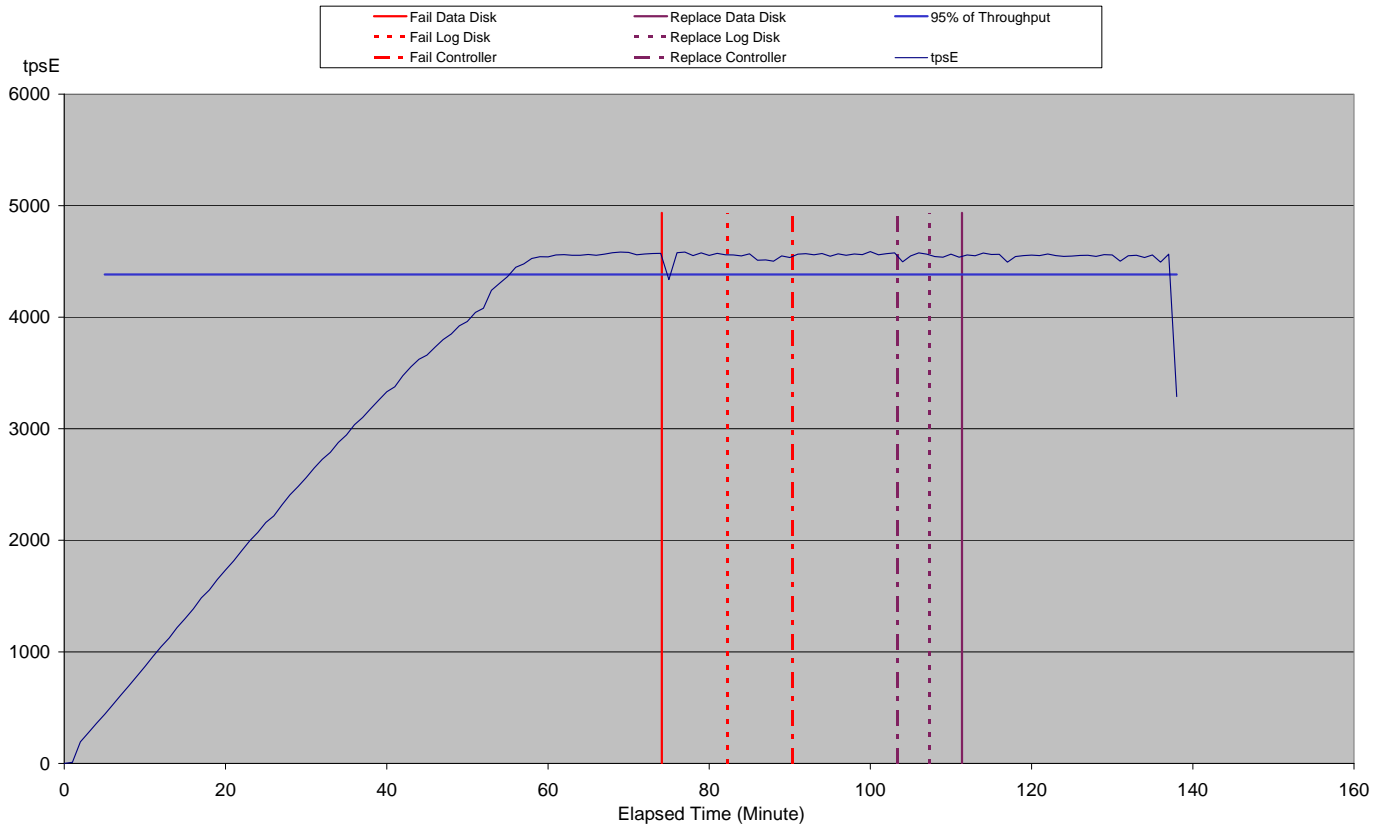
Durability Test for Business Recovery

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

The Business Recovery Time must be reported on the Executive Summary Statement and in the Report. If the failures described in Clauses 7.5.3.1, 7.5.3.2 and 7.5.3.3 were not combined into one Durability test (usually powering off the Database Server during the run), then the Business Recovery Time for the failure described for instantaneous interruption is the Business Recovery Time that must be reported in the Executive Summary Statement. All the Business Recovery Times for each test requiring Business Recovery must be reported in the Report.

The Business Recovery Time Graph (see Clause 7.5.8.3) must be reported in the Report for all Business Recovery tests.

The tests for "Loss of Processing," "Loss of Vulnerable Storage Component," and "Loss of External power to the SUT" were combined.

Note: Twenty-four UPSs have been priced for NEC Storage D3-10 for the Database Log Array and Dot Hill Systems Storage.

The following steps were successfully performed.
1. Determine the current number of completed trades in the database by running: *select count(*) as count1 from SETTLEMENT*
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.5.1) and satisfy those requirements for at least 20 minutes.
3. Removing power cords from the database server, NEC Express5800/A1080a-E.
4. Stop the Driver.
5. Re-power and restart the database server, NEC Express5800/A1080a-E.
6. On the NEC Express5800/A1080a-E when Windows has started, start up Microsoft® SQL Server® 2012. Then database recovery starts automatically. Microsoft® SQL Server® 2012 records timestamps out to the errorlog when

the recovery procedure has begun. The timestamp defines the time when Database Recovery starts (as defined in Clause 7.5.6.2).

7. Wait for Microsoft® SQL Server® 2012 to finish recovering the database. The timestamp in the errorlog of the message indicating that the recovery of database tpce is complete is considered the end of the Database Recovery (as defined in Clause 7.5.6.3).

8. Once the SUT will accept Transactions, start submitting Transactions and note this time as the start of Application Recovery (as defined in Clause 7.5.6.6). Ramp up to a Durability Throughput Requirements (as defined in Clause 7.5.5.1) and satisfy those requirements for at least 20 minutes.

9. Note the time of the beginning of that 20-minute window as the end of Application Recovery (as defined in Clause 7.5.6.7).

10. Terminate the Driver gracefully.

11. Verify that no errors were reported by the Driver during steps 7 through 10.

12. Retrieve the new number of completed trades in the database by running: *select count(*) as count2 from SETTLEMENT*

13. Compare the number of completed Trade-Result Transactions on the Driver to (count2 – count1). Verify that (count2 - count1) is greater or equal to the aggregate number of successful Trade-Result Transaction records in the Driver log file for the runs performed in step 2 and step 8. If there is an inequality, the SETTLEMENT table must contain additional records and the difference must be less than or equal to the maximum number of Transactions which can be simultaneously in-flight from the Driver to the SUT. This number is specific to the implementation of the Driver and configuration settings at the time of the crash.

14. Verify consistency conditions as specified in Clause 7.3.3.

The database recovery time was 0:12:53. The application recovery time was 0:56:00. The Business Recovery Time, which is the sum of the database recovery time and the application recovery time, was 1:08:53.

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
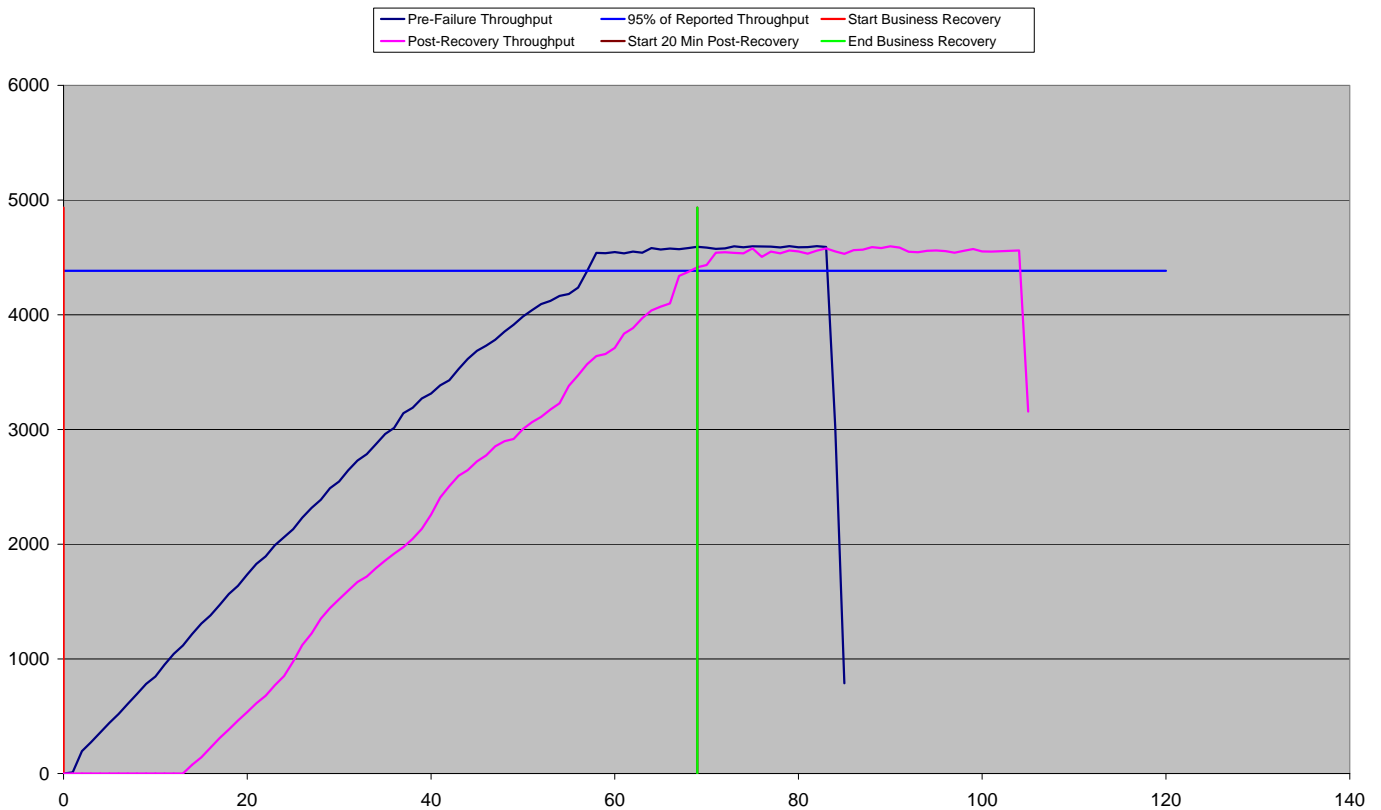
Clause 8 : Pricing Related Items

60-Day Space

Details of the 60-Day Space computations (see Clause 6.6.6.6) 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.

Table 8.1: TPC-E Disk Space Requirements

Customers Used	2,400,000	Performance	4,614.22	tpsE		
Growing File Group	**Initial Rows**	**Data (KB)**	**Index size (KB)**	**Extra 5% (KB)**	**Total + 5% (KB)**	**After run (KB)**	**Growth (KB)**
CASH_TRANSACTION	38,154,316,860	3,963,417,680	8,353,720		3,971,771,400	3,982,110,512	10,339,112
HOLDING	2,123,445,459	141,944,600	90,036,640		231,981,240	235,465,528	3,484,288
HOLDING_HISTORY	55,579,497,927	2,021,072,832	1,168,178,376		3,189,251,208	3,200,719,288	11,468,080
HOLDING_SUMMARY	119,360,046	5,231,088	19,696		5,250,784	5,250,784	0
SETTLEMENT	41,472,000,000	1,977,545,856	4,168,896		1,981,714,752	1,987,481,392	5,766,640
TRADE	41,472,000,000	4,950,933,840	2,496,273,336		7,447,207,176	7,473,818,336	26,611,160
TRADE_HISTORY	99,532,602,851	2,993,461,920	7,805,992		3,001,267,912	3,011,776,352	10,508,440
TRADE_REQUEST	0	8	8		16	507,600	507,584
Scaling File Group							
ACCOUNT_PERMISSION	17,040,108	938,152	5,400	47,178	990,730	943,624	72
ADDRESS	3,600,004	207,496	1,664	10,458	219,618	209,288	128
BROKER	24,000	1,752	2,040	190	3,982	3,792	0
COMPANY	1,200,000	255,832	70,480	16,316	342,628	326,312	0
COMPANY_COMPETITOR	3,600,000	96,528	77,280	8,690	182,498	173,808	0
CUSTOMER	2,400,000	393,152	102,224	24,769	520,145	495,376	0
CUSTOMER_ACCOUNT	12,000,000	1,087,216	231,160	65,919	1,384,295	1,318,376	0
CUSTOMER_TAXRATE	4,800,000	99,904	1,144	5,052	106,100	101,232	184
DAILY_MARKET	2,145,420,000	100,581,000	293,840	5,043,742	105,918,582	100,876,544	1,704
FINANCIAL	24,000,000	2,704,432	8,024	135,623	2,848,079	2,712,888	432
LAST_TRADE	1,644,000	102,352	1,184	5,177	108,713	103,536	0
NEWS_ITEM	2,400,000	260,396,504	5,496	13,020,100	273,422,100	260,402,000	0
NEWS_XREF	2,400,000	59,624	1,136	3,038	63,798	60,760	0
SECURITY	1,644,000	227,616	59,144	14,338	301,098	286,800	40
WATCH_ITEM	239,964,184	6,733,056	25,008	337,903	7,095,967	6,758,408	344
WATCH_LIST	2,400,000	59,616	47,504	5,356	112,476	107,120	0
Fixed File Group							
CHARGE	15	8	8	1	17	16	0
COMMISSION_RATE	240	16	16	2	34	32	0
EXCHANGE	4	8	8	1	17	16	0
INDUSTRY	102	8	24	2	34	32	0
SECTOR	12	8	24	2	34	32	0
STATUS_TYPE	5	8	8	1	17	16	0
TAXRATE	320	24	16	2	42	56	16
TRADE_TYPE	5	8	1,032	52	1,092	1,040	0
ZIP_CODE	14,741	488	160	32	680	648	0
TOTALS (KB)		16,427,552,632	3,775,770,688	18,743,942	20,222,067,262		
Initial Database Size (MB)		19,729,808	19,267 GB	18.82 TB			

Db/Filegroups	LUN Count	Partition Size(KB)	MB allocated	MB Loaded	MB Loaded+5%	Ending size	8 Hours
TPCE_FG	22	1,053,797,908	22,640,189	19,729,808	19,748,113	19,796,886	19,884,105
Settlements	57,771,729						

		Number of disks	18	
		Disk Capacity (MB)	142,520	
		RAID5 Overhead	6%	
		Subtotal Space (MB)	2,422,840	
		Number of disks	378	
		Disk Capacity (MB)	60,543	
		RAID5 Overhead	6%	
Initial Growing Space (MB)	19,363,715	Subtotal Space (MB)	21,613,851	
Final Growing Space (MB)	19,430,791	Number of disks	60	Initial Log size (MB)	59,240	Log Disks	16
Delta (MB)	67,075	Disk Capacity (MB)	135,893	Final Log size (MB)	443,269	Disk Capacity (MB)	136,320
Data Space per TR (MB)	0.001161044	RAID6 Overhead	20%	Log Growth (MB)	384,029	RAID10 overhead	50%
1 Day Data Growth (MB)	154,291	Subtotal Space (MB)	6,522,864	Log Growth/TR (MB)	0.0066473515	Tempdb	56,320
60 Day Space (MB)	28,987,240	Total Space (MB)	30,559,555	1 Day log space (MB)	883,363	Log Space (MB)	1,034,240

Component Substitution

The Test Sponsor has demonstrated to the Auditor's satisfaction that the substituting components do not negatively impact the Reported Throughput. All Substitutions must be reported in the Report.

The measured system included 378 spindles of 64GB SSD SATA drives that were substituted by the same number of 150GB SSD SAS drives in the priced configuration. The following data was collected in support of the substitution. The auditor verified that the substitution met the requirements of the TPC-E benchmark and the TPC-Pricing specifications.

Table 8.2: Performance Data for Substitution

	150GB SSD SAS	64GB SSD SATA
Disk#	39	15
Avg. Disk Bytes/Read	8,192.00	8,192.00
Avg. Disk Bytes/Transfer	8,300.48	8,302.99
Avg. Disk Bytes/Write	9,065.42	9,094.18
Avg. Disk Queue Length	4.734	13.076
Disk Bytes/sec	109,036,186.19	110,201,594.78
Disk Read Bytes/sec	95,371,902.13	96,379,832.39
Disk Reads/sec	11,642.08	11,765.12
Disk Transfers/sec	13,133.42	13,269.84
Disk Write Bytes/sec	13,664,284.06	13,821,762.39
Disk Writes/sec	1,491.34	1,504.73
Average Disk Response Time	0.00036	0.00099

Auditor's Attestation Letter

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

INFO SIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Tomonori Hoshino
NEC Corporation
1-10 Nisshincho
Fuchu-City, Tokyo 183-8501, Japan

March 27, 2012

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

Platform: NEC Express 5800/A1080a-E (8 processors)
Operating System: Microsoft Windows Server 2008 R2 Enterprise Edition w/ SP 1
Database Manager: Microsoft SQL Server 2012 Enterprise Edition

The results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
Tier B, Server: NEC Express 5800/A1080a-E (8 processors)				
8 x Intel Xeon E7-8870 (2.40GHz)	2048 GB (30MB L3)	76 x 147 GB 15K HDD 396 x 150 GB SSD	0.16 Seconds	4614.22
Tier A, Two Clients: NEC Express 5800/R120b-2				
2 x Intel Xeon X5675 (3.06 GHz)	8 GB (12MB L3)	1 x 300 GB 10K 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 v1.12.0.

• The transactions were correctly implemented.

• The database was properly scaled and populated for 2,400,000 customers.

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

• The ACID properties were met.

531 CRYSTAL HILLS BLVD • MANITOU SPRINGS, CO 80829 • 719-473-7555 • WWW.SIZING.COM

- Input data was generated according to the specified percentages.

- The reported response times were correctly measured.

- All 90% response times were under the specified maximums.

- The measurement interval was representative of steady state conditions.

- The reported measurement interval was 120 minutes.

- The implementation used Redundancy Level 1.

- The Business Recovery Time of 1:08:53 was correctly measured.

- The 60 day storage requirement was correctly computed.

- The system pricing was verified for major components and maintenance.

Additional Audit Notes:

The measured configuration included 378 64GB SSD SATA drives that were substituted by 378 150GB SSD SAS drives in the priced configuration. Based on the specifications of these items and on performance data collected during testing, it is my opinion that this substitution has no significant effect on performance.

Respectfully Yours,

Doug Johnson, Auditor   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/	3120StorageSetup.doc D3-10StorageSetup.doc mkmp.cmd mount.txt StorageDiagram.doc sydskmap_[01..07].png
	TierB(server) cofiguration	SupportingFiles/Introduction/Hardware/	TierB_A1080a-E_R120b-2_setup.doc
	TierA(client) setup	SupportingFiles/Introduction/Hardware/	TierA_R120b-2_setup.doc
	Database Tunable Parameters	SupportingFiles/Introduction/Software/	160cpu-affinity.sql largepages.reg Remove_Addon_Files.sql SoftNUMA-node-cpumask.reg SoftNUMA-ports.reg sp_configure.out startSQL.cmd tempdb.sql
	OS Tunable Parameters	SupportingFiles/Introduction/Software/	syostune.doc syhwTierB.out syhwTierA_[1..2].out
	Tier A Scripts	SupportingFiles/Introduction/Software/	ce[1..10,13…40].cmd me[1..10,13…40].cmd

Clause2	Table creation scripts	SupportingFiles/Clause2/DDL/	BulkInsert_[1..88].sql Convert_NI_ITEM_Data.sql Create_Check_Constraints_Fixed.sql Create_Check_Constraints_Growing.sql Create_Check_Constraints_Scaling.sql Create_FK_Constraints.sql Create_Tables_Fixed.sql Create_Tables_Growing.sql Create_Tables_Scaling.sql Create_Tables_Scaling_Flat.sql Create_TPCE_Types.sql Drop_FK_Constraints.sql Drop_Tables_Fixed.sql Drop_Tables_Growing.sql Drop_Tables_Scaling.sql
	Index creation scripts	SupportingFiles/Clause2/DDL/	Create_Indexes_Fixed_Tables.sql Create_Indexes_Growing_Tables.sql Create_Indexes_Scaling_Tables.sql
	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/	Alter_Tables_No_UDDT_Not_Null.sql 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_TL_TU_Warnings_Table.sql Create_TPCE_VERSIONS_Table.sql Create_TR_Indexes.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	2400000Customers_Load_Timer.log
			Alter_Tables_No_UDDT_Not_Null.out
			BrokerVolume.out
			BuildSteps1.log
			BuildSteps2.log
			BulkInsert_[1..88].out
			Check_Constraints_Fixed.log
			Check_Constraints_Growing.log
			Check_Constraints_Scaling.log
			Convert_NI_ITEM_Data.log
			Create_DM_Audit_Table.log
			Create_Indexes_Fixed_Tables.log
			Create_Indexes_Growing_Tables.log
			Create_Indexes_Scaling_Tables.log
			Create_TID_Ranges_Table.log
			Create_TL_TU_Warnings_Table.log
			Create_TPCE_VERSIONS_Table.log
			Create_TR_Indexes.out
			CreateDB.log
			CustomerPosition.out
			Database_Options_1.log
			Database_Options_2.log
			DataMaintenance.out
			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.out
			MarketWatch.out
			RemoveDB.log
			SecurityDetail.out
			SQL_Server_Configuration.log
			Tables_Fixed.log
			Tables_Growing.log
			Tables_Scaling.log
			TPCE_Types.log
			TPCE_VERSIONS.log
			TradeLookup.out
			TradeOrder.out
			TradeResult.out
			TradeStatus.out
			TradeUpdate.out
			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.vcxproj SUTServer.sln 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.vcxproj
Clause4			
Clause5	EGen modifications		
	EGenLoader extensions		
	EGenDriver Configuration	SupportingFiles/Clause5/	BenchCraftProfile.xml
	EGenLoader Parameters	SupportingFiles/Clause5/	BuildSteps.log EGenLoaderFrom1To27000.log EGenLoaderFrom27001To55000.log EGenLoaderFrom55001To82000.log EGenLoaderFrom82001To109000.log EGenLoaderFrom109001To136000.log EGenLoaderFrom136001To164000.log EGenLoaderFrom164001To191000.log EGenLoaderFrom191001To218000.log EGenLoaderFrom218001To245000.log EGenLoaderFrom245001To273000.log EGenLoaderFrom273001To300000.log EGenLoaderFrom300001To327000.log EGenLoaderFrom327001To355000.log EGenLoaderFrom355001To382000.log EGenLoaderFrom382001To409000.log EGenLoaderFrom409001To436000.log EGenLoaderFrom436001To464000.log EGenLoaderFrom464001To491000.log EGenLoaderFrom491001To518000.log EGenLoaderFrom518001To545000.log EGenLoaderFrom545001To573000.log EGenLoaderFrom573001To600000.log EGenLoaderFrom600001To627000.log EGenLoaderFrom627001To655000.log EGenLoaderFrom655001To682000.log EGenLoaderFrom682001To709000.log EGenLoaderFrom709001To736000.log EGenLoaderFrom736001To764000.log EGenLoaderFrom764001To791000.log EGenLoaderFrom791001To818000.log EGenLoaderFrom818001To845000.log EGenLoaderFrom845001To873000.log EGenLoaderFrom873001To900000.log EGenLoaderFrom900001To927000.log EGenLoaderFrom927001To955000.log EGenLoaderFrom955001To982000.log EGenLoaderFrom982001To1009000.log EGenLoaderFrom1009001To1036000.log EGenLoaderFrom1036001To1064000.log EGenLoaderFrom1064001To1091000.log

			EGenLoaderFrom1091001To1118000.log
			EGenLoaderFrom1118001To1145000.log
			EGenLoaderFrom1145001To1173000.log
			EGenLoaderFrom1173001To1200000.log
			EGenLoaderFrom1200001To1227000.log
			EGenLoaderFrom1227001To1255000.log
			EGenLoaderFrom1255001To1282000.log
			EGenLoaderFrom1282001To1309000.log
			EGenLoaderFrom1309001To1336000.log
			EGenLoaderFrom1336001To1364000.log
			EGenLoaderFrom1364001To1391000.log
			EGenLoaderFrom1391001To1418000.log
			EGenLoaderFrom1418001To1445000.log
			EGenLoaderFrom1445001To1473000.log
			EGenLoaderFrom1473001To1500000.log
			EGenLoaderFrom1500001To1527000.log
			EGenLoaderFrom1527001To1555000.log
			EGenLoaderFrom1555001To1582000.log
			EGenLoaderFrom1582001To1609000.log
			EGenLoaderFrom1609001To1636000.log
			EGenLoaderFrom1636001To1664000.log
			EGenLoaderFrom1664001To1691000.log
			EGenLoaderFrom1691001To1718000.log
			EGenLoaderFrom1718001To1745000.log
			EGenLoaderFrom1745001To1773000.log
			EGenLoaderFrom1773001To1800000.log
			EGenLoaderFrom1800001To1827000.log
			EGenLoaderFrom1827001To1855000.log
			EGenLoaderFrom1855001To1882000.log
			EGenLoaderFrom1882001To1909000.log
			EGenLoaderFrom1909001To1936000.log
			EGenLoaderFrom1936001To1964000.log
			EGenLoaderFrom1964001To1991000.log
			EGenLoaderFrom1991001To2018000.log
			EGenLoaderFrom2018001To2045000.log
			EGenLoaderFrom2045001To2073000.log
			EGenLoaderFrom2073001To2100000.log
			EGenLoaderFrom2100001To2127000.log
			EGenLoaderFrom2127001To2155000.log
			EGenLoaderFrom2155001To2182000.log
			EGenLoaderFrom2182001To2209000.log
			EGenLoaderFrom2209001To2236000.log
			EGenLoaderFrom2236001To2264000.log
			EGenLoaderFrom2264001To2291000.log
			EGenLoaderFrom2291001To2318000.log
			EGenLoaderFrom2318001To2345000.log
			EGenLoaderFrom2345001To2373000.log
			EGenLoaderFrom2373001To2400000.log
	EGenLogger Output	SupportingFiles/Clause5/	EGENLOG.xlt
Clause6	EGenValidate Output	SupportingFiles/Clause6/	EGenValidate.out

Clause7	ACID Procedure document	SupportingFiles/Clause7/	MSTPCE ACID Procedures.pdf
	ACID procedures	SupportingFiles/Clause7/AcidProcs/	AcidProc.cmd AcidProc.out Remove_AcidProcs.cmd
		SupportingFiles/Clause7/AcidProcs/Scripts/	AcidProc.vbs CustomerPosition_Iso3.sql CustomerPosition_Iso4.sql Remove_AcidProcs.vbs TradeOrder_C.sql TradeOrder_Iso1_1.sql TradeOrder_Iso1_2.sql TradeOrder_Iso2.sql TradeOrder_Iso3.sql TradeOrder_Iso4.sql TradeOrder_RB.sql TradeResult_Iso1_1.sql TradeResult_Iso1_2.sql TradeResult_Iso2_1.sql TradeResult_Iso2_2.sql TradeResult_Iso3.sql TradeResult_Iso4.sql
	Atomicity Scripts	SupportingFiles/Clause7/Atomicity/	Atomicity.cmd
		SupportingFiles/Clause7/Atomicity/Scripts/	atom.vbs Atomicity_C.sql Atomicity_RB.sql
	Atomicity Output	SupportingFiles/Clause7/Atomicity/	Atomicity_C.out Atomicity_RB.out
	Consistency Scripts	SupportingFiles/Clause7/Consistency/	Consistency.cmd
		SupportingFiles/Clause7/Consistency/Scripts/	Consistency.sql Consistency.vbs
	Consistency Output	SupportingFiles/Clause7/Consistency/	Consistency1.out
	Isolation Scripts	SupportingFiles/Clause7/Isolation/Scripts/	Isolation1_S1.sql Isolation1_S2.sql Isolation1_S3.sql Isolation1_S4.sql Isolation2_S1.sql Isolation2_S2.sql Isolation2_S3.sql Isolation2_S4.sql Isolation3_S1.sql Isolation3_S2.sql Isolation3_S3.sql Isolation4_S1.sql Isolation4_S2.sql Isolation4_S3.sql
	Isolation Output	SupportingFiles/Clause7/Isolation/	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.xlt Part1TxnReportAll.xlt Part2Step.xlt Part2TxnReport20min.xlt Part2TxnReportAll.xlt
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/DataAccessibility/	count1.sql count1DA.out count2.sql count2DA.out DataAccessibility_wholeRun_TxnReportE.xlt DataAccessibilityGraph.xls DBlgDataAccessibility.out loss_and_replace_data_disk.txt loss_log_disk_and_cont.png replace_log_cont_disk.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

February 27, 2012

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
*	**SQL Server 2012 Enterprise Edition** *2 Core License*	$13,472.50	40	$538,900.00
P73-04980	**Windows Server 2008 R2 Standard Edition** *Server License with 10 CALs* *Open Program - Level C* *Unit Price reflects a 31% discount from the retail unit price of $1,029.*	$711.00	3	$2,133.00
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident).*	$259.00	1	$259.00

Windows Server 2008 R2 Standard Edition is currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found in the Microsoft Product Information Center at http://pinpoint.microsoft.com/en-US/home.

SQL Server 2012 Enterprise Edition will be orderable by April 2, 2012. Actual reseller pricing may vary from the estimated retail price above.

The part number for SQL Server 2012 Enterprise Edition will be set by April 2, 2012.

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at $259.00 call.

This quote is valid for the next 90 days.

Reference ID: TPCE_qhtplylGYLKTVUKfhjjOjhiJhqjLlif85757.

CDW

800.800.4239

Shopping Cart

Item		Quantity	Availability	Unit Price	Item Total
			In Stock		
	NEC AccuSync AS171-BK 17" LCD MFG Part#: AS171-BK CDW Part#: 1994501 UNSPSC: 43211902 Pricing Option Applied: Advertised Price	8		$138.99	$1,111.92
			In Stock		
	Tripp Lite 2m External SAS Cable 4 Channel SFF-8088 to SFF-8088 MFG Part#: S524-02M CDW Part#: 1846505 UNSPSC: 26121604 Pricing Option Applied: Advertised Price	13		$123.99	$1,611.87
			In Stock		
	Belkin 10 meter Multimode LC/LC 62.5/125 Duplex Fiber Optic cable MFG Part#: F2F202LL-10M CDW Part#: 405050 UNSPSC: 26121609 Pricing Option Applied: Advertised Price	4		$29.99	$119.96
			In Stock		
	Tripp Lite 25' Blue Cat5e or Cat5 Snagless RJ45 UTP Patch Cable 25ft MFG Part#: N001-025-BL CDW Part#: 324500 UNSPSC: 26121604 Pricing Option Applied: Advertised Price	5		$6.99	$34.95
			In Stock		
	Tripp Lite 7' Gray Cat5e or Cat5 Snagless Crossover Cable, 7ft, cross over MFG Part#: N010-007-GY CDW Part#: 1321339 UNSPSC: 26121609 Pricing Option Applied: Advertised Price	5		$4.99	$24.95
			In Stock		
	Cisco SD2005 5-port 10/100/1000 Gigabit Switch MFG Part#: SD2005 CDW Part#: 507647 UNSPSC: 43222612 Pricing Option Applied: Advertised Price	3		$54.99	$164.97
			In Stock		
	Tripp Lite 3 Meter OM3 10Gb Aqua 50/125 Multimode Fiber Cable, LC/LC, 10ft MFG Part#: N820-03M CDW Part#: 793221 UNSPSC: 26121604 Pricing Option Applied: Advertised Price	4		$37.99	$151.96

Subtotal: $3,220.58

Tax and shipping will be calculated in checkout.

Lease Option ($100.48 /month)

Items Related to Products in Your Cart

Microsoft Natural Ergonomic Keyboard 4000 for Business	HP LaserJet P2035	APC NetShelter SX 42U AR3100 Server Rack Enclosure - Exclusive Price!	HP LaserJet P2035n Printer ($298.99-$50 Savings=$248.99, Ends 3/14)
Only $44.99	Only $248.99	Only $959.99	Only $248.99

Customers Who Bought Products in Your Cart Also Bought...

StarTech.com USB VGA Multi Monitor External Video Adapter	StarTech.com 6in LP4 to SATA Power Cable Adapter - M/M	APC Back-UPS ES 350 - "Green" 350VA UPS	NEC AccuSync AS192-BK 19" LCD
Only $65.99	Only $3.99	Only $48.99	Only $164.99

This page was printed on 3/14/2012 12:22:19 AM.

http://www.cdw.com/shop/cart/default.aspx?prc=1&printable=1   3/14/2012

Promark TECHNOLOGY

PROMARK TECHNOLOGY, INC.
10900 PUMP HOUSE ROAD
SUITE B
ANNAPOLIS JUNCTION, MD 20701
T: (240) 280-8030   F: (301) 725-7869

QUOTE

Quote #:	0095321
Date:	2/2/2012
Salesperson:	Troy Richards
Customer PO#:	

Quote To:
NEC CORPORATION
KEIICHI YAMADA
c/o NEC Corporation of America
10850 GOLD CENTER DRIVE
Rancho Cordova, CA 95670
Confirm To:
Keiichi Yamada

Ship To:
NEC CORPORATION
10850 Gold Center Drive
c/o NEC Corporation of America
Rancho Cordova, CA 95670

Qty	Part Number	Description	List Price	Unit Price	Ext. Price

**NOTICE: DUE TO SHORTAGES IN DRIVE SUPPLY FROM THE THAILAND FLOODING,
HDD PRICING IS SUBJECT TO SHORT TERM INCREASES WITHOUT NOTICE.
PLEASE CONFIRM PRICING OF STORAGE PRODUCTS AND SYSTEMS PRIOR TO PURCHASE.**

Qty	Part Number	Description	List Price	Unit Price	Ext. Price
22	D3120X000000DA	3120,2RM,NO DRIVES,AC	7,075.00	3,467.00	76,274.00
436	PFRUKF73-01	SSD,LFF,150GB,SLC,SAS,BB,PKG	5,015.00	2,323.00	1,012,828.00
2	PFRUKF31-48	DD,AMS SFF BLANK,48 BULK PACK	1,800.00	864.00	1,728.00
36	PFRUKF31-01	DD,AMS SFF BLANK,FRU,PKG	37.50	18.00	648.00
22	FHDW018-02	RACK MOUNT KIT,SHELF,LONG,ALL HW 25""-36""	245.00	120.00	2,640.00
22	DS3120XPA4D1SW0	3120 7x24 WARR ONSITE SPARES	0.00	2,046.00	45,012.00

QUOTE VALID FOR 60 DAYS

Prices subject to change - We shall not be liable for any loss of profits, business, goodwill, data, interruption of business, nor for incidental or consequential merchantability or fitness of purpose, damages related to this agreement. Minimum 15% restocking fee with original packaging.

SubTotal:	1,139,130.00
Shipping:	0.00
Sales Tax:	0.00
Order Total:	**$1,139,130.00**

If shipping and handling charges are not quoted, standard charges are FOB Shipping Point.

Page: 1