TPC Benchmark™ E
Full Disclosure Report
for
IBM® System x3850 M2
using
Microsoft® SQL Server 2008
Enterprise x64 Edition
and
Microsoft Windows® Server 2008
Enterprise x64 Edition

TPC-E Version 1.5.1

Submitted for Review
September 15, 2008

IBM Corporation

First Edition – September 2008

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Notes

[1] GHz and MHz only measures microprocessor internal clock speed, not application performance. Many factors affect application performance.
[2] When referring to hard disk capacity, GB, or gigabyte, means one thousand million bytes. Total user-accessible capacity may be less.

Abstract

IBM Corporation conducted the TPC Benchmark™ E on the IBM® System x3850 M2 configured as a client/server system. This report documents the full disclosure information required by the TPC Benchmark E Standard Specification, Revision 1.5.1, including the methodology used to achieve the reported results. All testing fully complied with this revision level.

The software used on the IBM System x3850 M2 system includes Microsoft® Windows® Server 2008 Enterprise x64 Edition operating system and Microsoft SQL Server 2008 Enterprise x64 Edition.

Standard metrics, transactions per second-E (tpsE), price per tpsE ($/tpsE) and Availability Date, are reported as required by the TPC Benchmark E Standard Specification.

The benchmark results are summarized in the following table.

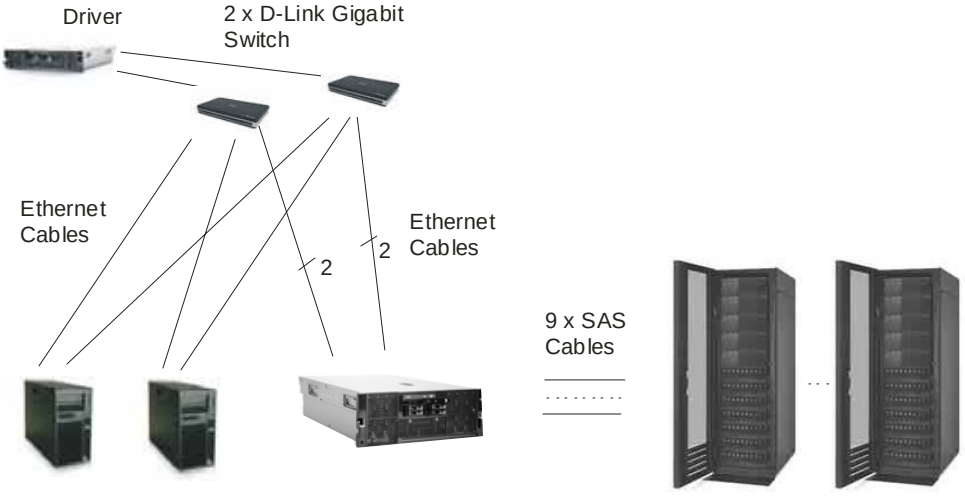
Hardware	Software	Total System Cost	tpsE	$ USD /tpsE	Total Solution Availability Date
IBM System x3850 M2	Microsoft SQL Server 2008 Enterprise x64 Edition Microsoft Windows Server 2008 Enterprise x64 Edition	$ 333,646 USD	729.65	$ 457.27 USD	October 10, 2008

The benchmark implementation and results were audited by Doug Johnson for InfoSizing (www.sizing.com). The auditor's attestation letter is contained in Section 9 of this report.

IBM®	**IBM® System x™ 3850 M2** **Microsoft® SQL Server 2008**		TPC-E Revision 1.5.1 TPC Pricing 1.3.0 Report Date: September 15, 2008
TPC-E Throughput **729.65 tpsE**	Price/Performance **$ 457.27 USD per tpsE**	Availability Date **October 10, 2008**	Total System Cost **$ 333,646 USD**

Database Server Configuration

Operating System	Database Manager	Processors/Cores/ Threads	Memory
Microsoft Windows Server 2008 Enterprise x64 Edition	**Microsoft SQL Server 2008 Enterprise x64 Edition**	**4/24/24**	**128GB**



Tier A - Clients

2 x IBM System x3200 M2
Each contains:
1 x Quad-Core Intel Xeon Processor X3360 2.83GHz (1 Processor, 4 Cores, 4 Threads)
2GB of Memory
2 x 73.4GB SAS Drive (RAID-1 for OS, Onboard RAID Controller, Onboard Gigabit Ethernet)
1 x NetXtreme II 1000 Express

Tier B - Database Server

IBM System x3850 M2
4 x Intel Xeon Processor X7460 2.66GHz (4 Processors, 24 Cores, 24 Threads)
128GB of Memory
5 x IBM ServeRAID-MR10M SAS Controller
Intel PRO/1000 Dual-Port Ethernet Adapter

34 x IBM System Storage EXP3000 Enclosure
2 x EXP3000s each contains:
8 x 15K rpm drives for a total of 16 drives arrayed as:
1 x 16-Disk (73.4GB) RAID-10
32 x EXP3000s each contains:
12 x 15K rpm drives for a total of 384 drives arrayed as:
16 x 24-Disk (73.4GB) RAID-5

Initial Database Size	Redundancy Level: 1	Storage
2,821 GB	**RAID-10 Log + RAID-5 Data**	**400 x 73.4 GB Drives**

IBM System x3850 M2
Microsoft SQL Server 2008

TPC-E Revision 1.5.1
TPC Pricing Spec 1.3.0

Report Date:
September 15, 2008

Availability Date:
October 10, 2008

Description	Part Number	Price Source	Unit Price	Quantity	Extended Price	3-Yr. Maint. Price
Server Hardware						
x3850 M2 with 2 x Intel Xeon Processor X7460 (2.66GHz / 9MB L2 Cache / 16MB L3 Cache) 4 Memory Cards, 8 x 1GB DIMM	72336RU	1a	16,539	1	16,539	
Intel Xeon Processor X7460 (2.66GHz/16MB L3 Cache)	44E4473	1a	4,469	2	8,938	
8GB (2x4GB) PC2-5300 CL5 ECC DDR2 SDRAM	41Y2768	1	849	16	13,584	
73GB 15K 2.5" Hot-Swap SAS SFF	43X0837	1	369	2	738	
IBM ServeRAID-MR10M SAS/SATA Controller	43W4339	1	899	5	4,495	
Intel PRO/1000 Dual-Port Ethernet Adapter	39Y6126	1	229	1	229	
IBM T115 15-inch TFT Display	494215U	1a	209	1	209	
IBM Preferred Pro USB Keyboard	40K9584	1	29	1	29	
IBM 3-Button Optical Mouse - Black - USB	40K9201	1	19	1	19	
ServicePac for 3-Year 24x7x4 Support (x3850 M2)	10N3059	1	1,695	1		1,695
ServicePac for 3-Year 24x7x4 Support (Display)	10N3110	1	90	1		90
				Subtotal	44,780	1,785
Server Storage						
IBM S2 42U Standard Rack	93074RX	1	1,489	3	4,467	
IBM System Storage EXP3000 Enclosure	1727-01X	1	3,199	34	108,766	
IBM 1M SAS cable	39R6529	1	119	25	2,975	
IBM 3M SAS cable	39R6531	1	135	9	1,215	
IBM Hot-Swap 3.5 inch 73.4GB 15K SAS HDD	43W7523	1	329	400	131,600	
ServicePac for 3-Year 24x7x4 Support (EXP3000)	41L2768	1	760	34		25,840
ServicePac for 3-Year 24x7x4 Support (Rack)	41L2760	1	300	3		900
				Subtotal	249,023	26,740
Server Software						
Microsoft SQL Server 2008 Enterprise x64 Edition	810-07507	2	24,999	4	99,996	
Microsoft Windows Server 2008 Enterprise x64 Ed.	P72-03168	2	3,999	1	3,999	
Microsoft Problem Resolution Services	N/A	2	245	1		245
				Subtotal	103,995	245
Client Hardware						
x3200 M2 with Intel Xeon X3360 (2.83GHz/12MB L2 Cache) and 2GB (2x1GB) PC2-5300 CL5 ECC DDR2 SDRAM	436772U	1	2,235	2	4,470	
73GB 15K 3.5" Hot-Swap SAS	43W7523	1	329	4	1,316	
NetXtreme II 1000 Express Ethernet Adapter	39Y6066	1	169	2	338	
ServicePac for 3-Year 24x7x4 Support (x3200 M2)	51J9054	1	399	2		798
				Subtotal	6,124	798
Client Software						
Microsoft Windows Server 2008 Standard x64 Edition	P73-04165	2	999	2	1,998	
				Subtotal	1,998	0
Infrastructure						
D-Link DGS-2208 10/20/100/1000/2000Mbps Switch (2 spares)	DGS-2208	3	48	4	192	
Ethernet Cable (2 spares)	A3L791-10-BLK	3	5	12	60	
				Subtotal	252	0
				Total	406,172	29,568
IBM Large Purchase Discount (See Note 1.)	30.82%	1			93,561	
Microsoft Open Program Discount Schedule	8.05%	2			8,533	

Pricing: 1 - IBM - 1-888-SHOP-IBM, ext. 5821; 2 - Microsoft; 3 - newegg.com
Note 1: Discount applies to all line items where Pricing=1; pricing is for these or similar quantities. Discount for similarly sized configurations will be similar to those quoted here but may vary based on the components in the price quotation

Three-Year Cost of Ownership USD:	$333,646
TPC-E Throughput:	729.65
$ USD/tpsE:	$457.27

Implementation and results audited by Doug Johnson for InfoSizing, Inc. (www.sizing.com)

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

IBM System x3850 M2
Microsoft SQL Server 2008

TPC-E Revision 1.5.1
TPC Pricing Spec 1.3.0

Report Date:
September 15, 2008

Availability Date:
October 10, 2008

Reported Throughput: 729.65 tpsE	**Configured Customers: 365,000**

Response Time (in seconds)	**Minimum**	**Average**	**90Th Percentile**	**Maximum**
Broker-Volume	0.00	0.03	0.06	2.17
Customer-Position	0.00	0.02	0.04	2.87
Market-Feed	0.00	0.03	0.07	6.56
Market-Watch	0.00	0.02	0.04	0.42
Security-Detail	0.00	0.01	0.02	0.44
Trade-Lookup	0.00	0.62	0.83	2.06
Trade-Order	0.00	0.06	0.12	6.57
Trade-Result	0.00	0.06	0.11	3.28
Trade-Status	0.00	0.02	0.04	0.45
Trade-Update	0.01	0.73	0.90	9.35
Data-Maintenance	0.00	0.07	N/A	0.36

Transaction Mix	**Transaction Count**	**Mix %**
Broker-Volume	2,573,376	4.900
Customer-Position	6,827,759	13.000
Market-Feed	525,354	1.000
Market-Watch	9,453,457	17.999
Security-Detail	7,352,956	14.000
Trade-Lookup	4,201,284	7.999
Trade-Order	5,304,816	10.100
Trade-Result	5,253,495	10.002
Trade-Status	9,979,273	19.000
Trade-Update	1,050,354	2.000
Data-Maintenance	120	N/A

Test Duration and Timings	
Ramp-up Time	00:43:00
Measurement Interval	02:00:00
Business Recovery Time	00:47:22.37
Total Number of Transactions Completed in Measurement Interval	52,522,124

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Clause 0 – Preamble

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

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

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

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

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

The benchmark defines:

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

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

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

the associated price-per-tpsE, and the **Availability Date** of the **Priced Configuration** (See Clause 6.7.3 for more detail).

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

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

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

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

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

Clause 1 – Introduction

Benchmark Sponsor

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

This benchmark was sponsored by IBM Corporation.

Configuration Diagrams

Diagrams of both the measured and priced configurations must be reported, accompanied by a description of the differences. A description of the steps taken to configure all of the hardware and software must be reported.

The measured and priced configurations were the same in this benchmark. The configuration diagram is provided on the following page.

The TPC-E Driver used for these TPC Benchmark E tests is a Microsoft proprietary Driver. The Driver software needed to implement the Driving & Reporting is run on an IBM system x3850 M2 machine that is not part of the SUT. The Driver communicates with Tier A over an Ethernet network using the Driver machine's onboard 1Gb Ethernet card.

Tier A is on two IBM System x3200 M2 servers, each with one Quad-Core Intel® Xeon® Processor X3360 (2.83GHz with 12MB L2 cache), 2GB of memory, two internal 73GB SAS drives in a RAID-1 array for the operating system, which is Microsoft Windows Server 2008 Standard x64 Edition. Tier A communicates with Tier B and the Driver over an Ethernet network using the IBM System x3200 M2's onboard 1Gb Ethernet card and one NetXtreme II 1000 Express Ethernet Adapter.

Tier B is on an IBM System x3850 M2. The x3850 M2 has:

- Four Intel Xeon Processor X7460 (2.66GHz with 9MB L2 cache and 16MB L3 cache)
- 128 GB of memory
- Two 73GB 15K rpm 2.5-inch Hot-Swap SAS SFF internal drives in a RAID-1 array for the operating system, which is Microsoft Windows Server 2008 Enterprise x64 Edition with Microsoft SQL Server 2008 Enterprise x64 Edition
- One Intel PRO/1000 PT Dual-Port Server Adapter
- One onboard Broadcom dual-port 1Gb Ethernet card.
- Five IBM ServeRAID-MR10M SAS Controllers

One IBM ServeRAID-MR10M SAS controller is used for the log file while others (four) are for the data files. Each IBM ServeRAID-MR10M controller has 2 ports. For the data files both 2 ports were used, each port of controller has one SAS 3m cable connected directly to four IBM EXP3000 enclosures. Each EXP3000 disk enclosure has twelve 15Krpm drives. Total 384 drives are organized as sixteen 24-Disk RAID-5 arrays for the database data. For the log file, only one port was used. The SAS cabe is connected directly to 2 IBM EXP3000 enclosures. Each EXP3000 disk enclosure has eight 15K rpm drives. The 16 drives are organized as one 16-Disk RAID-10 array for the database log.

Each array is seen as one LUN by the operating system on the x3850 M2. In Windows Disk Manager each of the LUNs from the RAID-5 arrays is configured to have a RAW partition for the fixed and scaling tables and another RAW partition for the growing tables. The rest of the space on the LUN is an NTFS partition used for DB backups and the temp DB.

Tier B communicates with Tier A over an Ethernet network using the Intel Pro/1000 PT Dual-Port Server Adapter and onboard Ethernet controller. Four Ethernet cables come out of server and runs to two D-Link 8-port Ethernet switches that also has the Ethernet cables from the Tier A and Driver machines.

Measured and Priced Configuration

The measured and priced configurations were identical as shown in Figure 1-1.

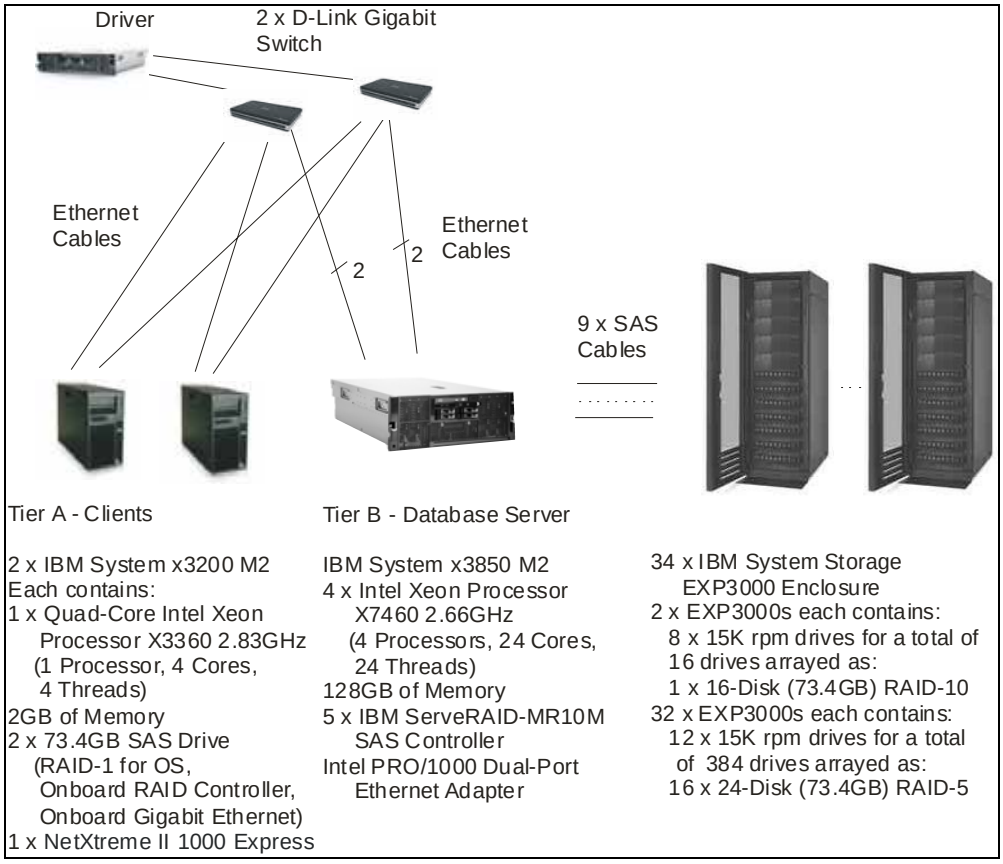

Figure 1-1. Measured and Priced Configuration

Hardware and Software Configuration Steps

*A description of the steps taken to configure all the hardware must be **reported** in the **Report**.*
*A description of the steps taken to configure all the software must be **reported** in the **Report**.*

Driver

The Driver is not part of the priced configuration/System Under Test. For this result an IBM System x3850 M2 machine running Microsoft Windows Server 2008 Enterprise x64 Edition was used. The Microsoft Benchcraft proprietary driver was installed on the machine. Two Ethernet cables were run from the machine's onboard Ethernet controller to the two D-Link switches.

Tier A

The IBM System x3200 M2 comes with one Quad-Core Intel Xeon X3360 Processor and 2GB of memory. Insert two 73.4GB SAS drives. During POST press Ctrl-C when prompted to drop into the LSI Logic Config Utility to configure the drives. Select onboard LSI controller 1064E.

1. RAID Properties

2. Create IM Volume
3. Arrow over to the RAID Disk column, use the space bar to toggle from No to Yes for both onboard SAS drives.
4. D to overwrite existing data
5. 69618MB, C to create.
6. Create and Save new array.
7. Save changes and exit the menu
8. RAID Properties
9. Manage Array
10. Synchronize Array, Y start array synchronization and exit this menu
11. Exit the configuration utility and reboot the x3200 M2.

The IBM System x3200 M2 will restart. Boot from the installation CD for Microsoft Windows Server 2008 Standard x64 Edition. Once the operating system is installed, add one NetXtreme II 1000 Express Ethernet Adapter at each Tier A machine. Then install the Broadcom Ethernet card's device driver using the Broadcom-provided executable, which is run from a USB memory stick. The executable can be downloaded from www.ibm.com. When the Ethernet card's device driver is installed, set a static IP address 192.168.50.226 for onboard Broadcom adapter and 192.168.122.30 for the NetXtreme II 1000 Express Ethernet Adapter on the first IBM System x3200 M2. On the second IBM System x3200 M2 set a static IP address 192.168.50.227 for onboard Broadcom and 192.168.122.40 for the NetXtreme II 1000 Express Ethernet Adapter. Connect Ethernet cables from the 190.168.50.226 and 192.168.50.227 ports. The other end of the Ethernet cables will be connected to a D-Link switch which has Ethernet connections to the Driver and Tier B machine. Connect Ethernet cables to the 192.168.122.30 and 192.168.122.40 ports. The other end of each of the Ethernet cable connects to the second D-Link switch, which has connections to the Driver and Tier B machine. Install the Microsoft SQL Server Workstation components (client), SUT_CE_Server.exe and SUT_MEE_Server.exe.

External storage subsystem

Log file

Before powering on two EXP3000 enclosures, load each enclosure with eight 73.4GB SAS drives. Connect these two EXP3000 with one SAS 1m cable, from the "in" port of top EXP3000 to the "out" port of bottom EXP3000. Then run another SAS 3m cable from IBM ServeRAID-MR10M controller to the "in" port of the bottom EXP3000.

Data files

Before powering on 32 EXP3000 enclosures, load each enclosure with twelve 73.4GB SAS drives. Separate them into eight groups; each group has four EXP3000 enclosures. Connect these four EXP3000 with three SAS 1m cables, from the "in" port of the top EXP3000 to the "out" port of next EXP3000. Continue until you reach the bottom EXP3000. Then run another SAS 3m cable from one port of the IBM ServeRAID-MR10M controller to the "in" port of the bottom EXP3000. Each IBM ServeRAID-MR10M has two ports. So four IBM ServeRAID-MR10M will connect eight groups (or 32 EXP3000 enclosures).

Power on the EXP3000s and the IBM System x3850 M2. Download MegaRAID Storage Manager from the IBM Web site. Install MegaRAID Storage Manager on the x3850 M2. In MegaRAID Storage Manager, you will see five IBM ServeRAID-MR10M SAS controllers. Right click on each adapter to select Configuration → Configuration Wizard.

Log file

1. Select "Manual Configuration" from a pop-up window; then click "Next."

2. In the new window, two enclosures each with eight drives are shown at the left pane. Select one drive from each enclosure; then click "Add." These two drives will be moved to the right pane as a new array. Click "Accept" to accept the move.
3. Go back to the left pane to select another two drives from each enclosure and click Accept after they are moved to the right pane. Repeat this procedure eight times until all drives have been moved to the right pane. It should have eight arrays each with two drives. Click "Next."
4. In the new window, select all eight new arrays at the same time.
5. At the Virtual Disk Properties, change the settings as follows:
    a. RAID Level: RAID 10
    b. Volume Name: Log
    c. Read Policy: Adaptive Read Ahead
    d. Default Write Policy: Write Through
    e. Disk Cache Policy: Enabled
6. Click "Accept," then "Next," then "Finish" to complete the configuration.

A log file of 549312MB with RAID-10 is now ready to use.

Data files

7. Select "Manual Configuration" from a pop-up window; then click "Next."
8. In the new window, eight enclosures each with 12 drives are shown at the left pane. Select 24 drives from two enclosures; then click "Add." These 24 drives will be moved to the right pane as a new array. Click "Accept" to accept the move.
9. Go back to the left pane to select another 24 drives from two enclosures and click Accept after they are moved to the right pane. Repeat this procedure four times until all drives have been moved to the right pane. The right pane should have four arrays each with 24 drives. Click "Next."
10. In the new window, select one array at a time.
11. Then at the Virtual Disk Properties, change the settings as follows:
    f. RAID Level: RAID 5
    g. Volume Name: Datafile_x (x from 1 to 16)
    h. Read Policy: No Read Ahead
    i. Default Write Policy: Write Through
    j. Disk Cache Policy: Enabled
12. Click "Accept," then "Next," then "Finish" to complete the configuration

Sixteen arrays, each with 1579272MB with RAID-5 are ready to use.

IBM System x3850 M2

The IBM System x3850 M2 comes with two Intel Xeon X7460 processors, eight 1GB DIMMs, four memory cards and an onboard dual-port Broadcom Ethernet card. Open the x3850 M2, and perform these steps:

1. Install two more Intel Xeon X7460 Processors.
2. Remove the eight 1GB DIMMs and install thirty-two 4GB DIMMs.
3. Install Intel Pro/1000 PT Dual-Port Ethernet Adapter in PCI-E slot 4.
4. Run Ethernet cables from the first port of Broadcom and the first port of Intel Pro/1000 PT Ethernet Adapter to the first D-Link switch; from the second port of Broadcom and the second port of Intel Pro/1000 PT Ethernet Adapter to the second D-link switch. Both switches have connections to the Tier A and Driver machines.
5. Close the x3850 M2.
6. Insert the two 73GB 10K rpm 2.5" Hot-Swap SAS SFF drives in the front of the x3850 M2.
7. Plug the power cords into the back of the machine.
8. Press the switch power switch on the front of the x3850 M2 to start it.

Press F1 while the x3850 M2 is going through POST. This causes the server to drop into BIOS Setup. In BIOS Setup change the following from their default values:

1. Set the correct date and time.
2. In Devices and I/O Ports, disable "High Precision Event Timer (HPET)."
3. In Start Options set the Startup Sequence to CD ROM, Diskette Drive 0, Hard Disk 0, Disabled.
4. Still in Start Options disable Planar Ethernet PXE/DHCP.
5. In Advanced Setup – Memory Settings – ensure that the Memory Array Setting is High Performance Memory Array.
6. In Advanced Setup – CPU Options, disable the following: Active Energy Manager, Processor Performance States, Processor Adjacent Sector Prefetch, Processor Hardware Prefetcher, Intel Virtualization Technology, and Processor DCU Prefetcher. Enable the following: Processor Execute Disable Bit, Processor IP Prefetcher and C1E. Leave the Clustering Technology in Logical Mode.
7. In Advanced Setup – Advanced PCI Settings, disable PCI ROM Control Execution for the seven PCI-E slots.

Save the BIOS changes and restart the x3850 M2.

During POST on the x3850 M2, when the LSI banner is displayed, press Ctrl-C. The LSI Logic Config Utility will come up. Create a RAID-1 array from the two onboard SAS drives.

12. SAS1078
13. RAID Properties
14. Create IM Volume
15. Arrow over to the RAID Disk column, use the space bar to toggle from No to Yes for both onboard SAS drives.
16. D to overwrite existing data
17. 69618MB, C to create.
18. Create and Save new array.
19. Save changes and exit the menu
20. RAID Properties
21. Manage Array
22. Synchronize Array, Y start array synchronization and exit this menu
23. Exit the configuration utility and reboot the x3850 M2.

Insert the Microsoft Windows Server 2008 Enterprise x64 Edition DVD in the x3850 M2's DVD/CDROM drive. Boot the x3850 M2 from the DVD.

1. Select Boot section 0
2. Language to install – English
3. Time and currency formtat – English (United States)
4. Keyboard or input method – U.S. [Next]
5. [Install Now]
6. Enter Product Key
7. Deselect "Automatically activate Windows when I'm online." [Next]
8. Windows Server 2008 Enterprise (Full Installation) x64 [Next]
9. Check "I accept the license terms" [Next]

10. Custom (advanced) install not upgrade
11. Where do you want to install Windows?
12. Disk 0 Unallocated Space 68.0GB
13. Drive Options (advanced)
14. New 69618 MB [Apply]
15. Disk 0 Partition 1 68.0GB Primary
16. [Next]
17. Installing Windows… That's all the information we need right now. Your computer will restart several times during installation.
18. Before the first reboot remove the DVD. There are two reboots.
19. After the second reboot the following message is displayed: "The user's password must be changed before logging on the first time" [OK]
20. Set a new secure password for the Administrator
21. The "Initial Configuration Tasks" window is displayed. On the Date and Time tab set the Time Zone to GMT-05:00 Eastern Time (US & Canada) [OK]
22. Internet Time tab [Change settings…], uncheck "Synchonize with an internet time server [OK] [OK]
23. Configure networking – Windows saw the Intel Pro/1000 PT Daul-port Server Adapter and installed a default driver, we upgraded them to v9.12.17.0 which can be downloaded from Intel website.
24. From "Control Panel" → "Network and Sharing Center" → "Manage network connections". Pick the first port of Intel Pro/1000 PT adapter then right click "Properties" . select "Intel Protocol version 4 (TCP/IPv4)" and "Properties". Check the radio button "Use the following IP address"; enter IP address 192.168.50.202 with a subnet mask of 255.255.255.0 [OK] [Close]; close the Networks folder.
25. Repeat steps 24 for the second port with an IP address 192.168.122.102.
26. Need to download firmware (v2.08a) and driver (v4.4.11) from IBM website for the onboard Broadcom to function. Run these two .exe files which will detect the onboard Broadcom then update the firmware and driver automatically. Reboot the server.
27. After the server comes up, assign 192.168.50.201 at the first port and 192.168.122.101 for the second port.
28. Provide computer name and domain – Computer description – TPC-E Athena Win2008 [Change] computer name – Dunnington4P [OK]. A message is displayed that says the server must be restarted for the change to take effect so save open files. [OK]. Still in "System Properties" "Computer Name" tab click the "Advanced" tab.
29. On the "Advanced" tab - Performance – [Settings…] – Visual Effects tab – check radio button for "Adjust for best performance". On the "Advanced" leave the radio button for background services checked.
30. Data Execution Prevention tab the default is DEP for all programs and services except those I select" [OK]. Close the Performance Options Window.
31. Startup and Recovery – [Settings…] – change the time to display a list of operating systems to 10 seconds instead of the default 30 seconds. In the System Failure section uncheck "Automatically restart". Change "Write debugging information" to "(none)". [OK]
32. In the System Properties Window change from the "Advanced" tab to the "Remote" tab.
33. Check the radio button to "Allow connections from computers running any version of Remote Desktop".
34. A warning about enabling Remote Desk making the server less secure is displayed. [OK] [Close]

35. A message saying the computer must be restarted to apply these change is displayed. [Restart later]
36. Back in Initial Configuration Tasks window. “2 Update This Server” – “Enable automatic updating and feedback – [Manually configure settings]
37. Manually Configure Settings window – Windows automatic updating [Change Setting…] – check the radio button for “Never check for updates” – [OK]
38. Windows Error Reporting – [Change Setting…] – check the button “I don’t want to participate, and don’t ask me again” – [OK]
39. Customer Experience Improvement Program – check the button “No, I don’t want to participate” – [OK] [Close]
40. Download and install updates – leave as no checking for updates
41. Windows Firewall – Change settings – Advanced tabe – Network Connections – uncheck. General tab – check the button “Off” – [Apply] [OK]
42. gpedit.msc (Global Policy Manager) – Computer Configuration – Windows Settings – Security Settings – Account Policies – Password Policy – Password must meet complexity requirements – disable – Maximum Password age – change from 42 to 0, which means your password never expires.
43. Still in gpedit.msc – Computer Configuration – Administrative Templates – System – right panel – Display shutdown event tracker – disable
44. Still in gpedit.msc – Computer Configuration – Windows Setting – Security Settings – Local Policies – User rights assignment – lock pages in memory add Administrators group.
45. Back on the initial settings page – check “do not show again.”
46. Restart, after restart change the Administrator’s password to a simple password.
47. Personal Settings – Screen Saver – Screen Save – (none) – Change power settings… - select the “High Performance” power plan – Choose when to turn off the display – Never – [Save Changes]
48. Sounds – Sound scheme – No Sounds – uncheck “Play Windows Startup Sound” [OK]
49. Move some icons onto my tool bar (e.g., Windows Explorer, command window, calculator, notepad).
50. Server Manager – Services – change the following services to Manual – Cryptographic Services, DHCP Client, DNS client, Print Spooler, Remote Registry, Windows Update, Windows Error Reporting Service.
51. Check that HKLM\SYSTEM\CurrentControlSet\Services\Lanman Server\Parameters – Size = 3.
52. Update my hosts file in c:\windows\system32\drivers\etc.

SQL Server Installation

Install Microsoft SQL Server 2008 Enterprise x64 Edition.

1. First, install prerequisites such as .net framework and hot fix. Reboot the server.
2. SQL Server Installation Center – New Standalone Installation
3. Setup Support rules – Passed: 5 Failed: 0, Warning 0 Skipped 0 [OK]
4. Product Key – Enter the key for Enterprise Edition, accept the license terms [Next]
5. Setup support files [install] – Passed: 9 Failed: 0, Warning 2 Skipped 0 [Next]
6. Feature Selection – check Database Engine Services
7. Shared Features – check Client Tools and Visual Configuration tools [Next]
8. Instance Configuration – check Default instance, MSSQLServer, C:\Program Files\Microsoft SQL Server [Next]
9. Service Accounts – SQL Server Agent left as manual, change SQL Server (MSSQL..) from automatic to manual, change SQL Server Browser from Disabled to Manual, picked Administrator as the account and applied it to all [Next]

10. Collation – check Windows Collation designator and sort order, Collation designation – Latin1_General, check Binary sort order [OK]
11. Database Engine Configuration – Account Provisioning tab – check Mixed Mode, Built-in SQL Server system administrator account, enter sa password and confirm the password. Specify SQL Server administrators – [Add Current User] – Dunnington4p\Administrator
12. Left the defaults on Data Directories and FILESTREAMING tabs [Next]
13. Error and Usage Reporting – uncheck "Send error reports to Microsoft or your corporate report server" and "Send anonymous feature usage data to Microsoft," [Next]
14. Ready to Install [Install]
15. Shows progress, when finished [Next]
16. Installation complete so [Close]

SQL Server softNUMA node configuration

- To do so edit the registry:
  - `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Microsoft SQL Server\100\NodeConfiguration`
  - Add keys named "Node0", "Node1".
  - Under each of those keys, add a DWORD value called "CPUMask" and set it to the CPU mask of the node.
    - For example:
      - `Node0 -> CPUMask = 0x0030000F`
      - `Node1 -> CPUMask = 0x000C00F0`
      - `Node2 -> CPUMASK = 0x00030F00`
      - `Node3 -> CPUMASK = 0x00C0F000`

- Now configure the TCP/IP ports so that one listens for each softNUMA node
  - Open the SQL Server Configuration Manager
  - Expand the SQL Server Network Configuration
  - Select "Protocols for MSSQLSERVER"
    - Shared Memory and TCP/IP should be enabled; the rest disabled
    - Open TCP/IP, Protocol tab
      - Enabled = yes
      - KeepAlive = 30000
      - Listen All = Yes
    - IP Addresses Tab
      - IPx (IP1, IP2, IP3, etc.) should all be disabled (they are only used if ListenAll = No)
      - IPAll
        - TCP Port. This is where you set the port->softNUMA node affinities. In this benchmark we use
        - `1433,1434[0x1],1436[0x2]`,1438[0x4],1440[0x8]

Connect x3850 M2 to External Storage

Power off the x3850 M2.

Install five IBM ServeRAID-MR10M SAS controllers in PCI-E slot 1, 3, 5, 6 and 7. The first four controllers are for data files and the last one is for the log file.

Run a SAS 3m cable from one port of IBM ServeRAID-MR10M SAS controllers to the "in" port of the bottom IBM EXP3000 enclosure which connects to other EXP3000s with other SAS 1m cables.

Power on the x3850 M2. Download MegaRAID Storage Manager, and the latest firmware and driver for IBM ServeRAID-MR10M from IBM website. Install MegaRAID Storage Manager on the x3850 M2. Use MegaRAID Storage Manager to flash the firmware. Open Device Manager and under the Storage Controllers find the SAS controller. Update the driver for SAS controller. Reboot the x3850 M2.

Mount Points and Disk Partitions

1. In a command window, create mount points:
   - c:
   - cd \
   - rc16.bat (rc16.bat provided in the SupportingFiles)

2. Open Windows Disk Manager.

3. If the Wizard prompts you to initialize disks, do so; don't upgrade the disks.

4. From a command prompt, run diskpart.exe /s create_dataPartitions.txt (create_dataPartitions.txt provided in the SupportingFiles).

5. From a command prompt, run diskpart.exe /s create_logPartition.txt (create_logPartition.txt provided in the SupportingFiles).

6. From a command prompt, run formtBackup.bat (formtBackup.bat provided in the SupportingFiles).

7. Close Windows Disk Manager: the disk partitions for the database have been created.

SQL Server configuration

Start Microsoft SQL Server from the command line using sqlservr –c –T3502.

Run runconfig.sql to set the SQL Server sp_configure settings (the file is included in the SupportingFiles). Run tempdb.sql to increase the size of the temporary database, which is used during database load (the file is included in the SupportingFiles).

Shutdown SQL Server. Start Microsoft SQL Server 2008 – Configuration Tools – SQL Server Configuration Manager - SQL Server Network Configuration - Protocols for MSSSQLSERVER – check Shared Memory, Named Pipes and TCP/IP are enabled.

Clause 2 –Database Design, Scaling and Population Related Items

Database Creation and Table Definitions

A description of the steps taken to create the database for the Reported Throughput must be reported in the Report.

Create a folder 365,000.cust\database. In the folder, create a create_database.sql script to create a TPC-E database with two filegroups. One filegroup called fixed_fg for the fixed and scaling TPC-E tables and the other filegroup called growing_fg for all growing TPC-E tables. fixed_fg uses all the c:\mp\fx* disk partitions. growing_fg uses all the c:\mp\gw* disk partitions. The database log is on E:. Modify the files provided by Microsoft:

- Create_Tables_Fixed.sql
- Create_Tables_Growing.sql
- Create_Tables_Scaling.sql
- Create_Tables_Scaling_Flat.sql
- 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

by replacing misc_fg, market_fg, broker_fg and customer_fg with fixed_fg or growing_fg.

Run the Microsoft file TPCE_Setup.cmd to start the database load (the file is included in the SupportingFiles). When prompted, fill in 365,000 for the number of customers to be loaded. TPCE_Setup.cmd calls files that are included in the SupportingFiles to create and load the TPC-E database.

Database Physical Organization

The physical organization of tables and indexes 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.

Horizontal/Vertical Partitioning

While there are few restrictions placed upon horizontal or vertical partitioning of tables and rows in the TPC-E benchmark, any such partitioning must be reported.

Partitioning was not used in this benchmark. However, the TPC-E tables were distributed over multiple disk arrays by SQL Server because the file groups were spread over 16 disk arrays.

Replication

Replication of tables, if used, must be reported in the Report.

Replication was not used in this benchmark.

Table Attributes

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

No additional attributes were used in this benchmark.

Cardinality of Tables

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

The database was built with 365,000 customers. Table 2-1 is on the following page.

Table Name	Rows
ACCOUNT_PERMISSION	2,591,143
ADDRESS	547,504
BROKER	3,650
CASH_TRANSACTION	5,802,618,211
CHARGE	15
COMMISSION_RATE	240
COMPANY	182,500
COMPANY_COMPETITOR	547,500
CUSTOMER	365,000
CUSTOMER_ACCOUNT	1,825,000
CUSTOMER_TAXRATE	730,000
DAILY_MARKET	326,282,625
EXCHANGE	4
FINANCIAL	3,650,000
HOLDING	322,972,999
HOLDING_HISTORY	8,452,751,589
HOLDING_SUMMARY	18,158,641
INDUSTRY	102
LAST_TRADE	250,025
NEWS_ITEM	365,000
NEWS_XREF	365,000
SECTOR	12
SECURITY	250,025
SETTLEMENT	6,307,200,000
STATUS_TYPE	5
TAXRATE	320
TRADE	6,307,200,000
TRADE_HISTORY	15,137,288,850
TRADE_REQUEST	0
TRADE_TYPE	5
WATCH_ITEM	36,547,719
WATCH_LIST	365,000
ZIP_CODE	14,741

Table 2-1. Initial Cardinality of Tables

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.

The IBM System x3850 M2 has 7 PCI-E slots. Four IBM ServeRAID-MR10M SAS Controllers used for data files were put in PCI-E slots 1, 3, 5, and 6. Each SAS controller has two ports, each port connects to four IBM EXP3000 enclosures. Each enclosure has twelve 73.4GB 15K rpm SAS drives. A total of 384 drives were used and were organized as sixteen 24-disk arrays with RAID-5 and write-through policy.

Another IBM ServeRAID-MR10M SAS Controller was installed in PCI-E slot 7 to connect two IBM EXP3000 enclosures with a SAS cable. Each EXP3000 has eight 73.4GB SAS drives. A total of 16 drives were used as the log file with RAID-10 and write-through policy.

Table 2-2 depicts the database configuration of the measured and priced systems to meet the 8-hour steady state requirement.

Table 2-2. Data Distribution for the Measured and Priced Configuration

Disk #	Controller #	Slot #	Drives Enclosure model RAID level	Partition/file system	Size	Use
0	1	1	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx1 (RAW) c:\mp\gw1 (RAW) c:\mp\bk1: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 1 Growing 1 Backup1
1	1	1	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx2 (RAW) c:\mp\gw2 (RAW) c:\mp\bk2: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 2 Growing 2 Backup2
2	1	1	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx3 (RAW) c:\mp\gw3 (RAW) c:\mp\bk3: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 3 Growing 3 Backup3
3	1	1	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx4 (RAW) c:\mp\gw4 (RAW) c:\mp\bk4: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 4 Growing 4 Backup4
4	2	3	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx5 (RAW) c:\mp\gw5 (RAW) c:\mp\bk5: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 5 Growing 5 Backup5
5	2	3	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx6 (RAW) c:\mp\gw6 (RAW) c:\mp\bk6: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 6 Growing 6 Backup6

6	2	3	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx7 (RAW) c:\mp\gw7 (RAW) c:\mp\bk7: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 7 Growing 7 Backup7
7	2	3	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx8 (RAW) c:\mp\gw8 (RAW) c:\mp\bk8: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 8 Growing 8 Backup8
8	3	5	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx9(RAW) c:\mp\gw9 (RAW) c:\mp\bk9: (NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 9 Growing 9 Backup9
9	3	5	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx10(RAW) c:\mp\gw10(RAW) c:\mp\bk10(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 10 Growing 10 Backup10
10	3	5	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx11(RAW) c:\mp\gw11(RAW) c:\mp\bk11(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 11 Growing 11 Backup11
11	3	5	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx12(RAW) c:\mp\gw12(RAW) c:\mp\bk12(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 12 Growing 12 Backup12
12	4	6	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx13(RAW) c:\mp\gw13(RAW) c:\mp\bk13(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 13 Growing 13 Backup13
13	4	6	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx14(RAW) c:\mp\gw14(RAW) c:\mp\bk14(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 14 Growing 14 Backup14
14	4	6	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx15(RAW) c:\mp\gw15(RAW) c:\mp\bk15(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 15 Growing 15 Backup15
15	4	6	24 X 73.4GB SAS EXP3000 Enclosure RAID-5	c:\mp\fx16(RAW) c:\mp\gw16(RAW) c:\mp\bk16(NTFS)	5.00GB 209.79GB 1327.47GB	Fixed 16 Growing 16 Backup16
16	5	7	16 X 73.4GB SAS EXP3000 Enclosure RAID-10	E: (RAW)	390.64GB	DB Log
17	onboard LSI	N/A	2 X 73GB SAS onboard x3850 M2 RAID-1	C: (NTFS)	67.99GB	OS

Database Interface and Model Implemented

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

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

Microsoft SQL Server 2008 Enterprise x64 Edition is a relational database. The interface used was Microsoft SQL Server stored procedures accessed with Remote Procedure Calls embedded in C++ code using the Microsoft ODBC interface.

Database Load Methodology

The methodology used to load the database must be reported in the Report.

The database was loaded using the flat files option on the EGenLoader command line. This will generate flat files first then used bulk insert the data into the tables. A further description is provided in the SupportingFiles in the file MSTPCE Database Setup Reference.pdf.

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 3.2.1.5) must be reported.

The SQL in the stored procedures for the transactions is functionally equivalent to the pseudo-code.

Database Footprint of Transactions

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

The database footprint requirements are met by the stored procedure code for the transactions.

Clause 4 – SUT, Driver and Network Related Items

EGen Instances

The number of EGenDriverMEE and EGenDriverCE instances used in the benchmark must be reported (see Clause 4.1.3).

A total of 625 EGenDriverCE instances was used in the benchmark. Four EGenDriverMEE instances were used in the benchmark.

Network Configuration

The Network configurations of both the measured and priced configurations must be described and reported. 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).

The Network configurations of both the measured and priced configurations were the same. The Driver machine used two ports of the onboard Gigabit Ethernet card. One port's IP address was 192.168.50.212. The port was connected to one D-Link switch via an Ethernet cable. Other Ethernet cables ran from the D-Link Switch to a port in the IBM System x3200 M2 machines that were used as the Tier A machines. That port on one x3200 M2 was configured with the IP address 192.168.50.226, and 192.168.50.227 on the other x3200 M2. The network connection between the port with IP address 192.168.50.212 on the Driver and the ports with IP addresses 192.168.50.226 nd 192.168.50.227 on the Tier A machines was the mandatory network.

There was also a network connection between the Tier A machines and the Tier B machine. The Tier B machine was the x3850 M2. The port on the Intel Pro/1000 PT Adapter in the x3850 M2 was configured with IP address 192.168.50.201/202 and was connected via an Ethernet cable to the D-Link switch.

Tier A used ODBC calls to Tier B.

Clause 5 – EGen Related Items

EGen Version

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

EGen v1.5.1 was used in the benchmark.

EGen Code and Modifications

A statement that all required TPC-provided EGen code was used in the benchmark must be reported. 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. If any of the changes to EGen do not have a formal waiver, that must also be reported. If the Test Sponsor extended EGenLoader, the use of the extended EGenLoader and the audit of the extension code by an Auditor must be reported (see Clause 5.7.3).

All required TPC-provided EGen code was used in the benchmark. EGen was not modified for use in this benchmark. EGenLoader was not extended for this benchmark.

Clause 6 – Performance Metrics and Response Time Related Items

Measured Throughput

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

Measured tpsE: 729.65 tpsE
Price per tpsE: $ 457.27 USD per tpsE

Throughput vs. Elapsed Time for Trade-Result Transaction

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

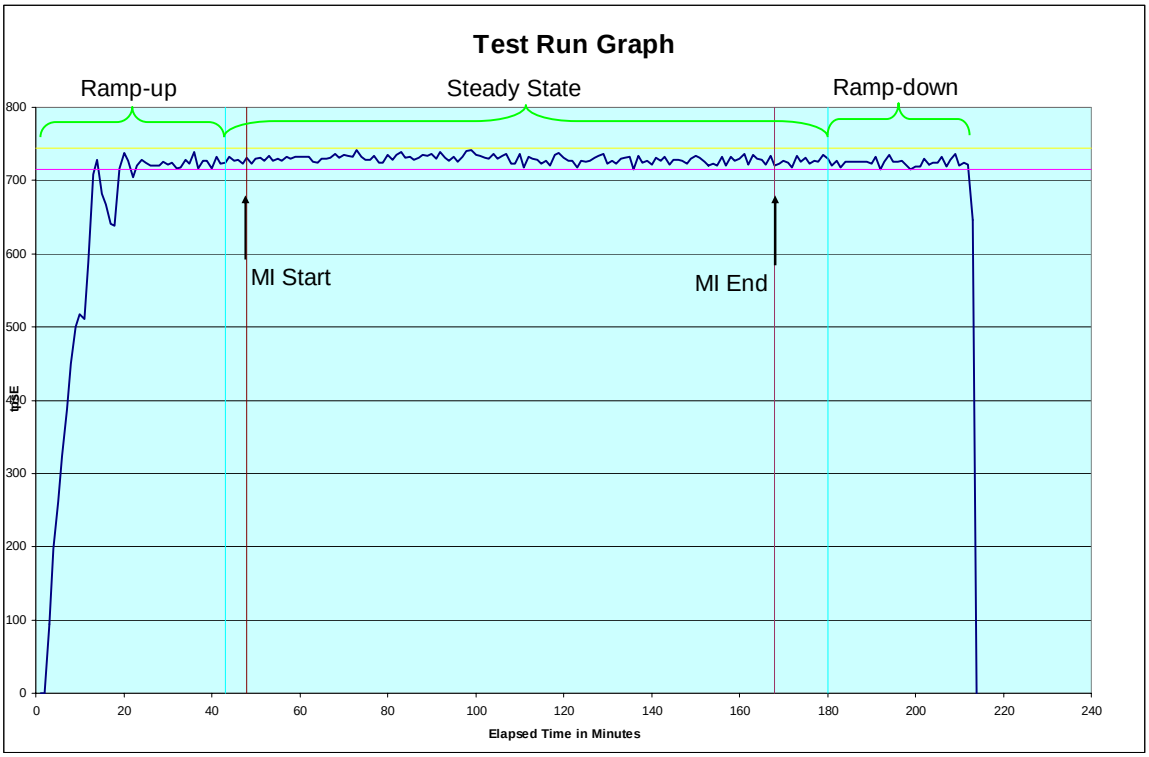

Figure 6-1. Test Run Graph

Steady State Methodology

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

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. Looking at the Test Run Graph and verifying 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 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 (e.g., checkpointing, writing Undo/Redo Log records).

Checkpoints were run once every 7 ½ minutes. Data-Maintenance was run every 60 seconds.

Transaction Statistics

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

Table 6-1 contains the transaction statistics.

Input Parameter	Value	Actul Pct	Required Range
Customer-Position			
by_tax_id	1	50.01%	48% to 52%
get_history	1	49.98%	48% to 52%
Market-Watch			
Securities chosen by	Watch list	60.01%	57% to 63%
	Account ID	35.00%	33% to 37%
	Industry	4.99%	4.5% to 5.5%
Security-Detail			
access_lob	1	1.00%	0.9% to 1.1%
Trade-Lookup			
frame_to_execute	1	30.01%	28.5% to 31.5%
	2	30.00%	28.5% to 31.5%
	3	29.97%	28% to 31.5%
	4	10.02%	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		40.00%	38% to 42%
type_is_margin	1	8.02%	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	24.99%	24% to 26%
	200	25.04%	24% to 26%
	400	24.99%	24% to 26%
	800	24.98%	24% to 26%
trade_type	TMB	30.00%	29.7% to 30.3%
	TMS	29.99%	29.7% to 30.3%
	TLB	19.99%	19.8% to 20.2%
	TLS	9.99%	9.9% to 10.1%
	TSL	10.03%	9.9% to 10.1%
Trade-Update			
frame_to_execute	1	32.89%	31% to 35%
	2	33.10%	31% to 35%
	3	34.01%	32% to 36%

Table 6-1. Transaction Statistics

Clause 7 – Transaction and System Properties Related Items

The ACID (Atomicity, Consistency, Isolation, and Durability) properties of transaction processing systems must be supported by the System Under Test during the running of this benchmark. It is the intent of this section to define the ACID properties informally and to specify a series of tests that must be performed to demonstrate that these properties are met.

Atomicity Requirements

The system under test must guarantee that database transactions are atomic; the system will either perform all individual operations on the data, or will assure that no partially completed operations leave any effects on the data.

All ACID tests were conducted according to specification. The following steps were performed to verify the Atomicity of the Trade-Order transactions.

Perform a market Trade-Order Transaction with the roll_it_back flag set to false. 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 true. 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 mstpce.1.5.1-1009\ACID\Atomicity directory.
3. Run Atomicity.cmd
4. The output will be in Atomicity_C.out and Atomicity_RB.out

Atomicity.cmd runs a Trade-Order with a commit and notes the new T_ID. Then it does a select on TRADE and TRADE_HISTORY to return the rows in those tables with the new T_ID.

Atomicity.cmd 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.

Consistency Requirements

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

Consistency conditions 1, 2 and 3 were tested using a batch file to issue queries to the database after the database was loaded and after the Business Recovery Test. The results of the queries demonstrated that the database was consistent for all three tests.

The specific procedure was:

1. Open a command prompt.
2. Change to the MSTPCE.1.5.1-1009\ACID\Consistency directory.
3. Run Consistency.cmd

4. The output will be in Consistency.out

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')

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')

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)

Isolation Requirements

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.

Execution of Isolation Test #1 (P3 Test in Read-Write)

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

1. Open the SQL Server Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1_S1.sql in the Management Studio. When prompted, connect to the database server.
3. Ctrl-T to convert results to text.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1_S2.sql in the Management Studio. When prompted, connect to the database server.
5. Ctrl-T to convert results to text.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1_S3.sql in the Management Studio. When prompted, connect to the database server.
7. Ctrl-T to convert results to text.
8. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation1_S4.sql in the Management Studio. When prompted, connect to the database server.
9. Ctrl-T to convert results to text.
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 immediately execute Isolation1_S4. Note that 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. 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. Verify that this is set to 0.
4. The Trade-Result in S4 completed, and the Trade-Result in S3 was selected as a deadlock victim.

Execution of Isolation Test #2 (P2 Test in Read-Write)

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

1. Open the SQL Server Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2_S1.sql in the Management Studio. When prompted, connect to the database server.
3. Ctrl-T to convert results to text.

4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2_S2.sql in the Management Studio. When prompted, connect to the database server.
5. Ctrl-T to convert results to text.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2_S3.sql in the Management Studio. When prompted, connect to the database server.
7. Ctrl-T to convert results to text.
8. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation2_S4.sql in the Management Studio. When prompted, connect to the database server.
9. Ctrl-T to convert results to text.
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 immediately execute Isolation2_S4. Note that 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 step 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. This value should match the value returned in step 1 above.
4. The Trade-Result in S4 ran to completion. The Trade-Result in S3 was selected as a deadlock victim.

Execution of Isolation Test #3 (P1 Test in Read-Write)

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

1. Open the SQL Server Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation3_S1.sql in the Management Studio. When prompted, connect to the database server.
3. Ctrl-T to convert results to text.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation3_S2.sql in the Management Studio. When prompted, connect to the database server.
5. Ctrl-T to convert results to text.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation3_S3.sql in the Management Studio. When prompted, connect to the database server.
7. Ctrl-T to convert results to text.
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 Isoaltion3_S2.sql.
11. Copy the Customer Account Used from Isolation3_S1 to the top of Isoaltion3_S2.sql.
12. Copy the second Trade ID Returned from Isolation3_S1 to the top of Isoaltion3_S3.sql.
13. Copy the Customer Account Used from Isolation3_S1 to the top of Isoaltion3_S3.sql.
14. Execute Isolation3_S2, then immediately execute Isolation3_S3. Note that 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 (P1 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 Isoaltion3_S3)

Execution of Isolation Test #4 (P1 Test in Read-Only)

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

1. Open the SQL Server Management Studio.
2. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation4_S1.sql in the Management Studio. When prompted, connect to the database server.
3. Ctrl-T to convert results to text.
4. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation4_S2.sql in the Management Studio. When prompted, connect to the database server.
5. Ctrl-T to convert results to text.
6. Open MSTPCE.1.5.1-1009\ACID\Isolation\Scripts\Isolation4_S3.sql in the Management Studio. When prompted, connect to the database server.
7. Ctrl-T to convert results to text.
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 Used," "Customer Account Balance," and the "Trade ID Returned."
10. Copy the "Customer Account 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 Used" from the Results window of Isolation4_S1 to the @acct_id variable near the top of Isolation4_S3.
14. Execut Isolation4_S2 and after a few seconds to make sure Isolation4_S2 has started 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 as follows:
    a. CA_BAL (from Isolation4_S1) + Settlement Amount (from Isolation4_S2) = Customer Account Balance (from Isoaltion4_S3)

Durability Requirements

The tested system must guarantee durability: the ability to preserve the effects of committed transactions and ensure database consistency after recovery from any one of the failures listed in Clauses 7.5.2.2, 7.5.2.3 and 7.5.2.4.

- *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. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in a database data array. Then wait 20 minutes or so to allow Durability Throughput Requirements to be met again, and then fail a disk in the database log array. Transactions should continue processing since the database log array has mirrored drives and the database data array uses RAID-5.
4. Begin the necessary recovery process, by replacing the failed drives in the database log array and the database data array. A rebuild on each replaced drive should start automatically.
5. Continue running the Driver for 20 minutes.
6. Terminate the run gracefully from the Driver.
7. Retrieve the new number of completed trades in the database by running: *select count(*) as count2 from SETTLEMENT*
8. 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.
9. 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:

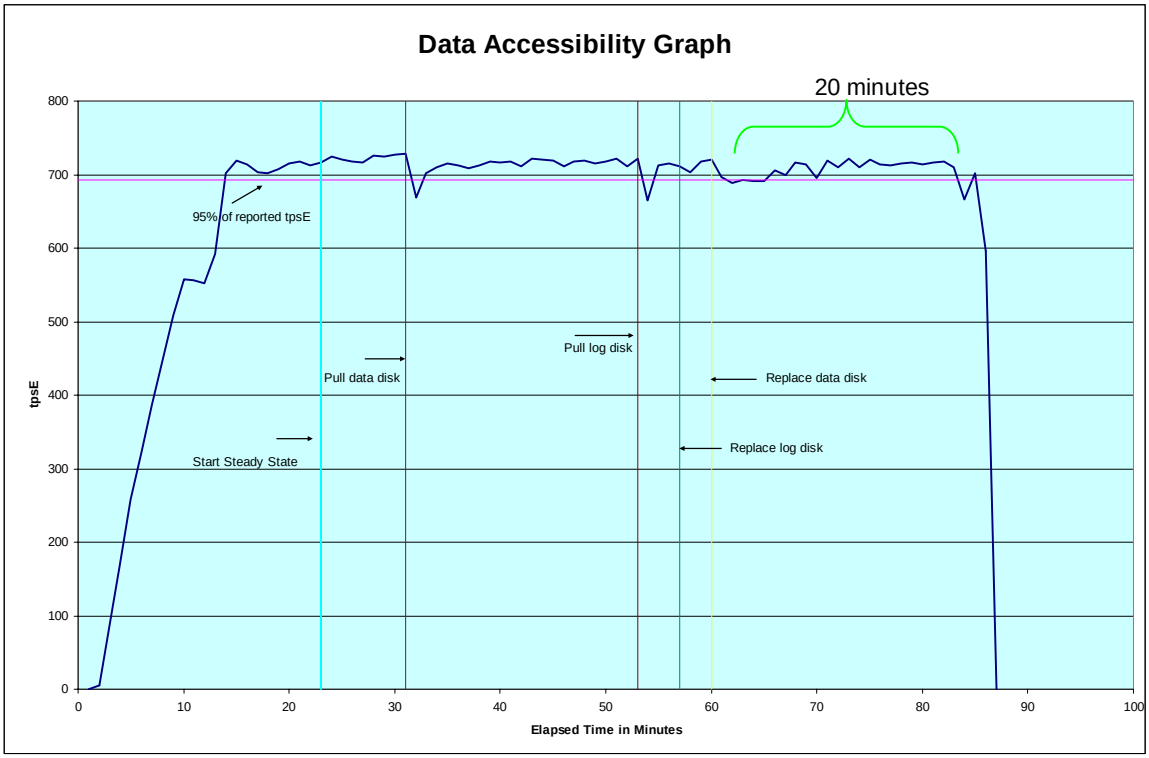

Figure 7-1. Data Accessibility Graph

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.

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, by pulling the power cords from the x3850 M2.
4. Stop the Driver.
5. Re-power and restart the x3850 M2.
6. On the x3850 M2 when Windows has started run StartSQLdashX.bat to start SQL Server and database recovery. SQL Server writes timestamps out to the errorlog when it is started. This timestamp can be used as 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 than 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 that 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 00:47:22.37.

    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:

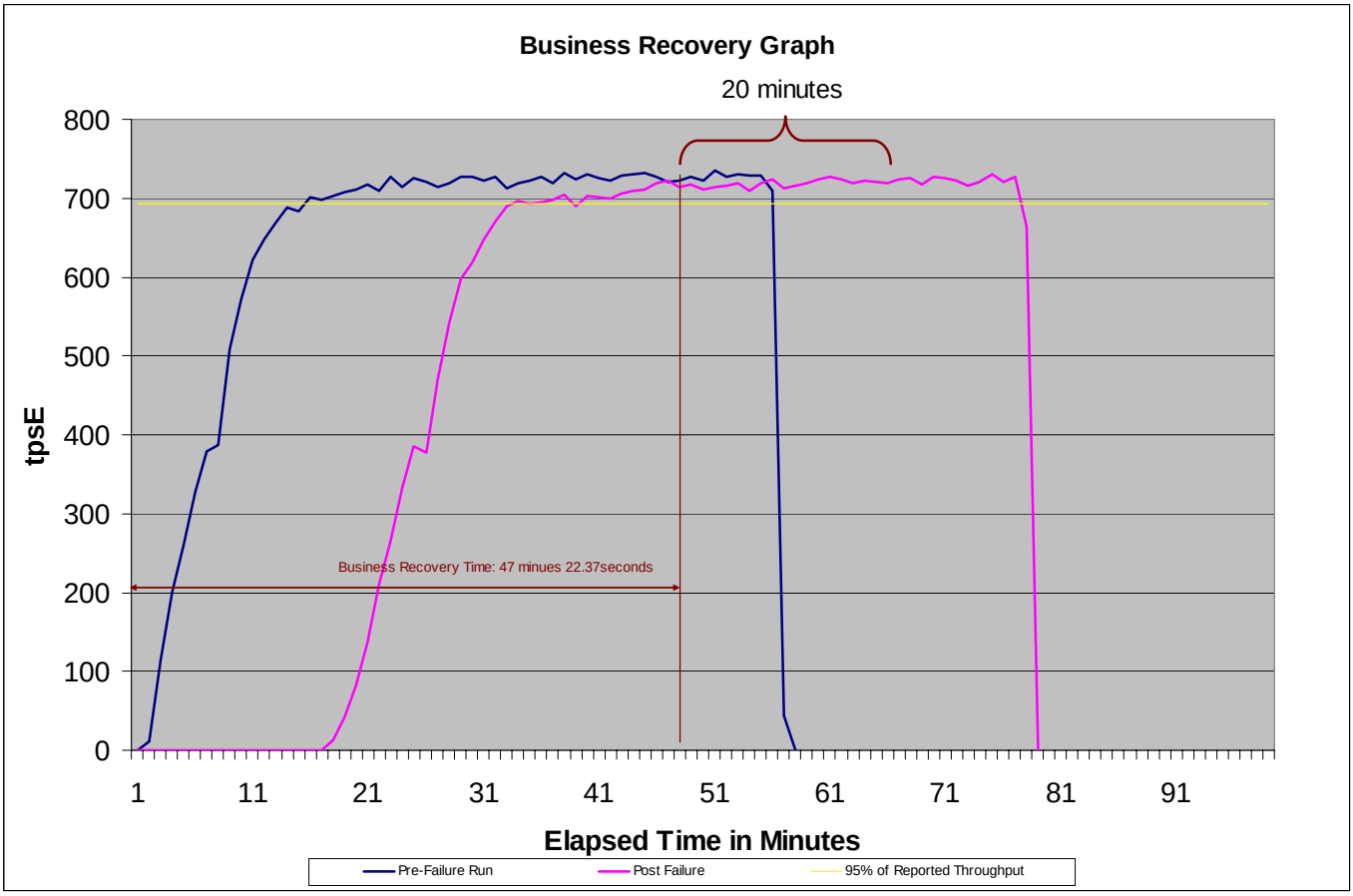

Figure 7-2. Business Recovery Time Graph

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.

Table 8-1 Disk Space Requirements

Customers Used	365,000	Performance	729.65	TpsE	Reported	729.65	TpsE		
Broker File Group	**Initial Rows**	**Data (KB)**	**Index size (KB)**	**Extra 5% (KB)**	**Total + 5% (KB)**	**After run (KB)**	**Growth (KB)**	**Bus. Day Growth (KB)**	**Req. Add. (KB)**
BROKER	3,650	208	416	31	655	840	216	506	506
CASH_TRANSACTION	5,802,618,211	574,715,192	1,213,440	28,796,432	604,725,064	591,484,056	15,555,424	36,404,779	36,404,779
CHARGE	15	8	8	1	17	16	-	-	1
COMMISSION_RATE	240	16	16	2	34	32	-	-	2
SETTLEMENT	6,307,200,000	309,521,216	652,960	15,508,709	325,682,885	324,582,216	14,408,040	33,719,525	33,719,525
TRADE	6,307,200,000	698,831,408	374,341,440	53,658,642	1,126,831,490	1,090,260,736	17,087,888	39,991,246	39,991,246
TRADE_HISTORY	15,137,288,850	434,044,200	1,132,504	21,758,835	456,935,539	436,860,672	1,683,968	3,941,036	3,941,036
TRADE_REQUEST	-	-	-	-	-	14,696	14,696	34,394	34,394
TRADE_TYPE	5	8	1,032	52	1,092	1,040	-	-	52
Customer File Group									-
ACCOUNT_PERMISSION	2,591,143	259,184	1,744	13,046	273,974	260,928	-	-	13,046
CUSTOMER	365,000	61,872	16,456	3,916	82,244	78,360	32	75	3,916
CUSTOMER_ACCOUNT	1,825,000	169,504	202,192	18,585	390,281	371,696	-	-	18,585
CUSTOMER_TAXRATE	730,000	15,240	488	786	16,514	15,872	144	338	786
HOLDING	322,972,999	17,187,360	12,736,776	1,496,207	31,420,343	41,920,920	11,996,784	28,076,398	28,076,398
HOLDING_HISTORY	8,452,751,589	307,372,856	160,188,168	23,378,051	490,939,075	469,379,880	1,818,856	4,256,718	4,256,718
HOLDING_SUMMARY	18,158,641	616,008	2,704	30,936	649,648	1,239,072	620,360	1,451,846	1,451,846
WATCH_ITEM	36,547,719	1,001,128	4,000	50,256	1,055,384	1,005,416	288	675	50,256
WATCH_LIST	365,000	9,120	7,920	852	17,892	17,040	-	-	852
Market File Group									
COMPANY	182,500	39,704	11,520	2,561	53,785	51,232	8	19	2,561
COMPANY_COMPETITOR	547,500	14,736	12,496	1,362	28,594	27,232	-	-	1,362
DAILY_MARKET	326,282,625	16,739,848	7,079,840	1,190,984	25,010,672	23,821,096	1,408	3,296	1,190,984
EXCHANGE	4	8	8	1	17	16	-	-	1
FINANCIAL	3,650,000	429,496	1,632	21,556	452,684	431,456	328	768	21,556
INDUSTRY	102	8	40	2	50	48	-	-	2
LAST_TRADE	250,025	11,648	496	607	12,751	23,800	11,656	27,279	27,279
NEWS_ITEM	365,000	39,572,776	904	1,978,684	41,552,364	39,573,712	32	75	1,978,684
NEWS_XREF	365,000	9,128	496	481	10,105	9,624	-	-	481
SECTOR	12	8	24	2	34	32	-	-	2
SECURITY	250,025	39,336	17,608	2,847	59,791	56,944	-	-	2,847
STATUS_TYPE	5	8	8	1	17	16	-	-	1
Misc File Group									
ADDRESS	547,504	31,624	488	1,606	33,718	32,128	16	38	1,606
TAXRATE	320	24	16	2	42	56	16	38	38
ZIP_CODE	14,741	488	128	31	647	616	-	-	31
TOTALS (KB)		**2,400,693,368**	**557,627,968**	**147,916,067**	**3,106,237,403**				
Initial Database Size (MB)		**2,888,986**	**2,821 GB**						

Db/Filegroups	**LUN Count**	**Partition Size(KB)**	**MB allocated**	**MB Loaded**	**MB Required**	
	0	-	-	-	-	OK
growing_fg	16	219,955,200	3,436,800	2,824,762	2,969,172	OK
	0	-	-	-	-	OK
fixed_fg	16	5,222,400	81,600	64,224	67,461	OK
Settlements	**8,979,053**					

Initial Growing Space (MB)	2,824,762						
Final Growing Space (MB)	2,886,467	**Data LUNS**	16	**Initial Log size (MB)**	24,932	**Log LUNS**	1
Delta (MB)	61,705	**Disks per LUN**	24	**Final Log size (MB)**	117,558	**Log Disks**	16
Data Space per Trade (MB)	0.006872116	**Disk Capacity (MB)**	69,495	**Log Growth (MB)**	92,626	**Disk Capacity (MB)**	69,495
1 Day Data Growth (MB)	144,410	**RAID5 overhead**	96%	**Log Growth/trade (MB)**	0.010315804261	**RAID10 overhead**	50%
60 Day Space (MB)	**11,553,591**	**Total Space (MB)**	**25,573,949**	**1 Day log space (MB)**	**216,775**	**Log Space (MB)**	**555,958**
			OK				OK

Auditor's Attestation Letter

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

The auditor's Attestation Letter is on the next two pages.

INFO SIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Benchmark Sponsor: Celia Schreiber, Manager
Modular Systems and Blade Performance Analysis and Benchmarking
IBM Systems and Technology Group
3039 Cornwallis Road
RTP, NC 27709

August 29, 2008

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

Platform: IBM System x3850 M2
Operating system: Microsoft Windows Server 2008 Enterprise 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: IBM System x3850 M2				
4 x Intel Xeon X7460 (2.66GHz)	128 GB (4 x 9 MB L2)	400 x 73.4 GB 15K SAS	0.11 Seconds	729.65
Tier A, Two Clients: IBM System x3200 M2				
1 x Intel Xeon X3360 (2.83 GHz)	2 GB	2 x 73 GB 15K Hot Swap SAS	n/a	n/a

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

The following 12 verification items were given special attention:

- All EGen components were verified to be v1.5.1.
- The transactions were correctly implemented.
- The database was properly scaled and populated for 365,000 customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.

- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.
- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The 60 day storage requirement was correctly computed.
- The system pricing was verified for major components and maintenance.

Additional Audit Notes:

None.

Respectfully Yours,

Doug Johnson, Auditor

François Raab, President

Supporting Files Index Table

The **Supporting Files Index** file can be found in the *SupportingFiles* directory (SupportingFiles.doc).

Clause	Description	Pathname
Introduction	Disk Configuration	SupportingFiles/Introduction/Hardware/1stDataAdapter.txt SupportingFiles/Introduction/Hardware/2nd DataAdapter.txt SupportingFiles/Introduction/Hardware/3rdDataAdapter.txt SupportingFiles/Introduction/Hardware/4thDataAdapter.txt SupportingFiles/Introduction/Hardware/Create_dataPartitions.txt SupportingFiles/Introduction/Hardware/Create_logPartition.txt SupportingFiles/Introduction/Hardware/DiskLayout_1.jpg SupportingFiles/Introduction/Hardware/DiskLayout_2.jpg SupportingFiles/Introduction/Hardware/formtBackup.bat SupportingFiles/Introduction/Hardware/input.txt SupportingFiles/Introduction/Hardware/LogAdapter.txt SupportingFiles/Introduction/Hardware/rc.bat SupportingFiles/Introduction/Hardware/rc16.bat SupportingFiles/Introduction/Hardware/StorageSetup.doc
	Tier B/x3850 M2 Configuration	SupportingFiles/Introduction/Hardware/TierB_x3850M2_setup.txt
	TierA/x3200 M2 setup	SupportingFiles/Introduction/Hardware/TierA_x3200M2_setup.txt
	Database Tunable Parameters	SupportingFiles/Introduction/software/runconfig.sql SupportingFiles/Introduction/software/startSQL.bat SupportingFiles/Introduction/software/stopSQL.bat
	Checkpoint Scripts	SupportingFiles/Introduction/software/runregularcheckpoints.bat SupportingFiles/Introduction/software/checkpoint.bat SupportingFiles/Introduction/software/checkpoint.sql
	Tier A Scripts	SupportingFiles/Introduction/software/StartTpce_vclient30.bat SupportingFiles/Introduction/software/StartTpce_vclient40.bat
	OS Tunable Parameters	SupportingFiles/Introduction/software/TierB_OSTune.doc SupportingFiles/Introduction/software/x3850M2_TierB_SysInfo.txt SupportingFiles/Introduction/software/vclient30_TierA_sysinfo.txt SupportingFiles/Introduction/software/vclient40_TierA_sysinfo.txt

Clause 2	Table creation scripts	SupportingFiles/Clause2/DDL/BulkInsert_1.sql SupportingFiles/Clause2/DDL/BulkInsert_2.sql SupportingFiles/Clause2/DDL/BulkInsert_3.sql SupportingFiles/Clause2/DDL/BulkInsert_4.sql SupportingFiles/Clause2/DDL/BulkInsert_5.sql SupportingFiles/Clause2/DDL/BulkInsert_6.sql SupportingFiles/Clause2/DDL/BulkInsert_7.sql SupportingFiles/Clause2/DDL/BulkInsert_8.sql SupportingFiles/Clause2/DDL/BulkInsert_9.sql SupportingFiles/Clause2/DDL/BulkInsert_10.sql SupportingFiles/Clause2/DDL/BulkInsert_11.sql SupportingFiles/Clause2/DDL/BulkInsert_12.sql SupportingFiles/Clause2/DDL/BulkInsert_13.sql SupportingFiles/Clause2/DDL/BulkInsert_14.sql SupportingFiles/Clause2/DDL/BulkInsert_15.sql SupportingFiles/Clause2/DDL/BulkInsert_16.sql SupportingFiles/Clause2/DDL/Convert_NI_ITEM_Data.sql SupportingFiles/Clause2/DDL/Create_Check_Constraints_Fixed.sql SupportingFiles/Clause2/DDL/Create_Check_Constraints_Growing.sql SupportingFiles/Clause2/DDL/Create_Check_Constraints_Scaling.sql SupportingFiles/Clause2/DDL/Create_FK_Constraints.sql SupportingFiles/Clause2/DDL/Create_Tables_Fixed.sql SupportingFiles/Clause2/DDL/Create_Tables _Growing.sql SupportingFiles/Clause2/DDL/Create_Tables _Scaling.sql SupportingFiles/Clause2/DDL/Create_Tables _Scaling_Flat.sql SupportingFiles/Clause2/DDL/Create_TPCE_Types.sql SupportingFiles/Clause2/DDL/Drop_FK_Constraints.sql SupportingFiles/Clause2/DDL/Drop_Tables_Fixed.sql SupportingFiles/Clause2/DDL/Drop_Tables_Growing.sql SupportingFiles/Clause2/DDL/Drop_Tables_Scaling.sql
	Index creation scripts	SupportingFiles/Clause2/DDL/Create_Clustered_Indexes_Fixed.sql SupportingFiles/Clause2/DDL/Create_Clustered_Indexes_Growing.sql SupportingFiles/Clause2/DDL/Create_Clustered_Indexes_Scaling.sql SupportingFiles/Clause2/DDL/Create_NC_Indexes_Fixed.sql SupportingFiles/Clause2/DDL/Create_NC_Indexes_Growing.sql SupportingFiles/Clause2/DDL/Create_NC_Indexes_Scaling.sql
	Load Transaction Frames	SupportingFiles/Clause2/DML/BrokerVolume.sql SupportingFiles/Clause2/DML/CustomerPosition.sql SupportingFiles/Clause2/DML/DataMaintenance.sql SupportingFiles/Clause2/Utility/Get_Next_T_ID.sql SupportingFiles/Clause2/DML/MarketFeed.sql SupportingFiles/Clause2/DML/MarketWatch.sql SupportingFiles/Clause2/DML/SecurityDetail.sql SupportingFiles/Clause2/Utility/Trade_Cleanup.sql SupportingFiles/Clause2/DML/TradeLookup.sql SupportingFiles/Clause2/DML/TradeOrder.sql SupportingFiles/Clause2/DML/TradeResult.sql SupportingFiles/Clause2/DML/TradeStatus.sql SupportingFiles/Clause2/DML/TradeUpdate.sql

	Create Database	SupportingFiles/Clause2/misc/Backup_database.sql SupportingFiles/Clause2/misc/backupdev.sql SupportingFiles/Clause2/Utility/Count_Customers.sql SupportingFiles/Clause2/misc/countSettlement.sql SupportingFiles/Clause2/misc/create_database.sql SupportingFiles/Clause2/Utility/Create_DM_Audit_Table.sql SupportingFiles/Clause2/Utility/Create_TID_Ranges_Tables.sql SupportingFiles/Clause2/Utility/Create_Timer_Table.sql SupportingFiles/Clause2/Utility/Database_Options_1.sql SupportingFiles/Clause2/Utility/Database_Options_2.sql SupportingFiles/Clause2/Utility/Drop_and_Create_TPCE_INFO.sql SupportingFiles/Clause2/Utility/End_Load_Timer.sql SupportingFiles/Clause2/Utility/Install_Load_Timer_Proc.sql SupportingFiles/Clause2/Utility/Load_TPCE_Info.sql SupportingFiles/Clause2/MSTPCE Database Setup Reference.pdf SupportingFiles/Clause2/misc/remove_database.sql SupportingFiles/Clause2/misc/restore.sql SupportingFiles/Clause2/misc/runconfig.sql SupportingFiles/Clause2/misc/selectDM_Audit_Table.sql SupportingFiles/Clause2/Utility/SQL_Server_Configuration.sql SupportingFiles/Clause2/misc/StartSQL.bat SupportingFiles/Clause2/misc/tempdb.sql SupportingFiles/Clause2/TPCE_Setup.cmd SupportingFiles/Clause2/Utility/Version.sql
	Database Space Scripts	SupportingFiles/Clause2/audit_scripts/Space/SPFiles.sql SupportingFiles/Clause2/audit_scripts/Space/SPLog.sql SupportingFiles/Clause2/audit_scripts/Space/SPUsed.sql
	Database Audit Scripts	SupportingFiles/Clause2/audit_scripts/database/Create_DB_Audit_Tables.sql SupportingFiles/Clause2/audit_scripts/database/DB_Check.sql SupportingFiles/Clause2/audit_scripts/database/DB_Primary_Key_Check.sql SupportingFiles/Clause2/audit_scripts/database/DB_Tables.sql SupportingFiles/Clause2/audit_scripts/database/Drop_DB_Audit_Tables.sql SupportingFiles/Clause2/audit_scripts/database/Insert_Duplicates_Tests.sql SupportingFiles/Clause2/Audit_Scripts/Database/Referential_Integrity_Tests.sql
Clause 3	Transaction Frames	SupportingFiles/Clause3/BrokerVolume.sql SupportingFiles/Clause3/CustomerPosition.sql SupportingFiles/Clause3/DataMaintenance.sql SupportingFiles/Clause3/Get_Next_T_ID.sql SupportingFiles/Clause3/MarketFeed.sql SupportingFiles/Clause3/MarketWatch.sql SupportingFiles/Clause3/SecurityDetail.sql SupportingFiles/Clause3/Trade_Cleanup.sql SupportingFiles/Clause3/TradeLookup.sql SupportingFiles/Clause3/TradeOrder.sql SupportingFiles/Clause3/TradeResult.sql SupportingFiles/Clause3/TradeStatus.sql SupportingFiles/Clause3/TradeUpdate.sql

	BaseServer	SupportingFiles/Clause3/BaseServer/BaseServer.cpp SupportingFiles/Clause3/BaseServer/BaseServer.h SupportingFiles/Clause3/BaseServer/BaseServer.vcproj SupportingFiles/Clause3/BaseServer/stdafx.cpp SupportingFiles/Clause3/BaseServer/stdafx.h SupportingFiles/Clause3/BaseServer/SUTServersLocals.h
	SUT_CE_Server	SupportingFiles/Clause3/SUT_CE_Server/CEServer.cpp SupportingFiles/Clause3/SUT_CE_Server/CEServer.h SupportingFiles/Clause3/SUT_CE_Server/CEServerMain.cpp SupportingFiles/Clause3/SUT_CE_Server/PortDefinitions.h SupportingFiles/Clause3/SUT_CE_Server/stdafx.cpp SupportingFiles/Clause3/SUT_CE_Server/stdafx.h SupportingFiles/Clause3/SUT_CE_Server/SUT_CE_Server.vcproj SupportingFiles/Clause3/SUT_CE_Server/SUTServer.sln SupportingFiles/Clause3/SUT_CE_Server/SUTServer.suo SupportingFiles/Clause3/SUT_CE_Server/SUTStructs.h
	SUT_MEE_Server	SupportingFiles/Clause3/SUT_MEE_Server/MEEServer.cpp SupportingFiles/Clause3/SUT_MEE_Server/MEEServer.h SupportingFiles/Clause3/SUT_MEE_Server/MEEServerMain.cpp SupportingFiles/Clause3/SUT_MEE_Server/stdafx.cpp SupportingFiles/Clause3/SUT_MEE_Server/stdafx.h SupportingFiles/Clause3/SUT_MEE_Server/SUT_MEE_Server.vcproj

	TransactionsSP	SupportingFiles/Clause3/TransactionsSP/BrokerVolumeDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/BrokerVolumeDB_SP.h SupportingFiles/Clause3/TransactionsSP/CheckpointDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/CheckpointDB_SP.h SupportingFiles/Clause3/TransactionsSP/CustomerPositionDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/CustomerPositionDB_SP.h SupportingFiles/Clause3/TransactionsSP/DataMaintenanceDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/DataMaintenanceDB_SP.h SupportingFiles/Clause3/TransactionsSP/MarketFeedDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/MarketFeedDB_SP.h SupportingFiles/Clause3/TransactionsSP/MarketWatchDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/MarketWatchDB_SP.h SupportingFiles/Clause3/TransactionsSP/SecurityDetailDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/SecurityDetailDB_SP.h SupportingFiles/Clause3/TransactionsSP/stdafx.cpp SupportingFiles/Clause3/TransactionsSP/stdafx.h SupportingFiles/Clause3/TransactionsSP/TradeLookupDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/TradeLookupDB_SP.h SupportingFiles/Clause3/TransactionsSP/TradeOrderDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/TradeOrderDB_SP.h SupportingFiles/Clause3/TransactionsSP/TradeResultDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/TradeResultDB_SP.h SupportingFiles/Clause3/TransactionsSP/TradeStatusDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/TradeStatusDB_SP.h SupportingFiles/Clause3/TransactionsSP/TradeUpdateDB_SP.cpp SupportingFiles/Clause3/TransactionsSP/TradeUpdateDB_SP.h SupportingFiles/Clause3/TransactionsSP/TransactionsSP.vcproj SupportingFiles/Clause3/TransactionsSP/TxnHarnessDBBase.cpp SupportingFiles/Clause3/TransactionsSP/TxnHarnessDBBase.h SupportingFiles/Clause3/TransactionsSP/TxnHarnessDBConn.cpp SupportingFiles/Clause3/TransactionsSP/TxnHarnessDBConn.h
	TxnHarness	SupportingFiles/Clause3/TxnHarness/TxnHarness.vcproj SupportingFiles/Clause3/TxnHarness/TxnHarness_stdafx.cpp SupportingFiles/Clause3/TxnHarness/TxnHarness_stdafx.h SupportingFiles/Clause3/TxnHarness/TxnHarnessSendToMarket.cpp SupportingFiles/Clause3/TxnHarness/TxnHarnessSendToMarket.h
Clause 4	No Requirements	
Clause 5	No EGen modifications	
	No EGenLoader extensions	
	EGenDriver Configuration	SupportingFiles/Clause5/365Kcust_4MEEs_v1.5.1_vclient30&40.xml

	EGenLoader Parameters	SupportingFiles/Clause5/EGenLoaderFlags.txt SupportingFiles/Clause5/EGenLoaderFrom1To23000.log SupportingFiles/Clause5/EGenLoaderFrom23001To46000.log SupportingFiles/Clause5/EGenLoaderFrom46001To68000.log SupportingFiles/Clause5/EGenLoaderFrom68001To91000.log SupportingFiles/Clause5/EGenLoaderFrom91001To114000.log SupportingFiles/Clause5/EGenLoaderFrom114001To137000.log SupportingFiles/Clause5/EGenLoaderFrom137001To160000.log SupportingFiles/Clause5/EGenLoaderFrom160001To183000.log SupportingFiles/Clause5/EGenLoaderFrom183001To205000.log SupportingFiles/Clause5/EGenLoaderFrom205001To228000.log SupportingFiles/Clause5/EGenLoaderFrom228001To251000.log SupportingFiles/Clause5/EGenLoaderFrom251001To274000.log SupportingFiles/Clause5/EGenLoaderFrom274001To297000.log SupportingFiles/Clause5/EGenLoaderFrom297001To319000.log SupportingFiles/Clause5/EGenLoaderFrom319001To342000.log SupportingFiles/Clause5/EGenLoaderFrom342001To365000.log
Clause 6	EGenValidate Output	SupportingFiles/Clause6/EGenValidate.txt
Clause 7	Scripts of ACID procedures	SupportingFiles/Clause7/AcidProcs/AcidProc.cmd SupportingFiles/Clause7/AcidProcs/Scripts/AcidProc.vbs SupportingFiles/Clause7/AcidProcs/Scripts/CustomerPosition_Iso3.sql SupportingFiles/Clause7/AcidProcs/Scripts/CustomerPosition_Iso4.sql SupportingFiles/Clause7/AcidProcs/Scripts/Drop_SPROC.sql SupportingFiles/Clause7/AcidProcs/Scripts/Remove_AcidProcs.vbs SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_C.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_Iso1_1.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_Iso1_2.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_Iso2.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_Iso3.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_Iso4.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeOrder_RB.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeResult_Iso1_1.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeResult_Iso1_2.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeResult_Iso2_1.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeResult_Iso2_2.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeResult_Iso3.sql SupportingFiles/Clause7/AcidProcs/Scripts/TradeResult_Iso4.sql SupportingFiles/Clause7/AcidProcs/Remove_AcidProcs.cmd
	ACID procedures output	SupportingFiles/Clause7/AcidProcs/AcidProc.out
	Atomicity Scripts	SupportingFiles/Clause7/Atomicity/Atomicity.cmd SupportingFiles/Clause7/Atomicity/Scripts/Atomicity_C.sql SupportingFiles/Clause7/Atomicity/Scripts/Atomicity_RB.sql SupportingFiles/Clause7/Atomicity/Scripts/atom.vbs
	Atomicity Output	SupportingFiles/Clause7/Atomicity/Atomicity_C.out SupportingFiles/Clause7/Atomicity/Atomicity_RB.out
	Consistency Scripts	SupportingFiles/Clause7/Consistency/Consistency.cmd SupportingFiles/Clause7/Consistency/Scripts/Consistency.sql SupportingFiles/Clause7/Consistency/Scripts/Consistency.vbs

	Consistency Output	SupportingFiles/Clause7/Consistency/Consistency.afterDBLoad.out SupportingFiles/Clause7/Consistency/Consistency.afterBusinessRecovery.out SupportingFiles/Clause7/Consistency/Consistency.afterMeasuredRun.out
	Isolation Scripts	SupportingFiles/Clause7/Isolation/Scripts/Isolation1_S1.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation1_S2.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation1_S3.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation1_S4.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation2_S1.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation2_S2.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation2_S3.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation2_S4.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation3_S1.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation3_S2.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation3_S3.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation4_S1.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation4_S2.sql SupportingFiles/Clause7/Isolation/Scripts/Isolation4_S3.sql
	solation Output	SupportingFiles/Clause7/Isolation/Isolation1_S1.rpt SupportingFiles/Clause7/Isolation/Isolation1_S2.rpt SupportingFiles/Clause7/Isolation/Isolation1_S3.rpt SupportingFiles/Clause7/Isolation/Isolation1_S4.rpt SupportingFiles/Clause7/Isolation/Isolation2_S1.rpt SupportingFiles/Clause7/Isolation/Isolation2_S2.rpt SupportingFiles/Clause7/Isolation/Isolation2_S3.rpt SupportingFiles/Clause7/Isolation/Isolation2_S4.rpt SupportingFiles/Clause7/Isolation/Isolation3_S1.rpt SupportingFiles/Clause7/Isolation/Isolation3_S2.rpt SupportingFiles/Clause7/Isolation/Isolation3_S3.rpt SupportingFiles/Clause7/Isolation/Isolation4_S1.rpt SupportingFiles/Clause7/Isolation/Isolation4_S2.rpt SupportingFiles/Clause7/Isolation/Isolation4_S3.rpt
	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryTime.txt SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryTimeGraph.xls SupportingFiles/Clause7/Durability/BusinessRecovery/Consistency.afterBusinessRecovery.out SupportingFiles/Clause7/Durability/BusinessRecovery/CountSettlement.afterBusinessRecovery.txt SupportingFiles/Clause7/Durability/BusinessRecovery/CountSettlement.beforeBusinessRecovery.txt SupportingFiles/Clause7/Durability/BusinessRecovery/countSettlement.sql SupportingFiles/Clause7/Durability/BusinessRecovery/ERRORLOG.BusinessRecoveryPart1.txt SupportingFiles/Clause7/Durability/BusinessRecovery/ERRORLOG.BusinessRecoveryPart2.txt SupportingFiles/Clause7/Durability/BusinessRecovery/TierB_x3850M2.SystemEventLog.csv SupportingFiles/Clause7/Durability/BusinessRecovery/TxnReportE_20minAt95percent_part1.xls SupportingFiles/Clause7/Durability /BusinessRecovery/TxnReportE_20minAt95percent_part2.xls SupportingFiles/Clause7/Durability/BusinessRecovery/ TxnReportE_whole_run_part1.xls SupportingFiles/Clause7/Durability/BusinessRecovery/ TxnReportE_whole_run_part2.xls SupportingFiles/Clause7/Durability/BusinessRecovery/ TxnStepReport_part1.xlt SupportingFiles/Clause7/Durability/BusinessRecovery/ TxnStepReport_part2.xlt

	Durability Data Accessibility	SupportingFiles/Clause7/Durability/DataAccessbility/CountSettlement.afterDataAccessibility.txt SupportingFiles/Clause7/Durability/DataAccessbility/CountSettlement.beforeDataAccessibility.txt SupportingFiles/Clause7/Durability/DataAccessbility/countSettlement.sql SupportingFiles/Clause7/Durability/DataAccessbility/DataAccessibilityGraph.xls SupportingFiles/Clause7/Durability/DataAccessbility/ERRORLOG.DataAccessibility.txt SupportingFiles/Clause7/Durability/DataAccessbility/pulledDataDrive.JPG SupportingFiles/Clause7/Durability/DataAccessbility/pulledLogDrive.JPG SupportingFiles/Clause7/Durability/DataAccessbility/rebuildingDataDrive.JPG SupportingFiles/Clause7/Durability/DataAccessbility/rebuildingLogDrive.JPG SupportingFiles/Clause7/Durability/DataAccessbility/rebuiltDataDrive.JPG SupportingFiles/Clause7/Durability/DataAccessbility/rebuiltLogDrive.JPG SupportingFiles/Clause7/Durability/DataAccessbility/TxnReportE_5min_beforePulledDataDrive.xls SupportingFiles/Clause7/Durability/DataAccessbility/TxnReportE_5min_beforePulledLogDrive.xls SupportingFiles/Clause7/Durability/DataAccessbility/TxnReportE_whole_run.xls
	ACID Procedures Document	SupportingFiles/Clause7/MSTPCE ACID Procedures.pdf
Clause 8	60-Day Space Calculations	SupportingFiles/Clause8/tpce_space.xls

Appendix A – Price Quotes

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

August 26, 2008

IBM Corporation
Chris King
3079 Cornwallis Road
Durham, NC 27709

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	4	$93,728
P73-04165	**Windows Server 2008 Standard Edition (x64)** *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	2	$1,422
P72-03168	**Windows Server 2008 Enterprise Edition (x64)** *Server License with 25 CALs* *Discount Schedule: Open Program - Level C* *Unit Price reflects a 42% discount from the retail unit price of $3,999.*	$2,310	1	$2,310
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident)*	$245	1	$245

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

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

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

This quote is valid for the next 90 days.

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

Reference ID: PEchki0808260000000342.
Please include this Reference ID in any correspondence regarding this price quote.

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Update Qtys | Remove Selected | Move Selected To...

	Qty.	Product Description	Savings	Total Price
☐	1	 D-Link DGS-2208 10/100/1000Mbps 8-Port Desktop Green Ethernet Switch - Retail Item #: N82E16833127082 Return Policy: Limited 30-Day Return Policy **Protect Your Investment** (expand for options)	$10.00 Mail-in Rebate	$47.99
☐	1	 BELKIN A3L791-10-BLK 10 ft. Cat 5E Black RJ45 CAT5e Patch Cable - Retail Item #: N82E16812106332 Return Policy: Standard Return Policy		$4.49

Subtotal: **$52.48**

Calculate Shipping

Zip Code: | UPS Guaranteed 3 Day Service GO

Shipping: **$0.00**

Redeem Gift Certificates

Claim Code:

Security Code: | Redeem

Gift Certificates: **$0.00**

Apply Promo Code

Promo Code: | Apply

Promo Code: **$0.00**

Grand Total:* **$52.48**

* Above total does not include shipping or taxes. Please input zip code to calculate your grand total.

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