

TPC BenchmarkTM E
Full Disclosure Report
for
IBM[®] System x3650 M2
using
Microsoft[®] SQL Server 2008
Enterprise x64 Edition
and
Microsoft Windows[®] Server 2008
Enterprise x64 Edition

TPC-E Version 1.7.0

Submitted for Review
March 30, 2009

IBM Corporation

First Edition – March 2009

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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 x3650 M2 configured as a client/server system. This report documents the full disclosure information required by the TPC Benchmark E Standard Specification, Revision 1.7.0, including the methodology used to achieve the reported results. All testing fully complied with this revision level.

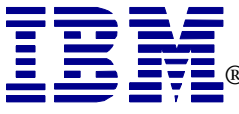
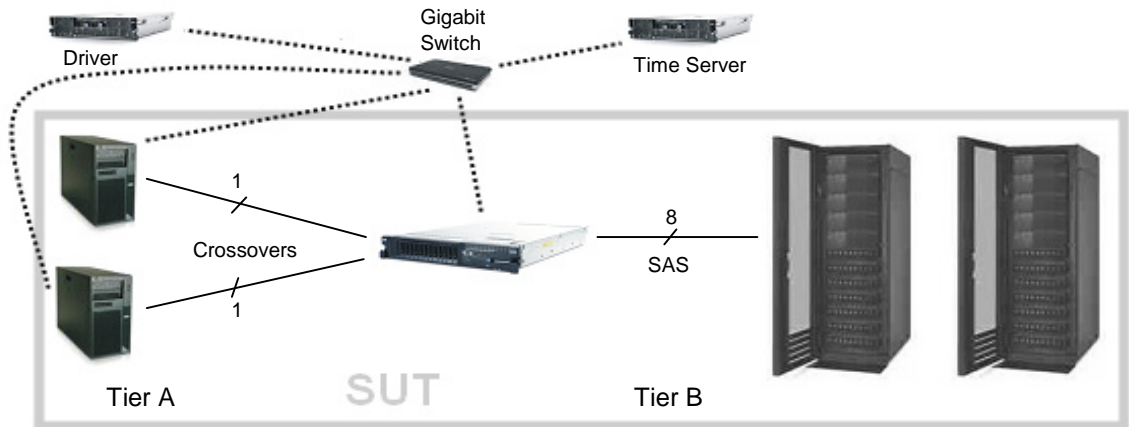
The software used on the IBM System x3650 M2 system included Microsoft® Windows® Server 2008 Enterprise x64 Edition and Microsoft SQL Server 2008 Enterprise x64 Edition.

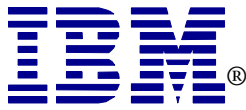
Standard metrics, transactions per second-E (tpsE), price per tpsE (\$/tpsE) and Availability Date, are reported as required by the TPC Benchmark E Standard Specification.

The benchmark results are summarized in the following table:

Hardware	Software	Total System Cost	tpsE	\$ USD /tpsE	Total Solution Availability Date
IBM System x3650 M2	Microsoft SQL Server 2008 Enterprise x64 Edition Microsoft Windows Server 2008 Enterprise x64 Edition	\$302,146 USD	798.00	\$378.63 USD	June 30, 2009

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

	IBM[®] System x[™] 3650 M2 Microsoft[®] SQL Server 2008		TPC-E 1.7.0 TPC Pricing 1.4.0
			Report Date: March 30, 2009
TPC-E Throughput 798.00 tpsE	Price/Performance \$378.63 USD per tpsE	Availability Date June 30, 2009	Total System Cost \$302,146 USD
Database Server Configuration			
Operating System Microsoft Windows Server 2008 Enterprise x64 Edition	Database Manager Microsoft SQL Server 2008 Enterprise x64 Edition	Processors/Cores/Threads 2/8/16	Memory 96GB
			
2 x IBM x3200 M2 Each contains: - 1 x Quad-Core Intel Xeon Processor X3360 2.83GHz (1 Proc/4 Cores/4 Threads) - 2GB Memory - 2 x 73GB 15K SAS (RAID-1) - Onboard RAID Controller - Onboard Gigabit Ethernet - 1 x NetXtreme II 1000 Express	IBM System x3650 M2 - 2 x Intel Xeon Processor X5570 2.93GHz (2 Procs/8 Cores/16 Threads) - 96GB Memory - 2 x 73GB 15K SAS (RAID-1) - 4 x IBM ServeRAID-MR10M SAS Controller - 1 x IBM ServeRAID-MR10i SAS Controller - Onboard Gigabit Ethernet - 1 x Ethernet Daughter Card	38 x IBM System Storage EXP3000 Enclosure - 2 of those contain (log): 8 x 73GB 15K SAS = 1 x 16-drive RAID-10 - 36 of those contain (data): 12 x 73GB 15K SAS = 18 x 24-drive RAID-10 448 Total External Drives	
Initial Database Size 3,093 GB	Redundancy Level: 1 RAID-10 Log & Data		Storage 450 x 73.4 GB Drives



IBM System x3650 M2 Microsoft SQL Server 2008

TPC-E 1.7.0
TPC Pricing 1.4.0

Report Date:
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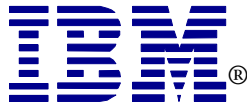
Description	Part Number	Price Source	Unit Price	Quantity	Extended Price	3-Yr. Maint. Price
Server Hardware						
x3650 M2 with 1 x Intel Xeon Processor X5570 (2.93GHz / 1MB L2 Cache / 8MB L3 Cache) 2x 2GB Memory	794792U	1a*	4,625	1	4,625	
Dual port 1Gb Ethernet Daughter Card	46M1076	1a*	199	1	199	
Intel Xeon Processor X5570 (2.93GHz/1MB L2/8MB L3 Cache)	46M1087	1a*	2,209	1	2,209	
IBM 8 GB PC2-5300 AMF 8GB (1x8GB) Dual Rank	44C7449	1a*	1,999	12	23,988	
73GB 15K 2.5" Hot-Swap SAS SFF	43X0837	1	369	2	738	
IBM ServeRAID-MR10M SAS/SATA Controller	43W4339	1	899	4	3,596	
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 (x3650 M2)	21P2078	1	600	1		600
Acer V173 b Black 17" 5ms LCD Monitor (2 spares)	V173b	3	120	3	360	
				Subtotal	35,763	600
Server Storage						
IBM S2 42U Standard Rack	93074RX	1	1,489	2	2,978	
IBM System Storage EXP3000 Enclosure	1727-01X	1	3,199	38	121,562	
IBM 1M SAS cable	39R6529	1	119	32	3,808	
IBM 3M SAS cable	39R6531	1	135	6	810	
IBM Hot-Swap 3.5 inch 73.4GB 15K SAS HDD	43W7523	1	309	448	138,432	
ServicePac for 3-Year 24x7x4 Support (EXP3000)	41L2768	1	760	38		28,880
ServicePac for 3-Year 24x7x4 Support (Rack)	41L2760	1	300	2		600
				Subtotal	267,590	29,480
Server Software						
Microsoft SQL Server 2008 Enterprise x64 Edition	810-07509	2	24,999	2	49,998	
Microsoft Windows Server 2008 Enterprise x64 Edition	P72-03195	2	3,999	1	3,999	
Microsoft Problem Resolution Services	N/A	2a	245	1		245
				Subtotal	53,997	245
Client Hardware						
x3200 M2 with Intel Xeon X3360 (2.83GHz/12MB L2 Cache) 1GB (2x512GB) PC2-6400 CL6 ECC DDR2 800MHz	436776U	1-S	1,575	2	3,150	
1GB (2x512MB) PC2-6400 CL6 ECC DDR2 800MHz DIMM	46C7443	1-S	115	2	230	
73GB 15K 2.5" SFF Hot-Swap SAS	43X0837	1-S	369	4	1,476	
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	5,194	798
Client Software						
Microsoft Windows Server 2008 Standard x64 Edition	P73-04190	2	999	2	1,998	
				Subtotal	1,998	0
Infrastructure						
Ethernet Crossover Cable (2 spares)	RCW-717	3	2	4	8	
				Subtotal	8	0
				Total	364,550	31,123
Dollar Volume Discount (See Note 1)		28.94%	1		89,161	
Microsoft Open Program Discount Schedule		7.80%	2		4,366	

Pricing: 1 - IBM - 1-866-426-0472; 2 - Microsoft; 3 - newegg.com
 Note 1: Discount applies to all line items where Pricing=1; pricing is for these or similar quantities.
 Discounts for similarly sized configurations will be similar to what is quoted here, but may vary based on the components in the price quotation
 S: One or more components of the measured configuration have been substituted in the priced configuration. See the FDR for details.
 * These components are not immediately orderable. See the FDR for more information.

Three-Year Cost of Ownership USD: \$302,146
TPC-E Throughput: 798.00
\$ USD/tpsE: \$378.63

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 x3650 M2
Microsoft SQL Server 2008**

**TPC-E 1.7.0
TPC Pricing 1.4.0**

Report Date:
March 30, 2009

Availability Date:
June 30, 2009

Numerical Quantities Summary				
Reported Throughput: 798.00 tpsE		Configured Customers: 400,000		
Response Time (in seconds)	Minimum	Average	90 th Percentile	Maximum
Broker-Volume	0.00	0.03	0.06	0.35
Customer-Position	0.00	0.03	0.06	2.04
Market-Feed	0.00	0.04	0.13	2.04
Market-Watch	0.00	0.02	0.05	0.85
Security-Detail	0.00	0.02	0.03	0.97
Trade-Lookup	0.00	0.55	0.70	2.26
Trade-Order	0.00	0.09	0.14	3.26
Trade-Result	0.00	0.09	0.16	3.31
Trade-Status	0.00	0.03	0.05	1.13
Trade-Update	0.03	0.64	0.75	9.42
Data-Maintenance	0.01	0.13	N/A	0.51
Transaction Mix		Transaction Count	Mix %	
Broker-Volume		2,815,264	4.900	
Customer-Position		7,469,289	13.000	
Market-Feed		574,562	1.000	
Market-Watch		10,341,677	18.000	
Security-Detail		8,043,639	14.000	
Trade-Lookup		4,596,188	8.000	
Trade-Order		5,803,028	10.100	
Trade-Result		5,745,610	10.000	
Trade-Status		10,916,453	19.000	
Trade-Update		1,148,906	2.000	
Data-Maintenance		120	N/A	
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)			00:42:59	
Measurement Interval (hh:mm:ss)			02:00:00	
Business Recovery Time (hh:mm:ss)			00:27:54	
Total Number of Transactions Completed in Measurement Interval			57,454,616	

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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. 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.

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.

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.

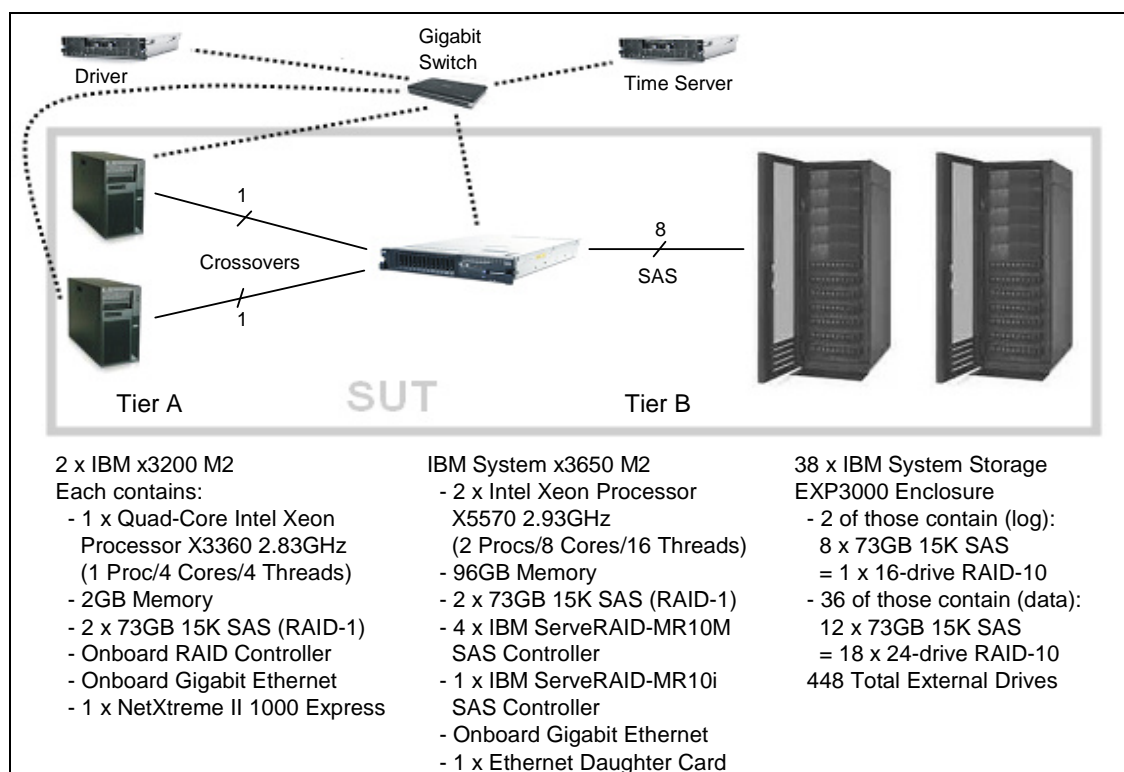
Configuration Diagrams

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.

Measured and Priced Configuration

The measured and priced configurations are shown in Figure 1-1.

Figure 1-1. Measured and Priced Configuration



The measured and priced configurations differed in only the specific model of the Tier A clients used. Both the measured and priced configurations used IBM System x3200 M2 systems, machine type 4367. The measured configuration used model 4367-72U. This specific model is no longer offered by IBM. The priced configuration used model 4367-76U. The models are identical except as follows:

- Measured model 4367-72U includes 2GB of PC2-5300 CL5 ECC DDR2 667MHz memory. The measurements were conducted with 2GB of this memory in each Tier A client.
- Priced model 4367-76U includes 1GB of PC2-6400 CL6 ECC DDR2 800MHz memory. An additional 1GB of this memory was priced for each client, bringing each of them up to 2GB.
- Measured model 4367-72U uses 3.5" SAS drives. A pair of 3.5" 73GB 15K SAS drives, per client, was therefore used for the measurements.
- Priced model 4367-76U uses 2.5" SFF SAS drives. A pair of 2.5" SFF 73GB 15K SAS drives, per client, was priced.

Disk stats were collected on the Tier A clients as the benchmark was running in steady state. These stats showed that the Tier A clients were doing less than one disk IO per second, on average.

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.

Detailed instructions for installing and configuring the SUT, hardware and software, are included in the supporting files:

- Information specific to the Tier A clients can be found in:
SupportingFiles\Introduction\TierA\TierA_x3200M2_Setup.pdf
- Information specific to the Tier B database server and storage can be found in:
SupportingFiles\Introduction\TierB\TierB_x3650M2_Setup.pdf

Clause 2- Database Design, Scaling, and Population

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.

The database was created and populated using the Microsoft TPC-E benchmark kit. Instructions for doing so are included in the supporting files. See SupportingFiles\Clause2\MSTPCE Database Setup Reference.pdf.

Changes and customizations were made to some of the kit files. First, the filegroups the database was loaded onto were changed in number from four filegroups to two. Second, several scripts were modified to customize the load to the specific hardware configuration of this SUT.

The default kit files create the database on four filegroups: customer_fg, misc_fg, broker_fg, and market_fg. That was changed so that only two filegroups were used, fixed_fg and growing_fg. The modified files are included as part of SupportingFiles\Clause2:

- All of the items in the following files should be changed to fixed_fg:
 - Utility\Create_TID_Ranges_Table.sql
 - DDL\Create_Tables_Scaling.sql
 - DDL\Create_Tables_Fixed.sql
 - DDL\Create_NC_Indexes_Scaling.sql
 - DDL\Create_NC_Indexes_Fixed.sql
 - DDL\Create_Clustered_Indexes_Scaling.sql
 - DDL\Create_Clustered_Indexes_Fixed.sql
- DDL\Create_Tables_Growing.sql
 - BROKER goes to fixed_fg
 - The rest go to growing_fg
- DDL\Create_NC_Indexes_Growing.sql
 - BROKER goes to fixed_fg (NC1 and NC2)
 - The rest go to growing_fg
- DDL\Create_Clustered_Indexes_Growing.sql
 - BROKER goes to fixed_fg
 - The rest go to growing_fg
- DDL\Create_Tables_Scaling_Flat.sql
 - NEWS_ITEM_TEMP goes to growing_fg
 - The rest go to fixed_fg

The files that were customized for this specific SUT hardware are included in the folder SupportingFiles\Clause2\400000.Cust\Database:

- Tempdb.sql creates a larger temporary database for SQL Server
- Shrinktempdb.sql shrinks it back down
- Backupdev.sql creates devices for SQL Server to backup the database to
- Dropbackupdev.sql removes those devices
- Backup_Database.sql backs up the tpce database to the specified device names
- Restore_Database.sql restores the tpce database from the specified device names
- Create_Database.sql maps the database filegroups and log to physical storage
- Flatfile.txt tells the database loader where to store the database flatfiles during the load
- Remove_Database.sql drops the current tpce database

Database Physical Organization

The physical organization of tables and indexes within the database must be reported in the Report.

The following tables and related indexes were on the growing_fg filegroup:

- CASH_TRANSACTION
- SETTLEMENT
- TRADE
- TRADE_HISTORY
- TRADE_REQUEST
- HOLDING
- HOLDING_HISTORY
- HOLDING_SUMMARY

The remaining tables and their related indexes were all on the fixed_fg filegroup.

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 for this benchmark.

Replication

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

Replication was not used for 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 for 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 400,000 customers. The cardinality is shown in Table 2-1.

Table 2-1. Initial Cardinality of Tables

Table Name	Rows
ACCOUNT_PERMISSION	2,840,015
ADDRESS	600,004
BROKER	4,000
CASH_TRANSACTION	6,359,035,497
CHARGE	15
COMMISSION_RATE	240
COMPANY	200,000
COMPANY_COMPETITOR	600,000
CUSTOMER	400,000
CUSTOMER_ACCOUNT	2,000,000
CUSTOMER_TAXRATE	800,000
DAILY_MARKET	357,570,000
EXCHANGE	4
FINANCIAL	4,000,000
HOLDING	353,876,585
HOLDING_HISTORY	9,263,259,270
HOLDING_SUMMARY	19,899,625
INDUSTRY	102
LAST_TRADE	274,000
NEWS_ITEM	400,000
NEWS_XREF	400,000
SECTOR	12
SECURITY	274,000
SETTLEMENT	6,912,000,000
STATUS_TYPE	5
TAXRATE	320
TRADE	6,912,000,000
TRADE_HISTORY	16,588,808,173
TRADE_REQUEST	0
TRADE_TYPE	5
WATCH_ITEM	40,030,356
WATCH_LIST	400,000
ZIP_CODE	14,741

Distribution of Tables and Logs

The distribution of tables, partitions and logs across all media must be explicitly depicted for the measured and priced configurations.

The database storage was the same for the measured and priced configurations.

The entire database, data and log, was stored on external SAS storage. This storage was accessed by four IBM ServeRAID-MR10M SAS controllers, filling the four PCI-E slots in the server. All of the external storage consisted of IBM System Storage EXP3000 enclosures, which can hold twelve 3.5" SAS drives each. Thirty-eight EXP3000 enclosures were connected to the server, all via SAS cables. Three of the ServeRAID-MR10M adapters connected to 10 enclosures each; the final adapter connected to 8 enclosures, 2 of which contained only 8 drives each and were used to hold the log. All the other EXP3000 enclosures held 12 drives. All of the drives were 73GB 15K 3.5" SAS. There were 448 total external drives.

The lone log array was configured as 16-drive RAID-10. Adapter write caching was disabled. The log array was broken into drives E: (RAW), for the database log, and F: (NTFS) for the database MDF.

The 18 data arrays were each configured as 24-drive RAID-10. Adapter write caching was disabled. Each data array was broken into three partitions: one for fixed_fg (RAW), one for growing_fg (RAW), and one for backup, tempdb, and flatfiles (NTFS).

The OS was loaded onto a RAID-1 array located on two 73GB SAS drives in the server. This array was handled by the ServeRAID-MR10i internal SAS controller.

Further details on the storage configuration are available in the supporting files. See the files in the directory SupportingFiles\Introduction\TierB.

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 RAID level	Partition (File System)	Size	Use
0	1	1	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx1 (RAW) c:\mp\gw1 (RAW) c:\mp\bk1 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 1 Growing 1 Backup1
1	1	1	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx2 (RAW) c:\mp\gw2 (RAW) c:\mp\bk2 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 2 Growing 2 Backup2
2	1	1	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx3 (RAW) c:\mp\gw3 (RAW) c:\mp\bk3 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 3 Growing 3 Backup3
3	1	1	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx4 (RAW) c:\mp\gw4 (RAW) c:\mp\bk4 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 4 Growing 4 Backup4
4	1	1	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx5 (RAW) c:\mp\gw5 (RAW) c:\mp\bk5 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 5 Growing 5 Backup5
5	2	2	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx6 (RAW) c:\mp\gw6 (RAW) c:\mp\bk6 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 6 Growing 6 Backup6
6	2	2	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx7 (RAW) c:\mp\gw7 (RAW) c:\mp\bk7 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 7 Growing 7 Backup7

Disk #	Controller #	Slot #	Drives Enclosure RAID level	Partition (File System)	Size	Use
7	2	2	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx8 (RAW) c:\mp\gw8 (RAW) c:\mp\bk8 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 8 Growing 8 Backup8
8	2	2	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx9 (RAW) c:\mp\gw9 (RAW) c:\mp\bk9 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 9 Growing 9 Backup9
9	2	2	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx10 (RAW) c:\mp\gw10 (RAW) c:\mp\bk10 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 10 Growing 10 Backup10
10	3	3	16 X 73.4GB SAS EXP3000 RAID-10	E: (RAW) F: (NTFS)	390.67GB 145.76GB	Log MDF
11	3	3	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx11 (RAW) c:\mp\gw11 (RAW) c:\mp\bk11 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 11 Growing 11 Backup11
12	3	3	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx12 (RAW) c:\mp\gw12 (RAW) c:\mp\bk12 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 12 Growing 12 Backup12
13	3	3	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx13 (RAW) c:\mp\gw13 (RAW) c:\mp\bk13 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 13 Growing 13 Backup13
14	4	4	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx14 (RAW) c:\mp\gw14 (RAW) c:\mp\bk14 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 14 Growing 14 Backup14
15	4	4	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx15 (RAW) c:\mp\gw15 (RAW) c:\mp\bk15 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 15 Growing 15 Backup15
16	4	4	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx16 (RAW) c:\mp\gw16 (RAW) c:\mp\bk16 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 16 Growing 16 Backup16
17	4	4	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx17 (RAW) c:\mp\gw17 (RAW) c:\mp\bk17 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 17 Growing 17 Backup17
18	4	4	24 X 73.4GB SAS EXP3000 RAID-10	c:\mp\fx18 (RAW) c:\mp\gw18 (RAW) c:\mp\bk18 (NTFS)	5.18GB 217.19GB 582.17GB	Fixed 18 Growing 18 Backup18
19	internal	N/A	2 X 73GB SAS internal RAID-1	C: (NTFS)	67.05GB	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 bulk insert the data into the tables. A further description is provided in SupportingFiles\Clause2\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 stored procedure code for the transactions was functionally equivalent to the pseudo-code. The stored procedures can be seen in SupportingFiles\Clause3\StoredProcedures.

The code to interface the stored procedures can be seen in:

- SupportingFiles\Clause3\BaseServer
- SupportingFiles\Clause3\TransactionsSP
- SupportingFiles\Clause3\TxnHarness

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 were met.

Clause 4 – SUT, Driver, and Network

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 the measured and priced configurations were the same. Refer to Figure 1-1 for a diagram of the network connections.

The Tier A clients and Tier B database server were connected by two Ethernet crossover cables. Each client was configured with one NetXtreme II 1000 Express Ethernet Adapter. A crossover cable was connected from that adapter on each client to one of the two onboard Ethernet ports on the database server. These two gigabit networks handled all of the network traffic between Tier A and Tier B while a measurement was underway.

Another network connected the driver, the database server, the clients, and a time server. This network was connected via a gigabit Ethernet switch. On each client, this network was connected to the onboard Ethernet port. On the database server, this network was connected to one of the two Ethernet ports on the Dual-port 1Gb Ethernet daughter card. This network fulfills the mandatory network between the driver and Tier A. It also allows the driver, clients, and database server to sync and verify their times with the time server.

Clause 5 – EGen

EGen Version

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

EGen v1.7.0 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.

EGen Files

The make/project files used to compile/link EGenLoader and EGenValidate must be reported in the Supporting Files. The compiler/linker options and flags used to compile/link EGen objects for the SUT must be reported in the Supporting Files.

See the supporting files directory SupportingFiles\Clause3\prj for the files related to EGenLoader and EGenValidate.

See the supporting files directory SupportingFiles\Clause3\SUT_CE_Server for the files related to the SUT_CE_Server.

See the supporting files directory SupportingFiles\Clause3\SUT_MEE_Server for the files related to the SUT_MEE_Server.

Clause 6 – Performance Metrics and Response Time

EGen Instances

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

There were four EGenDriverCEs with a total of 680 EGenDriverCE instances used in the benchmark.

There were four EGenDriverMEEs with a dynamic number of instances used in the benchmark.

Measured Throughput

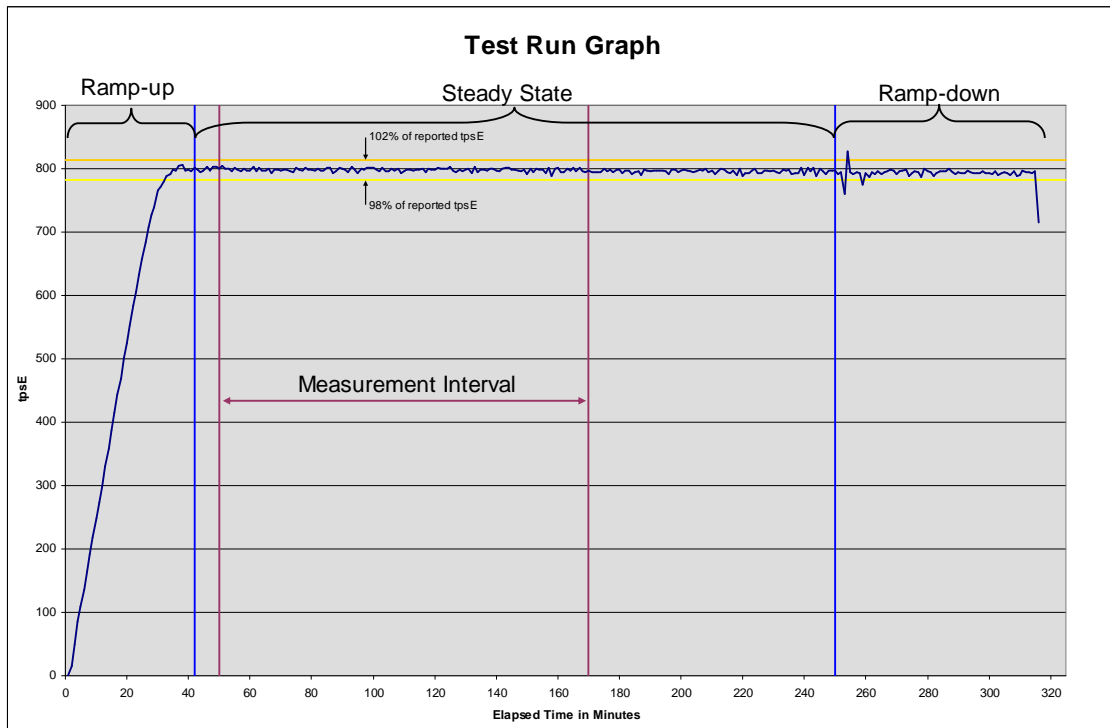
The Measured Throughput must be reported (see Clause 6.7.1.2).

The measured throughput was 798.00 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. Calculating the average tpsE over 60-minute windows during Steady State, with the start of each window 10 minutes apart. Then it was 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. Calculating the average tpsE over 10-minute windows during the Steady State, with the start of each window 1 minute apart. Then it was 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 continuously every 7½ minutes during the entire run.

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.

Table 6-1. Transaction Statistics

Input Parameter	Value	Actual Percentage	Required Range
Customer-Position			
By Tax ID	1	49.98%	48% to 52%
Get History	1	50.00%	48% to 52%
Market-Watch			
Securities chosen by	Watch List	59.99%	57% to 63%
	Account ID	35.02%	33% to 37%
	Industry	4.99%	4.5% to 5.5%
Security-Detail			
Access LOB	1	1.01%	0.9% to 1.1%
Trade-Lookup			
Frame to execute	1	29.99%	28.5% to 31.5%
	2	29.99%	28.5% to 31.5%
	3	30.03%	28.5% to 31.5%
	4	10.00%	9.5% to 10.5%
Trade-Order			
Transactions requested by a third party		9.99%	9.5% to 10.5%
By Company Name		40.00%	38% to 42%
Buy On Margin	1	8.01%	7.5% to 8.5%
Rollback	1	0.99%	0.94% to 1.04%
LIFO	1	35.00%	33% to 37%
Trade Quantity	100	25.02%	24% to 26%
	200	24.97%	24% to 26%
	400	25.00%	24% to 26%
	800	25.01%	24% to 26%
Trade Type	Market Buy	30.05%	29.7% to 30.3%
	Market Sell	29.96%	29.7% to 30.3%
	Limit Buy	20.00%	19.8% to 20.2%
	Limit Sell	9.99%	9.9% to 10.1%
	Stop Loss	10.01%	9.9% to 10.1%
Trade-Update			
Frame to execute	1	33.12%	31% to 35%
	2	32.99%	31% to 35%
	3	33.89%	32% to 36%

Clause 7 – Transaction and System Properties

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.*

The procedure for running the atomicity tests is documented in the file SupportingFiles\Clause7\MSTPCE ACID Procedures.pdf

The atomicity scripts and outputs are located in the directory SupportingFiles\Clause7\Atomicity

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.

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 $(HS_S_SYMB = H_S_SYMB)$

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 procedure for running the consistency tests is documented in the file SupportingFiles\Clause7\MSTPCE ACID Procedures.pdf

The consistency scripts and outputs are located in the directory SupportingFiles\Clause7\Consistency

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.

Isolation tests 1 through 4 were successfully done following the procedure documented in the file SupportingFiles\Clause7\MSTPCE ACID Procedures.pdf

The isolation scripts and outputs are located in the directory SupportingFiles\Clause7\Isolation

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. The test for Redundancy Level 1 is the test for permanent irrecoverable failure of any single durable medium.

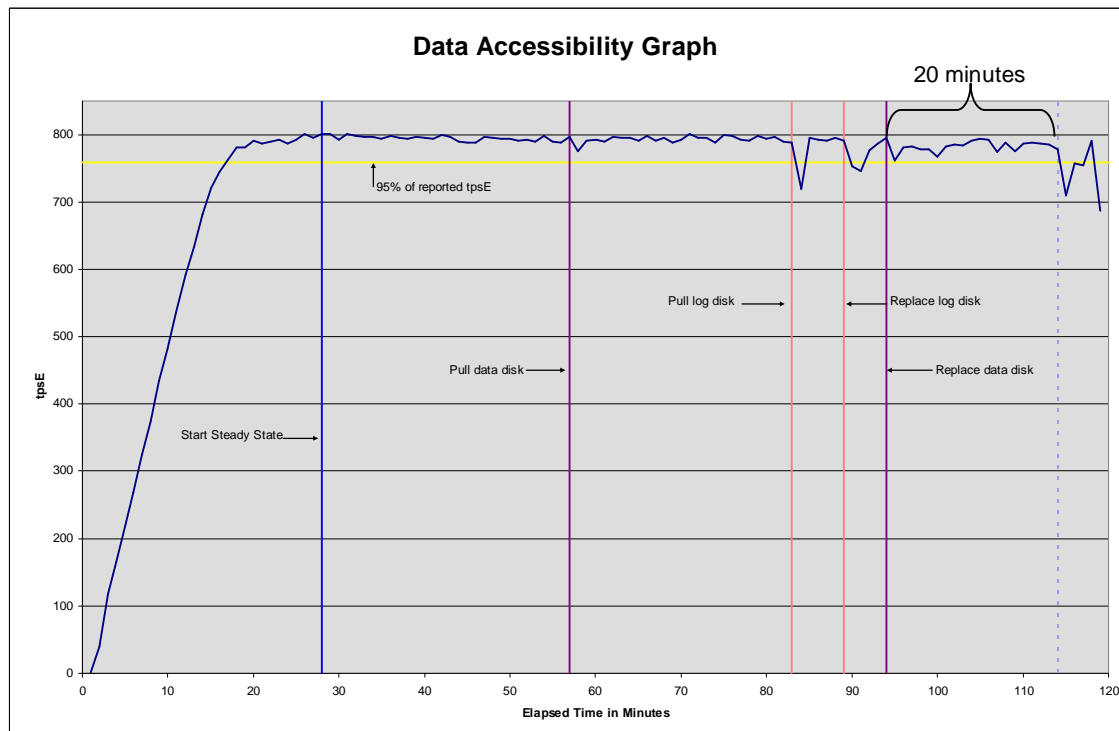
To prove Redundancy Level 1, the following steps were successfully performed:

1. Determined the current number of completed trades in the database by running *select count(*) as count1 from SETTLEMENT.*
2. Started a run, using the profile from the measured run, with checkpoints, and let it get to steady state for at least 5 minutes with a score at least 95% of the reported throughput.
3. Induced the first failure, which in this case was failing a drive in a database data array by physically removing it from its enclosure. Since the database data arrays are RAID protected, transaction processing continued.
4. Let the performance get back to steady state, again over 95% of the reported throughput, for at least 5 minutes.
5. Induced the second failure, which in this case was failing a drive in the database log array by physically removing it from its enclosure. Since the database log array is RAID protected, transaction processing continued.
6. After a few minutes passed, a new drive was inserted into the log enclosure to replace the failed log drive. The log array rebuilding process commenced automatically.
7. After a few minutes passed, a new drive was inserted into the data enclosure to replace the failed data drive. The data array rebuilding process commenced automatically.
8. Continued running the benchmark for at least 20 minutes.
9. Terminated the run gracefully.
10. Retrieved the new number of completed trades in the database by running *select count(*) as count2 from SETTLEMENT.*

11. Verified that (count2 – count1), which is the number of completed trades done during the run, equaled the number of successful Trade-Result transactions reported by the Driver.
12. Allowed the recovery process to complete.

Figure 7-1 is a graph of the measured throughput versus elapsed time for the data accessibility run. The timings of the induced failures as well as the recovery process are indicated.

Figure 7-1. Data Accessibility Graph



The files related to this data accessibility test are located in SupportingFiles\Clause7\Durability\DataAccessibility

Durability Test for Business Recovery

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 test Business Recovery:

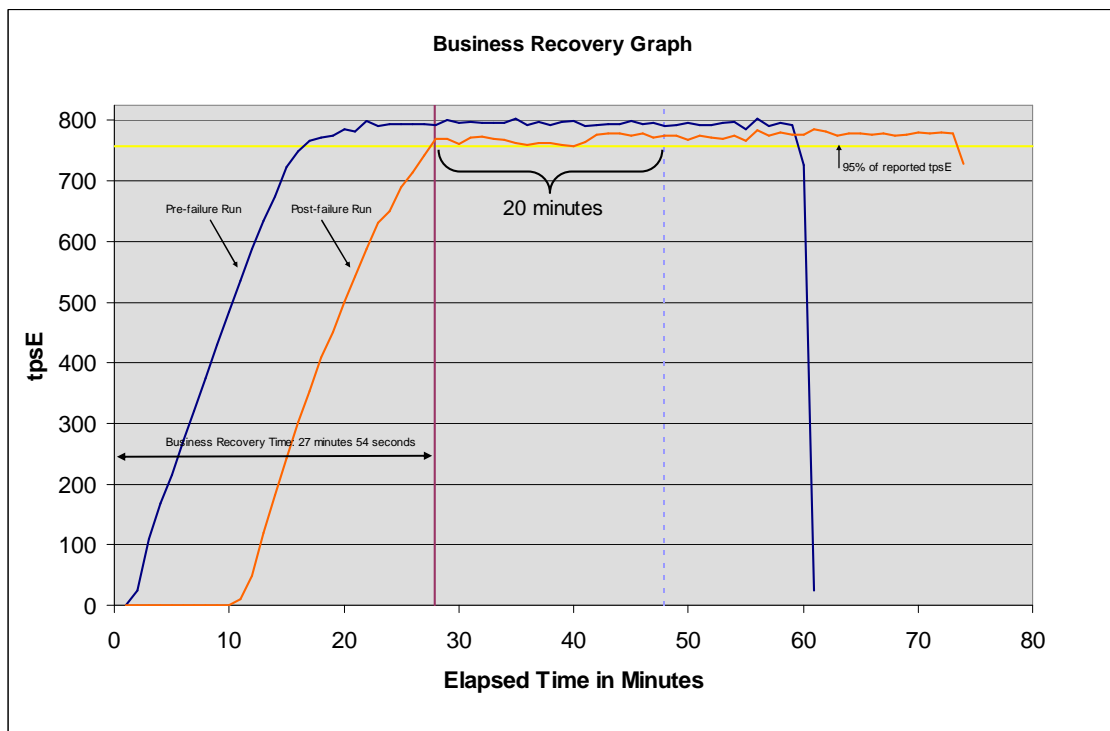
1. Determined the current number of completed trades in the database by running `select count(*) as count1 from SETTLEMENT`.
2. Started a run, using the profile from the measured run, with checkpoints, and let it get to steady state for at least 20 minutes with a score at least 95% of the reported throughput.
3. Pulled the power cords from the x3650 M2 database server.
4. Stopped the driver.
5. Plugged in and restarted the database server.
6. Started SQL Server on the database server. It automatically began recovery of the tpce database. The timestamp in the SQL Server ERRORLOG of the first message related to database tpce is considered the start of the database recovery time.

7. Waited for SQL Server to finish recovering the database. The timestamp in the SQL Server ERRORLOG of the message indicating that the recovery of database tpcE is complete is considered the end of the database recovery time.
8. Started a run, using the profile from the measured run, with checkpoints. The time when the first transaction is submitted to the database is considered the start of the application recovery time.
9. Let the run proceed until it ran for at least 20 minutes with a score at least 95% of the reported throughput. The time of the beginning of that 20-minute window is considered the end of the application recovery time.
10. Terminated the run gracefully.
11. Verified that no errors were reported during steps 8 through 10.
12. Retrieved the new number of completed trades in the database by running *select count(*) as count2 from SETTLEMENT*.
13. Verified that $(count2 - count1)$, which is the number of completed trades done during the run, was greater than or equal to the combined number of successful Trade-Result transactions reported by the Driver for both runs. In the case of an inequality, verified that the difference is less than or equal to the maximum number of transactions that could be in-flight from the Driver to the SUT.
14. Verified database consistency.

Figure 7-2 is a graph of the measured throughput versus elapsed time for the business recovery runs.

The database recovery time was 00:10:01. The application recovery time was 00:17:53. The Business Recovery Time, which is the sum of the database recovery time and the application recovery time, was 00:27:54.

Figure 7-2. Business Recovery Time Graph



The files related to this business recovery test are located in SupportingFiles\Clause7\Durability\BusinessRecovery

Clause 8 – Pricing

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

TPC-E Disk Space Requirements													
Customers Used	400,000	Performance			798.00	TpsE		Reported			798.00	TpsE	
	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	4,000	224	408	32	664	856	224	359	359				
CASH_TRANSACTION	6,359,035,497	630,016,800	1,328,328	31,567,256	662,912,384	655,533,200	24,188,072	38,720,996	38,720,996				
CHARGE	15	8	8	1	17	16	-	-	1				
COMMISSION_RATE	240	16	16	2	34	32	-	-	2				
SETTLEMENT	6,912,000,000	339,201,288	715,200	16,995,824	356,912,312	362,683,864	22,767,376	36,446,703	36,446,703				
TRADE	6,912,000,000	766,426,104	410,736,792	58,858,145	1,236,021,041	1,201,775,584	24,612,688	39,400,734	39,400,734				
TRADE_HISTORY	16,588,808,173	475,664,824	1,240,416	23,845,262	900,750,502	479,584,176	2,678,936	4,288,522	4,288,522				
TRADE_REQUEST	-	-	-	-	-	15,352	15,352	24,576	24,576				
TRADE_TYPE	5	8	1,032	52	1,092	1,040	-	-	52				
ACCOUNT_PERMISSION	2,840,015	241,760	1,576	12,167	255,503	243,704	368	590	12,167				
CUSTOMER	400,000	67,752	17,808	4,278	89,838	85,576	16	26	4,278				
CUSTOMER_ACCOUNT	2,000,000	185,728	220,944	20,334	427,006	406,672	-	-	20,334				
CUSTOMER_TAXRATE	800,000	16,696	408	855	17,959	17,296	192	308	855				
HOLDING	353,876,585	18,856,736	13,981,152	1,641,894	34,479,782	49,597,384	16,759,496	26,829,107	26,829,107				
HOLDING_HISTORY	9,263,259,270	336,845,840	175,546,256	25,619,605	538,011,701	515,371,384	2,979,288	4,769,335	4,769,335				
HOLDING_SUMMARY	19,899,625	676,472	2,800	33,964	713,236	1,360,544	681,272	1,090,601	1,090,601				
WATCH_ITEM	40,030,356	1,099,200	4,256	55,173	1,158,629	1,103,848	392	628	55,173				
WATCH_LIST	400,000	9,968	8,416	919	19,303	18,384	-	-	919				
COMPANY	200,000	43,504	12,176	2,784	58,464	55,704	24	39	2,784				
COMPANY_COMPETITOR	600,000	16,120	13,368	1,474	30,962	29,488	-	-	1,474				
DAILY_MARKET	357,570,000	18,368,704	7,783,528	1,307,612	27,459,844	26,154,112	1,880	3,010	1,307,612				
EXCHANGE	4	8	8	1	17	16	-	-	1				
FINANCIAL	4,000,000	470,632	1,648	23,614	495,894	472,672	392	628	23,614				
INDUSTRY	102	8	40	2	50	48	-	-	2				
LAST_TRADE	274,000	12,760	416	659	13,835	25,968	12,792	20,478	20,478				
NEWS_ITEM	400,000	43,367,376	840	2,168,411	45,536,627	43,368,320	104	167	2,168,411				
NEWS_XREF	400,000	9,968	416	519	10,903	10,384	-	-	519				
SECTOR	12	8	24	2	34	32	-	-	2				
SECURITY	274,000	43,088	18,824	3,096	65,008	61,920	8	13	3,096				
STATUS_TYPE	5	8	8	1	17	16	-	-	1				
ADDRESS	600,004	34,608	408	1,751	36,767	35,064	48	77	1,751				
TAXRATE	320	24	16	2	42	56	16	26	42				
ZIP_CODE	14,741	488	144	32	664	632	-	-	32				
TOTALS (KB)		2,631,676,728	611,637,680	162,165,720	3,405,480,128								
Initial Database Size (MB)		3,167,299	3,093 GB										
Db/Filegroup	LUN Count	Partition Size(KB)	MB allocated	MB Loaded	MB Required								
growing_fg	18	227,737,600	4,003,200	3,096,913	3,244,931					OK			
fixed_fg	18	5,427,200	95,400	70,386	73,925					OK			
Settlements	14,356,551									OK			
Initial Growing Space (MB)	3,096,913												
Final Growing Space (MB)	3,189,376	Data LUNS	18	Initial Log Size (MB)	12,643	Log LUNS	1						
Delta (MB)	92,463	Disks per LUN	24	Final Log Size (MB)	155,130	Log Disks	16						
Data Space per Trade (MB)	0.006440499	Disk Capacity (MB)	68,664	Log Growth (MB)	142,487	Disk Capacity (MB)	68,664						
1 Day Data Growth (MB)	148,018	RAID Overhead	50%	Log Growth/Trade (MB)	0.009924006532	RAID Overhead							
60 Day Space (MB)	12,048,587	Total Space (MB)	14,831,424	1 Day Log Space (MB)	228,098	Log Space (MB)	549,312						

OK

OK

The 60-day space calculations are included in SupportingFiles\Clause8\ tpc_e_space.xls

Availability Date

The committed delivery date for general availability (availability date) of products used in the price calculations must be reported. When the priced system includes products with different availability dates, the reported availability for the priced system must be the date at which all components are committed to be available.

The total solution as priced will be generally available June 30, 2009. The dates for ordering and availability are detailed in Table 8-2 for those components that are not immediately orderable.

Table 8-2. Ordering and Pricing Information

Description	Part Number	Order Date	Availability Date	Order Method	Price Verification
x3650 M2 with Intel Xeon Processor X5570	794792U	03-31-2009	04-30-2009	See Note 1	See Note 2
Dual port 1Gb Ethernet Daughter Card	46M1076	03-31-2009	04-30-2009	See Note 1	See Note 2
Intel Xeon Processor X5570	46M1087	03-31-2009	04-30-2009	See Note 1	See Note 2
IBM 8 GB PC2-5300 AMF 8GB (1x8GB) Dual Rank	44C7449	06-30-2009	06-30-2009	See Note 1	See Note 2

Note 1: IBM, 1-866-426-0472

Note 2: These components are not immediately orderable. For price verification before the order date, call 1-866-426-0472.

Supporting Files Index

An index of the files contained in the supporting files is here: [SupportingFiles\SupportingFilesIndex.pdf](#)

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.

Celia Schreiber, Manager
 IBM System x and BladeCenter Performance Analysis and Benchmarking
 IBM Systems and Technology Group
 3039 Cornwallis Road
 RTP, NC 27709

March 25, 2009

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

Platform: IBM System x3650 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 x3650 M2				
2 x Intel Xeon X5570 (2.93GHz)	96 GB (8 x 256 KB L2) (2 x 8MB L3)	450 x 73.4 GB 15K SAS	0.16 Seconds	798.00
Tier A, Two Clients: IBM System x3200 M2				
1 x Intel Xeon X3360 (2.83 GHz)	2 GB (2 x 6MB L2)	2 x 73 GB 15K SAS	n/a	n/a

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

The following verification items were given special attention:

- All EGen components were verified to be v1.7.0.
- The transactions were correctly implemented.
- The database was properly scaled and populated for 400,000 customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.

- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.
- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 00:27:54 was correctly measured.
- The 60 day storage requirement was correctly computed.
- The system pricing was verified for major components and maintenance.

Additional Audit Notes:

The measured system included (2) IBM System x3200 M2 4367-72U Tier-A client systems that were substituted by (2) IBM System x3200 M2 4367-76U Tier-A client systems in the priced configuration. Based on the specifications of these systems and on performance data collected during testing, it is my opinion that this substitution has no significant effect on performance.

Respectfully Yours,



Doug Johnson, Auditor



François Raab, President

Appendix A – Price Quotes



Confirmation number	145917939
Last modified	March 23, 2009 9:31:16 PM MST
Expires	April 22, 2009
Prepared for	Chris King

Your quote details

Part number / Description	Quantity	List			Approved		
		Component price	Line / Configuration	Total price	Component price	Line / Configuration	Total price
41L2768 3 Year Onsite Repair 24x7 4 Hour Response	38		\$760.00	\$28,880.00		\$638.00	\$24,244.00
43X0837 IBM Server 73GB SAS 15K 2.5" SFF HS	2		\$369.00	\$738.00		\$280.00	\$560.00
39R6531 IBM 3m SAS Cable	6		\$135.00	\$810.00		\$92.00	\$552.00
43X0837 IBM Server 73GB SAS 15K 2.5" SFF HS	2		\$369.00	\$738.00		\$280.00	\$560.00
46C7443 1GB (2x512MB) PC2-6400 CL6 ECC DDR2 800MHz DIMM	2		\$115.00	\$230.00		\$90.00	\$180.00
41L2760 3 Year Onsite Repair 24x7 4 Hour Response	2		\$300.00	\$600.00		\$252.00	\$504.00
43W7523 73GB 15K 3.5" SAS Hot-Swap HDD	448		\$309.00	\$138,432.00		\$219.00	\$98,112.00
39R6529 IBM 1m SAS Cable	32		\$119.00	\$3,808.00		\$81.00	\$2,592.00
172701X IBM System Storage EXP3000	38		\$3,199.00	\$121,562.00		\$2,175.00	\$82,650.00
93074RX NetBAY S2 42U Standard Rack Cabinet	2		\$1,489.00	\$2,978.00		\$1,229.00	\$2,458.00
21P2078 3 Year Onsite Repair 24x7 4 Hour Response	1		\$600.00	\$600.00		\$504.00	\$504.00
40K9201 IBM 3 Button Optical Mouse - Black - USB	1		\$19.00	\$19.00		\$13.00	\$13.00
40K9584 IBM Preferred Pro Keyboard USB - US English 103P	1		\$29.00	\$29.00		\$18.00	\$18.00
43W4339 ServeRAID-MR10M SAS/SATA Controller	4		\$899.00	\$3,596.00		\$562.00	\$2,248.00
43X0837 IBM Server 73GB SAS 15K 2.5" SFF HS	2		\$369.00	\$738.00		\$280.00	\$560.00
51J9054 3 Year Onsite Repair 24x7 4 Hour Response	2		\$399.00	\$798.00		\$335.00	\$670.00
436776U IBM System x3200 M2	2		\$1,575.00	\$3,150.00		\$1,102.00	\$2,204.00
39Y6066 NetXtreme II 1000 Express Ethernet Adapter	2		\$169.00	\$338.00		\$127.00	\$254.00
		Subtotal		\$308,044.00			\$218,883.00
		Total					\$218,883.00
		Your savings		\$89,161.00			

Shipping & delivery

Shipping method: Standard Shipping

Shipping address
Not available

Comments

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Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

March 20, 2009

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
810-07509	SQL Server 2008 Enterprise x64 Edition <i>Per Processor License</i> <i>Discount Schedule: Open Program - No Level</i> <i>Unit Price reflects a 4% discount from the retail unit price of \$24,999.</i>	\$23,911	2	\$47,822
P73-04190	Windows Server 2008 Standard Edition (x64) <i>Server License with 5 CALs</i> <i>Discount Schedule: Open Program - No Level</i> <i>Unit Price reflects a 27% discount from the retail unit price of \$999.</i>	\$725	2	\$1,450
P72-03195	Windows Server 2008 Enterprise Edition (x64) <i>Server License with 25 CALs</i> <i>Discount Schedule: Open Program - No Level</i> <i>Unit Price reflects a 41% discount from the retail unit price of \$3,999.</i>	\$2,357	1	\$2,357
N/A	Microsoft Problem Resolution Services <i>Professional Support</i> <i>(1 Incident)</i>	\$245	1	\$245

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



All products listed above are currently orderable and available.

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

This quote is valid for the next 90 days.



Shopping Cart

Qty.	Product Description	Savings	Total Price
1	 Acer V173 b Black 17" 5ms LCD Monitor - Retail Item #: N82E16824009136 Return Policy: LCD Limited Non-Refundable 30-Day Return Policy	-\$20.00 Instant	\$119.99 \$99.99
1	 Rosewill RCW-717 3ft. Network Cable Cat 6 (Crossover) Yellow - Retail Item #: N82E16812119153 Return Policy: Standard Return Policy		\$1.29
Subtotal:			\$101.28
Calculate Shipping Zip Code: <input type="text" value="UPS Guaranteed 3 Day Service"/>		Shipping:	\$0.00
Redeem Gift Certificates Claim Code: Security Code:		Gift Certificates:	\$0.00
Apply Promo Code(s):		Promo Code:	\$0.00
Grand Total:*			\$101.28

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

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