TPC Benchmark™ E
Full Disclosure Report
for
IBM® System x3850 M2
using
Microsoft® SQL Server 2005
Enterprise x64 Edition SP2
and
Microsoft Windows® Server 2003
R2 Enterprise x64 Edition

TPC-E Version 1.2.0

Submitted for Review
October 23, 2007

IBM Corporation

First Edition – October 2007

Trademarks

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 with attached IBM System Storage™ DS4800. This report documents the full disclosure information required by the TPC Benchmark E Standard Specification, Revision 1.2.0, including the methodology used to achieve the reported results. All testing fully complied with this revision level.

The software used on the IBM System x3850 M2 system includes Microsoft® Windows® Server 2003 R2 Enterprise x64 Edition operating system and Microsoft SQL Server 2005 Enterprise x64 Edition SP2.

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.

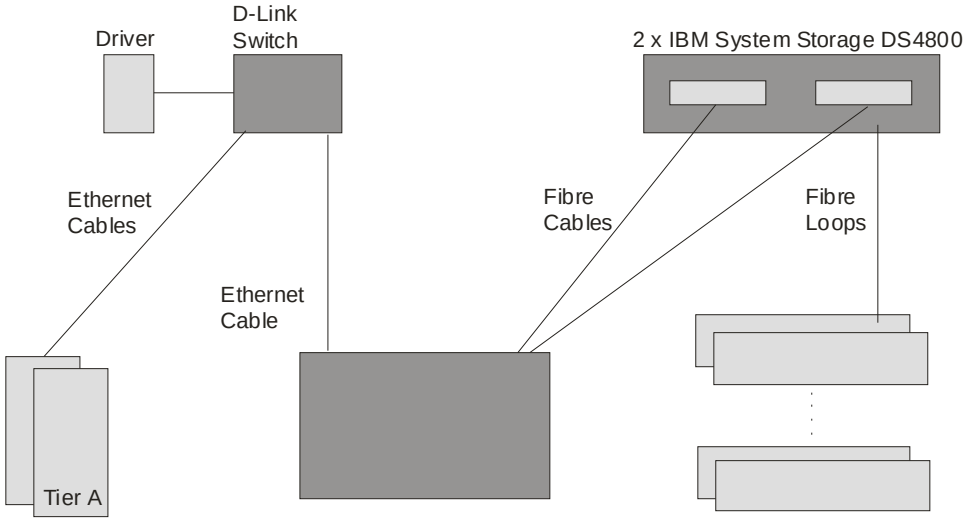
Hardware	Software	Total System Cost	tpsE	$ USD /tpsE	Total Solution Availability Date
IBM System x3850 M2	Microsoft SQL Server 2005 Enterprise x64 Edition SP2 Microsoft Windows Server 2003 R2 Enterprise x64 Edition	$641,140	419.80	$ 1,527.25	December 7, 2007

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 2005**		TPC-E Revision 1.2.0 TPC Pricing 1.2.0 Report Date: October 23, 2007
TPC-E Throughput **419.80 tpsE**	Price/Performance **$ 1,527.25 USD per tpsE**	Availability Date **December 7, 2007**	Total System Cost **$ 641,140 USD**

Database Server Configuration

Operating System	Database Manager	Processors/Cores/ Threads	Memory
Microsoft Windows Server 2003 R2 Enterprise x64 Edition	**Microsoft SQL Server 2005 Enterprise x64 Edition SP2**	**4/16/16**	**128GB**



2 x IBM System x3500
Each contains:
1 x Quad-Core Intel Xeon Processor E5345 2.33GHz (1 Processor, 4 Cores, 4 Threads)
4GB of Memory
2 x 73.4GB SAS Drive (RAID-1 for OS, Onboard RAID Controller, Onboard Dual-Port 1 Gigabit Ethernet Controller)

IBM System x3850 M2
4 x Quad-Core Intel Xeon Processor X7350 2.93GHz (4 Processors, 16 Cores, 16 Threads)
128GB of Memory
2 x IBM 4Gb FC Dual-Port PCI-E HBA
1 x IBM NetXtreme II 1000 Express Ethernet Adapter

24 x IBM System Storage EXP810 Enclosure
Each Contains:
16 x 36.4GB 15K rpm Drives
(Total of 384 Drives arrayed as:
1 x 16-Disk RAID-10
23 x 16-Disk RAID-5)

Initial Database Size	Redundancy Level: 1	Storage
1,774 GB	**RAID-10 Log + RAID-5 Data**	**384 x 36.4 GB 15K**

IBM System x3850 M2
Microsoft SQL Server 2005

TPC-E Revision 1.2.0
TPC Pricing Spec 1.2.0

Report Date:
October 23, 2007

Availability Date:
December 7, 2007

Description	Part Number	Price Source	Unit Price	Quantity	Extended Price	3-Yr. Maint. Price
Server Hardware						
IBM System x3850 M2 (2 x Intel Xeon Processor X7350 (2.93GHz/2x4MB L2 Cache) with 4 Memory Cards and 8 x 1GB DIMM	7141-4RU	1a	17,499	1	17,499	
Intel Xeon Processor X7350 (2.93GHz/1066MHz FSB/2x4MB L2)	44E4243	1a	4,799	2	9,598	
8GB (2x4GB) PC2-5300 CL5 ECC DDR2 SDRAM (Chipkill)	41Y2768	1b	4,299	16	68,784	
73GB 10K 2.5" Hot-Swap SAS SFF	40K1052	1b	319	2	638	
IBM 4Gb FC Dual-Port PCI-E HBA for IBM System x	39R6527	1a	1,329	2	2,658	
NetXtreme II 1000 Express Ethernet Adapter	39Y6066	1b	279	1	279	
IBM T115 15-inch TFT Display	494215U	1a	209	1	209	
IBM Preferred Pro USB Keyboard	40K9584	1b	29	1	29	
IBM 3-Button Optical Mouse - Black - USB	40K9201	1b	19	1	19	
ServicePac for 3-Year 24x7x4 Support (x3850 M2)	96P2688	1b	3,390	1		3,390
ServicePac for 3-Year 24x7x4 Support (Display)	10N3110	1b	90	1		90
				Subtotal	99,713	3,480
Server Storage						
4 Gbps SW SFP Transceiver 4 Pack	22R4897	1b	550	9	4,950	
IBM 1m LC-LC Fibre Channel Cable	39M5696	1b	79	40	3,160	
IBM 5m LC-LC Fibre Channel Cable	39M5697	1b	129	12	1,548	
IBM S2 42U Standard Rack	93074RX	1b	1,489	3	4,467	
IBM UPS 750TLV	2130R1X	1b	299	1	299	
ServicePac for 3-Year 24x7x4 Support (Rack)	41L2760	1b	300	3		900
IBM System Storage DS4800 Disk Upgrade to 8GB Cache	1815-82A	2	53,995	2	107,990	
IBM System Storage DS4000 EXP810 Storage Exp. Unit	1812-81A	2	6,000	24	144,000	
36.4GB 15K 4Gbps FC E-DDM Hot-Swap HDD	40K6812	2	892	384	342,528	
ServicePac for 3-Year 24x7x4 Support (EXP810)	10N3651	2	960	24		23,040
ServicePac for 3-Year 24x7x4 Support (DS4800)	41C5953	2	3,200	2		6,400
				Subtotal	608,942	30,340
Server Software						
Microsoft SQL Server 2005 Enterprise x64 Edition	810-03150	3a	24,999	4	99,996	
Microsoft Windows Server 2003 R2 Enterprise x64 Edition	P72-01684	3a	3,999	1	3,999	
Microsoft Problem Resolution Services		3b	245	1		245
				Subtotal	103,995	245
Client Hardware						
x3500 with Intel Xeon E5345 (2.33GHz/8MB), 4GB Memory	7977EGU	1a	2,599	2	5,198	
73.4GB 15K 3.5" Hot-Swap SAS	40K1043	1b	309	4	1,236	
ServicePac for 3-Year 24x7x4 Support (x3500)	21P2084	1b	689	2		1,378
				Subtotal	6,434	1,378
Client Software						
Microsoft Windows Server 2003 R2 Standard Edition	P73-01972	3a	999	2	1,998	
				Subtotal	1,998	0
Infrastructure						
D-Link DGS 1008TLEthernet Switch (2 spares)	DGS1008TL	4	206	4	824	
Ethernet Cable (2 spares)	A3L791-10-BLK	5	4	11	44	
				Subtotal	868	
				Total	821,950	35,443
IBM Large Purchase Discount (See Note 1.)	28.38%	1b			-25,872	
Compsat Technology Large Purchase Discount	29.15%	2			-181,888	
Microsoft Open Program Discount Schedule	8.01%	3a			-8,493	

Pricing: 1 - IBM - 1-888-SHOP-IBM, ext. 5821; 2 - Compsat Technology
3 - Microsoft; 4 - www.superwarehouse.com; 5 - newegg.com
Note 1: Discount based on IBM Direct guidance applies to all line items where Pricing=1b. Pricing is for this system or one of similar size.
Note 2: Discount applies to all line items where Pricing=2; pricing is for these or similar quantities.

Three-Year Cost of Ownership USD: $641,140

TPC-E Throughput: 419.80

$ USD/tpsE: $1,527.25

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 2005

TPC-E Revision 1.2.0
TPC Pricing Spec 1.2.0

Report Date:
October 23, 2007

Availability Date:
December 7, 2007

Reported Throughput: 419.80 tpsE	**Configured Customers: 230,000**

Response Time (in seconds)	**Minimum**	**Average**	**90Th Percentile**	**Maximum**
Broker-Volume	0.00	0.05	0.08	1.56
Customer-Position	0.00	0.04	0.07	0.27
Market-Feed	0.00	0.04	0.07	0.44
Market-Watch	0.00	0.04	0.08	0.71
Security-Detail	0.00	0.02	0.04	1.41
Trade-Lookup	0.00	0.46	0.64	0.98
Trade-Order	0.00	0.11	0.17	1.55
Trade-Result	0.00	0.12	0.18	3.44
Trade-Status	0.00	0.03	0.05	0.37
Trade-Update	0.02	0.55	0.70	1.21
Data-Maintenance	0.01	0.11	N/A	1.43

Transaction Mix	**Transaction Count**	**Mix %**
Broker-Volume	1,481,229	4.900
Customer-Position	3,929,916	13.000
Market-Feed	302,262	1.000
Market-Watch	5,441,519	18.001
Security-Detail	4,232,089	14.000
Trade-Lookup	2,418,134	7.999
Trade-Order	3,053,256	10.100
Trade-Result	3,022,591	9.999
Trade-Status	5,743,993	19.001
Trade-Update	604,568	2.000
Data-Maintenance	124	N/A

Test Duration and Timings	
Ramp-up Time	00:41:00
Measurement Interval	02:00:00
Business Recovery Time	01:17:48
Total Number of Transactions Completed in Measurement Interval	30,229,557

Table of Contents

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 are the same. The configuration diagram for the measured and priced system is provided on the following pages.

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 xSeries 226 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 x3500 servers, each with one Quad-Core Intel® Xeon® Processor E5345 (2.33GHz with 2 x 4MB L2 Cache), 4GB of memory, two onboard 73.4GB SAS drives in a RAID-1 array for the operating system, which is Microsoft Windows Server 2003 R2 Standard x86 Edition. Tier A communicates with Tier B and the Driver over an Ethernet network using the IBM System x3500's onboard 1Gb Ethernet card.

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

- Four Quad-Core Intel Xeon Processor X7350 (2.93GHz with 2 x 4MB L2 Cache)
- 128GB of memory
- Two 73.4GB 10K rpm 2.5" Hot-Swap SAS SFF onboard drives in a RAID-1 array for the operating system, which is Microsoft Windows Server 2003 R2 Enterprise x64 Edition (SP2) with Microsoft SQL Server 2005 Enterprise x64 Edition SP2
- Two IBM 4Gb Fibre Channel Dual-Port PCI-E HBA cards
- One NetXtreme II 1000 Express Ethernet Adapter.

The x3850 M2 has an onboard dual-port 1Gb Ethernet card, but for the measurements this was disabled in BIOS. Each IBM 4Gb Fiber Channel Dual-Port PCI-E HBA card has two Fibre Channel cable connections. One cable is connected to controller A of an IBM System Storage DS4800 controller. The other cable is connected to controller B of an IBM System Storage DS4800 controller. Each DS4800 is connected to 12 IBM System Storage EXP810 disk enclosures. Each EXP810 disk enclosure has sixteen 36.4GB 15Krpm drives. The 384 drives are organized as:

- One 16-disk RAID-10 array for the database log
- Twenty-three 16-disk RAID-5 arrays for the database data

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 broker tables and another RAW partition for all the other TPC-E tables (customer, market and dimension all in one file group called customer). The rest of the space on the LUN is an NTFS partition used for DB backups or the temp DB, or is not used at all.

Tier B communicates with Tier A over an Ethernet network using the NetXtreme II 1000 Express Ethernet Adapter with TOE (TCP/IP Offload Engine) enabled. One Ethernet cable comes out of the NetXtreme II

1000 Express Ethernet Adapter and runs to a D-Link 8-port Ethernet switch that also has the Ethernet cables from the Tier A and Driver machines.

Measured and Priced Configuration

The measured and priced configurations are the same.

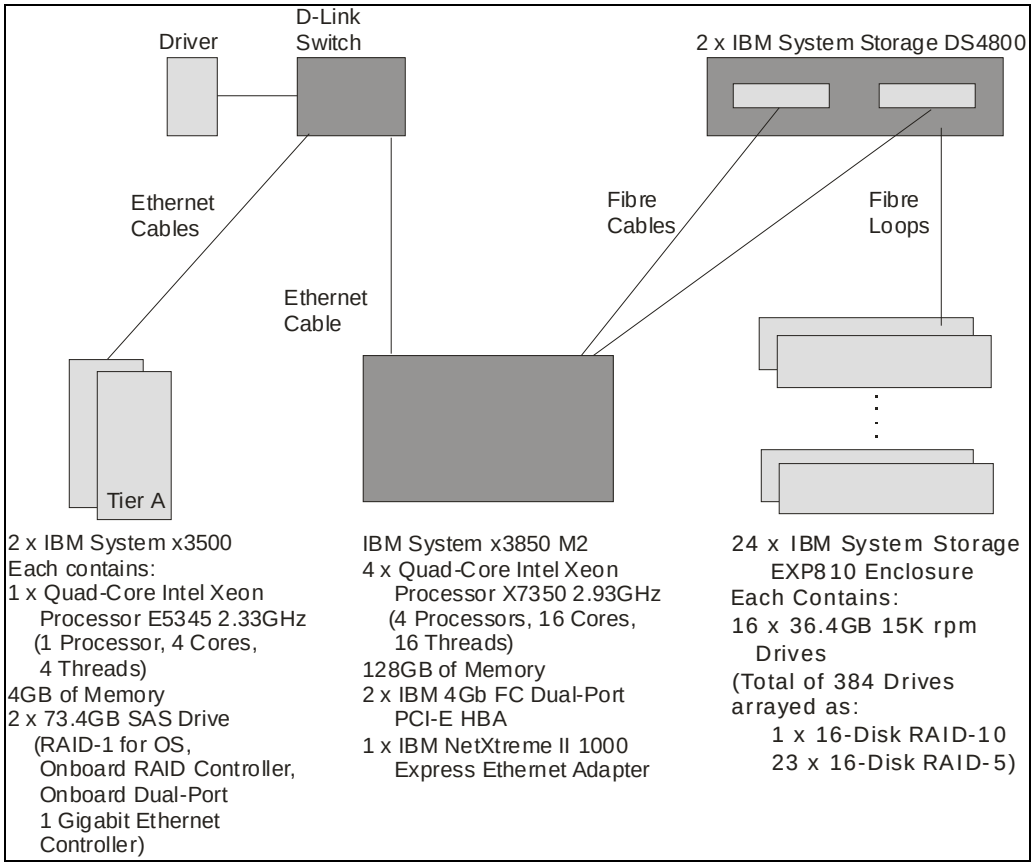


Figure 1-2. Measured and Priced Configuration

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 xSeries x226 machine running Microsoft Windows Server 2003 R2 Standard x86 Edition was used. The Microsoft Benchcraft proprietary driver was installed on the machine. An Ethernet cable was run from the machine's onboard Ethernet controller to the D-Link switch. The driver machine was configured with an IP address of 192.168.200.12.

Tier A

The IBM System x3500 comes with one Quad-Core Intel Xeon E5345 Processor and 4GB of memory. Insert two 73.4GB SAS drives. Temporarily, attach a USB floppy driver to the IBM System x3500. Power on the IBM System x3500. During POST press Ctrl-A when prompted to drop into the IBM ServeRAID Config Utility to configure the drives. Pick "Array Configuration Utility." Initialize both drives. Create the array using:

- RAID-1
- Read caching: Y
- Quick Initialization

Once the RAID array has been created, escape to the main menu and select "Serial Select Utility" – "Controller Configuration," and "Disable Array background consistency check." Then exit the tool; the IBM System x3500 will restart. Boot from the installation CD for Microsoft Windows Server 2003 Standard x86 Edition. Press F6 when prompted to load the Driver for the SAS RAID controller from diskette. The driver can be downloaded from www.ibm.com. During the operating system install, select the per seat 9999 option.

Once the operating system is installed, install the onboard 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 192.168.200.7 for one port on the first IBM System x3500. Leave the other port of the dual-port onboard Ethernet card as DHCP. On the second IBM System x3500 set a static IP address 192.168.200.8 for one port and 192.168.128.8 for the other port of the dual-port onboard Ethernet card. Connect an Ethernet cable from the 190.168.128.8 port. The other end of the Ethernet cable will be connected to a second D-Link switch which has Ethernet connections to the IBM System Storage DS4800s. Connect Ethernet cables to the 192.168.200.7 and 192.168.200.8 ports. The other end of each of the Ethernet cables connects to the first D-Link switch, which has connections to the Driver and Tier B machines. Install the Microsoft SQL Server Workstation components (client), SUT_CE_Server.exe and SUT_MEE_Server.exe.

External storage subsystem

Before powering on the EXP810 enclosures and the DS4800s, load all 24 EXP810s with the 36.4GB 15K rpm drives. Set the speed switch on the front of the EXP810 to 4Gb. Each DS4800 will connect to 12EXP810s.

The IBM System Storage DS4800 comes with eight 4Gb IBM short wave SFP modules. The IBM System Storage EXP810 comes with two 4Gb IBM short wave SFP modules. Move the SFP modules to the appropriate places as indicated in the diagram below, and use the additional SFP modules that were purchased separately to fill all the necessary spots according to the diagram. Then cable the configuration as directed by the diagram below, which shows how to cable one DS4800 to the first three EXP810s. The cabling pattern is repeated for the remaining three sets of three EXP810s for that DS4800. So set two would start with a cable from channel 2, port 2 on the top contoller of the DS4800; this cable would go to port 1B on the left of the fourth EXP810. Both DS4800s are cabled the same way, so repeat the cabling for the second DS4800.

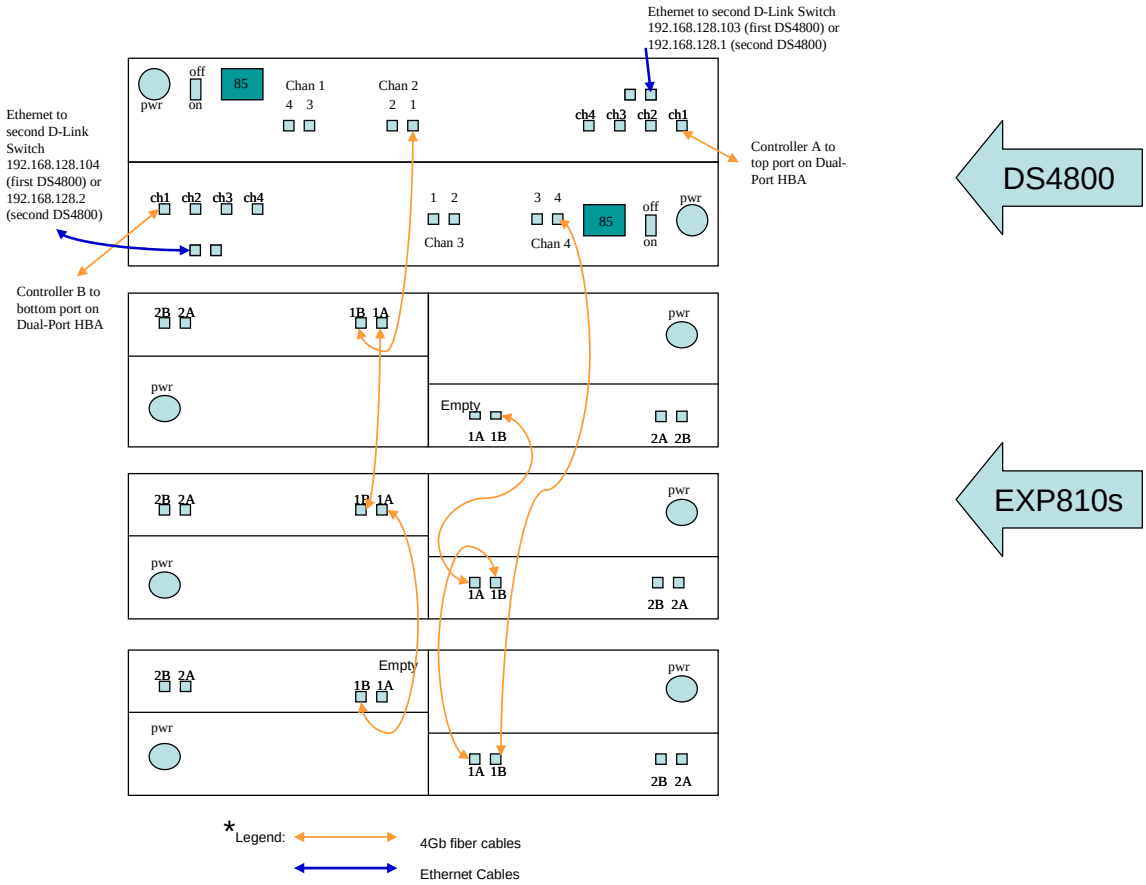


Figure 1-3. IBM System Storage DS4800 and IBM System Storage EXP810 cabling diagram

Run an Ethernet cable from the top and bottom controllers in each DS4800 to the the second D-Link switch.

Download IBM Storage Manager 9 Client from www.ibm.com and install it on one of the x3500s (Tier A machine with the second Ethernet port configured to static IP address 192.168.128.8). During the installation, do not start the monitor service.

The default IP addresses for the controllers on the DS4800 are 192.168.128.101/102 and 192.168.129.101/102.

Perform the following steps for both controllers in each DS4800:

1. Hook up a standard serial cable to the DS4800 controller from another machine.
2. On the other machine, Hyperterminal into the DS4800 controller:
    a. Speed 38400
    b. Other settings: 8, none, 1, none
    c. Press CTRL-BRK, ESC to get the command prompt.
3. Enter the Default password = infiniti
4. Select **sysWipe** to clear all RAID configuration information, which can travel with drives.
    a. **Wait for sysWipe to complete on both sides**. sysWipe runs in the background and takes some time to complete, but it tells you when it's done. Wait for the message that sysWipe has completed.
    b. After sysWipe is finished on both controllers, power cycle the controller.
5. **safeSysWipe** returns quickly.
6. Relog into the controller, and use:
    a. **netCfgShow** to see the current Ethernet configuration
    b. **netCfgSet** to change the Ethernet configuration.

i. Set the hostname and IP to suit your needs. (We used IP addresss 192.168.128.1 for the top controller and 192.168.128.2 for the bottom controller on one DS4800 and IP address 192.168.128.103 for the top controller and 192.168.128.104 for the bottom controller on the other DS4800.)

After completing those steps on all of the DS4800s, start the IBM Storage Manager 9 Client on the x3500 and discover all the devices. In IBM Storage Manager 9 Client, do the following:

1. Doubleclick the DS4800 icon to open a window for that DS4800.
2. In the new window, sync the date/time on all the devices – right click on the DS4800 Icon – Set Controller Clocks.
3. In the new window, disable any premium features – right click on the DS4800 Icon – Premium Features - Disable
4. From the Enterprise Management Window: right click Tools – Execute Script – Load – ds4800_setup.script (provided in the supportingFiles)
5. From Tools: right click Verify and Execute the ds4800_setup.script. This script sets the no FUA bit, and makes it so that Microsoft Windows only sees one copy of each of the LUNs.
6. For the first DS4800 - from the Enterprise Management Window: right click Tools – Load Configuration – "firstDS4800.cfg" (provided in the supportingFiles). This loads the RAID array configurations. 16-drive RAID-10 array for the database log. Eleven 16-drive RAID-5 arrays for the database data.
7. For the second DS4800 - from the Enterprise Management Window: right click Tools – Load Configuration – "secondDS4800.cfg" (provided in the supportingFiles). This loads the RAID array configurations. Twelve 16-drive RAID-5 arrays for the database data.

The external storage subsystem is now ready.

IBM System x3850 M2

The IBM x3850 M2 comes with two Quad-Core Intel Xeon X7350 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 Quad-Core Intel Xeon X7350 Processors.
2. Remove the eight 1GB DIMMs and install thirty-two 4GB DIMMs.
3. Install the NetXtreme II 1000 Express Ethernet Adapter in PCI-E slot 7.
4. Run an Ethernet cable from the NetXtreme II 1000 Express Ethernet Adapter to the first D-Link switch which has connections to the Tier A and Driver machines.
5. Close the x3850 M2.
6. Insert the two 73.4GB 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 an I/O Ports, disable "Planar Ethernet" and "Display Onboard MAC Address During Boot."
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 – make sure the Memory Array Setting is High Performance Memory Array.
6. In Advanced Setup – CPU Options - disable nearly everything (PowerExecutive Power Capping, Processor Performance States, Processor Hardware Prefetcher, Processor Execute Disable Bit, Intel Virtualization Technology, Processor IP Prefetcher, Processor DCU Prefetcher, C1E). Enable Processor Adjacent Sector Prefetch. 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.

1. SAS1078
2. RAID Properties
3. Create IM Volume
4. Arrow over to the RAID Disk column, use the space bar to toggle from No to Yes for both onboard SAS drives
5. D to overwrite existing data
6. 7006MB, C to create
7. Create and Save new array
8. Save changes and exit the menu
9. RAID Properties
10. Manage Array
11. Synchronize Array, Y start array synchronization and exit this menu
12. Exit the configuration utility and reboot the x3850 M2.

Put the Microsoft Windows Server 2003 R2 Enterprise x64 Edition with SP1 CD in the x3850 M2's DVD/CDROM drive. Boot the x3850 M2 from the CD. Press F6 when prompted by the Windows installation program to load the LSI driver from diskette. The driver can be downloaded from www.ibm.com. During the operating system installation, select the per seat 9999 option.

Install Service Pack 2 for Microsoft Windows Server 2003 R2 Enterprise x64 Edition.

After installing the operating system, install the Broadcom 5708 (NetXtreme II 1000 Express Ethernet Adapter) 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. After installing the Ethernet card's device driver, set a static IP address (192.168.200.102) for the x3850 M2.

Now customize the operating system as follows:.

1) Control Panel Settings:
    a) System
        i) Advanced
            (1) Performance
                (a) Visual effects: Adjust for best performance
                (b) Advanced
                    (i) Set for Background services & system cache
                    (ii) Check page file settings
            (2) Startup & Recovery
                (a) No administrative alert
                (b) No auto restart
                (c) No debugging information
                (d) If desired, lower the default 30 second boot.ini selection timeout
            (3) Error Reporting
                (a) Disable, but notify when errors occur
        ii) Auto Updates

(1) Disable

iii) Remote

(1) Disable Remote Assistance

(2) Enable Remote Desktop (if you plan to use it)

b) Display

i) Ensure video performance troubleshooting slider all the way to the right

ii) Turn screen saver off

iii) Select “Always On” for power management. (If desired, set the monitor to be turned off after 30 minutes or so.)

c) Sounds

i) “no sounds” sound scheme

d) Internet Settings

i) Use blank homepage

e) Folder options:

i) Don’t automatically search for network folder and printers

ii) Show all files

iii) Don’t hide file extensions

iv) Don’t hide protected OS files

v) Ensure that offline files are disabled

f) Date and Time

i) Disable syncing time with Internet time server

Regedit

1) HKLM\System\CurrentControlSet\Control\Session Manager\I/O System\
   a) CountOperations (DWORD=0) [turns off some perf monitoring]
2) HKLM\System\CurrentControlSet\Control\Session Manager\Memory Management\
   a) DontVerifyRandomDrivers (DWORD=1)
   b) LargeSystemCache (DWORD=0)
   c) DisablePagingExecutive (DWORD = 1)
      i) 0 = kernel can be paged out
      ii) 1 = kernel can not be paged out
3) HKLM\System\CurrentControlSet\Services\TCPIP\Parameters\
   a) MaxUserPort (DWORD = 40,000 Decimal, or higher)
4) HKLM\System\CurrentControlSet\Services\lanmanserver\parameters\Size (DWORD = 3)

Stop unneeded services and make them manual startup rather than automatic startup:

1. Automatic Updates
2. Computer Browser
3. Crytographic Services
4. DHCP Client
5. DNS Client
6. Error Reporting Service
7. Help and Support
8. IPSEC Services
9. Print Spooler
10. Remote Registry Service
11. Wireless Configuration

Disable Windows 2003 Shutdown Event Tracker and Autoplay:

1. Go into Group Policy Object Editor (Start -> Run -> gpedit.msc)
2. Browse to Computer Configuration -> Administrative Templates -> System
3. In the right window pane, double click on "Display Shutdown Event Tracker"
4. You'll see the disable choice- select it and you are DONE!
5. Now in the right window pane, double click on "Turn off Autoplay"
6. **Enable** for “All Drives” (which disables Autoplay)

7. Also in in gpedit.msc – Computer Configuration – Windows Settings – Security Settings – Local Policies – User Rights Assignment
8. In the right window pane, double click on "Lock pages in memory"
9. Click the "Add User or Group" button
10. Click "Object Types…" button
11. Tick "Groups". Click OK.
12. Type "Administrators" in the box. Click "Check Names", click OK, and then OK again.

SQL Server Installation

Install Microsoft SQL Server 2005 Enterprise x64 Edition, apply Service Packs 1 and 2 for SQL Server. Select the binary sort order.

Connect x3850 M2 to External Storage

Power off the x3850 M2.

1. Install one IBM Gb Fibre Channel Dual-Port PCI-E HBA in PCI-E slot 1, and the other in PCI-E slot 5. Don't connect any Fibre Channel cables to the adapters yet.
2. Run two 4Gb Fibre cables from each IBM 4Gb Fibre Channel Dual-Port PCI-E HBA to a DS4800. One Fibre cable plugs into the input for controller A (top controller) on the DS4800. The other Fibre cable plugs into the input for controller B (bottom controller) on the DS4800. The 4Gb Fibre cables from the HBA in PCI-E slot 1 should go to the DS4800 with the 16-disk RAID-10 array on it. The 4Gb Fibre cables from the HBA in PCI-E slot 5 should go to the other DS4800.

Power on the x3850 M2. During POST on the x3850 M2, when the QLogic banner is displayed, press Ctrl-Q. Change the following settings in Fast!UTIL for each fibre port (there are four of them).

1. Configuration Settings – Adapter Settings – change "Loop Reset Delay" from 5 to 8 and "Fibre Channel Tape Support" to disabled
2. Disable selectable boot and BIOS
3. Advanced Adapter Settings
4. Execution Throttle from 16 to 255
5. LUNs per Target from 128 to 0
6. Enable Target Reset from Yes to No
7. Login Retry Count from 8 to 30
8. Port Down Retry Count from 30 to 70
9. Link Down Timeout from 30 to 60
10. Operation Mode from 0 to 5
11. Interrupt Delay Timer from 0 to 10

Save the settings and restart the x3850 M2.

Mount Points and Disk Partitions

1. In a command window, create mount points:
   - c:
   - cd \
   - mkmp.cmd (mkmp.cmd 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 dblog.txt (dblog.txt provided in the SupportingFiles).

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

6. From a command prompt, run formats.cmd (formats.cmd 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 StartSQL.bat (the file is included in the supporting files).

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

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 230000.cust\database. In the folder create a create_database.sql script to create a TPC-E database with two filegroups. One filegroup called broker_fg for the Broker-related TPC-E tables and the other filegroup called customer_fg for all the other TPC-E tables. broker_fg uses all the c:\mp\b* disk partitions. customer_fg uses all the c:\mp\c* disk partitions. The database log is on E:. Modify the Microsoft provided files:

- Create_Tables_Fixed.sql
- Create_Tables_Scaling.sql
- Create_Clustered_Indexes_Fixed.sql
- Create_Clustered_Indexes_Scaling.sql
- Create_NC_Indexes_Fixed.sql
- Create_NC_Indexes_Scaling.sql

by replacing misc_fg and market_fg with customer_fg.

Run the Microsoft provided file TPCE_Setup.cmd to start the database load (the file is included in the supporting files). Fill in 230000 for the number of customers to be loaded when prompted. TPCE_Setup.cmd calls files that are included in the supporting files 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 2005 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 23 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 230,000 customers.

Table 2-1. Initial Cardinality of Tables

Table Name	Rows
ACCOUNT_PERMISSION	1,633,287
ADDRESS	345,004
BROKER	2,300
CASH_TRANSACTION	3,656,423,647
CHARGE	15
COMMISSION_RATE	240
COMPANY	115,000
COMPANY_COMPETITOR	345,000
CUSTOMER	230,000
CUSTOMER_ACCOUNT	1,150,000
CUSTOMER_TAXRATE	460,000
DAILY_MARKET	205,602,750
EXCHANGE	4
FINANCIAL	2,300,000
HOLDING	203,470,465
HOLDING_HISTORY	5,326,400,817
HOLDING_SUMMARY	11,444,387
INDUSTRY	102
LAST_TRADE	157,550
NEWS_ITEM	230,000
NEWS_XREF	230,000
SECTOR	12
SECURITY	157,550
SETTLEMENT	3,974,400,000
STATUS_TYPE	5
TAXRATE	320
TRADE	3,974,400,000
TRADE_HISTORY	9,538,574,237
TRADE_REQUEST	0
TRADE_TYPE	5
WATCH_ITEM	23,015,902
WATCH_LIST	230,000
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 x3850 M2 has seven PCI-E slots. An IBM 4Gb Fibre Channel Dual-Port HBA was put in PCI-E slots 1 and 5. Two IBM System Storage DS4800s were used in this benchmark. The DS4800 has two controllers: the top controller A and the bottom controller B. Each HBA card has two ports. The top port was connected to the top controller of a DS4800. The bottom port was connected to the bottom controller.

The HBA in PCI-E slot one was connected to the first DS4800. That first DS4800 has the 16-Disk RAID-10 database log and five 16-Disk RAID-5 arrays on controller A and six 16-Disk RAID-5 arrays on controller B.

The HBA in PCI-E slot five was connected to the second DS4800. The second DS4800 has six 16-Disk RAID-5 arrays on controller A and another six 16-Disk RAID-5 arrays on controller B.

All the drives are 36.4GB 15K rpm 4Gb Fiber Channel drives. Figure 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 Benchmarked and Priced Configuration

Disk #	Controller #	Slot #	Drives Enclosure model RAID level	Partition/file system	Size	Use
0	1A	1	16 X 36.4GB Fibre EXP810 Enclosure RAID- 10	E: (RAW)	267.20GB	DB Log
1	1A	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b1 (RAW) c:\mp\c1 (RAW) c:\mp\back1disk1: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 1 Customer 1 backup1
2	1A	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b2 (RAW) c:\mp\c2 (RAW) F: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 2 Customer 2 Extra Temp DB file
3	1A	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b3 (RAW) c:\mp\c3 (RAW) G: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 3 Customer 3 MDF File
4	1A	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b4 (RAW) c:\mp\c4 (RAW) H: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 4 Customer 4 Extra Temp DB File
5	1A	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b5 (RAW) c:\mp\c5 (RAW) I: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 5 Customer 5 Not used
6	1B	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b6 (RAW) c:\mp\c6 (RAW) J: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 6 Customer 6 Not used
7	1B	1	16 X 36.4GB Fibre EXP810 Enclosure	c:\mp\b7 (RAW) c:\mp\c7 (RAW)	97.67GB 34.20GB	Broker 7 Customer 7

			RAID-5	c:\mp\back2disk7 (NTFS)	369.14GB	backup2
8	1B	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b8 (RAW) c:\mp\c8 (RAW) c:\mp\back3disk8 (NTFS)	97.67GB 34.20GB 369.14GB	Broker 8 Customer 8 backup3
9	1B	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b9 (RAW) c:\mp\c9 (RAW) K: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 9 Customer 9 Not used
10	1B	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b10 (RAW) c:\mp\c10 (RAW) L: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 10 Customer 10 Not used
11	1B	1	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b11 (RAW) c:\mp\c11 (RAW) M: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 11 Customer 11 Extra Temp DB file
12	2A	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b12 (RAW) c:\mp\c12 (RAW) N: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 12 Customer 12 Extra Temp DB file
13	2A	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b13 (RAW) c:\mp\c13 (RAW) O: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 13 Customer 13 Extra Temp DB file
14	2A	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b14 (RAW) c:\mp\c14 (RAW) P: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 14 Customer 14 Not used
15	2A	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b15 (RAW) c:\mp\c15 (RAW) c:\mp\back4disk15 (NTFS)	97.67GB 34.20GB 369.14GB	Broker 15 Customer 15 backup4
16	2A	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b16 (RAW) c:\mp\c16 (RAW) c:\mp\back5disk16 (NTFS)	97.67GB 34.20GB 369.14GB	Broker 16 Customer 16 backup5
17	2A	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b17 (RAW) c:\mp\c17 (RAW) Q: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 17 Customer 17 Not used
18	2B	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b18 (RAW) c:\mp\c18 (RAW) R: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 18 Customer 18 Not used

19	2B	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b19 (RAW) c:\mp\c19 (RAW) S: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 19 Customer 19 Extra Temp DB file
20	2B	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b20 (RAW) c:\mp\c20 (RAW) T: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 20 Customer 20 Extra Temp DB file
21	2B	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b21 (RAW) c:\mp\c21 (RAW) U: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 21 Customer 21 Extra Temp DB file
22	2B	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b22 (RAW) c:\mp\c22 (RAW) V: (NTFS)	97.67GB 34.20GB 369.14GB	Broker 22 Customer 22 Extra Temp DB log
23	2B	5	16 X 36.4GB Fibre EXP810 Enclosure RAID-5	c:\mp\b23 (RAW) c:\mp\c23 (RAW) c:\mp\back6disk23 (NTFS)	97.67GB 34.20GB 369.14GB	Broker 23 Customer 23 backup6
24	onboard LSI	N/A	2 X 73GB SAS onboard x3850 M2 RAID-1	C: (NTFS)	67.98GB	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 2005 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 –l ODBC option on the EGenLoader command line. This direct loads into a Microsoft SQL Server database. 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).

350 EGenDriverCE instances were used in the benchmark. Two 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 one of the ports on the onboard dual-port Gigabit Ethernet card. The port's IP address was 192.168.200.12. The port was connected to the first D-Link switch via an Ethernet cable. Other Ethernet cables ran from the first D-Link Switch to a port on the onboard dual-port Gigabit Ethernet card in the IBM System x3500 machines that were used as the Tier A machines. That port on one x3500 was configured with the IP address 192.168.200.7, and 192.168.200.8 on the other x3500. The network connection between the port with IP address 192.168.200.12 on the Driver and the ports with IP addresses 192.168.200.7 and 192.168.200.8 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 NetXtreme II 1000 Express Ethernet Adapter in the x3850 M2 was configured with IP address 192.168.200.102 and was connected via an Ethernet cable to the first 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 v1.2.0 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.

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: 419.80 tpsE
Price per tpsE: $ 1,527.25 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).

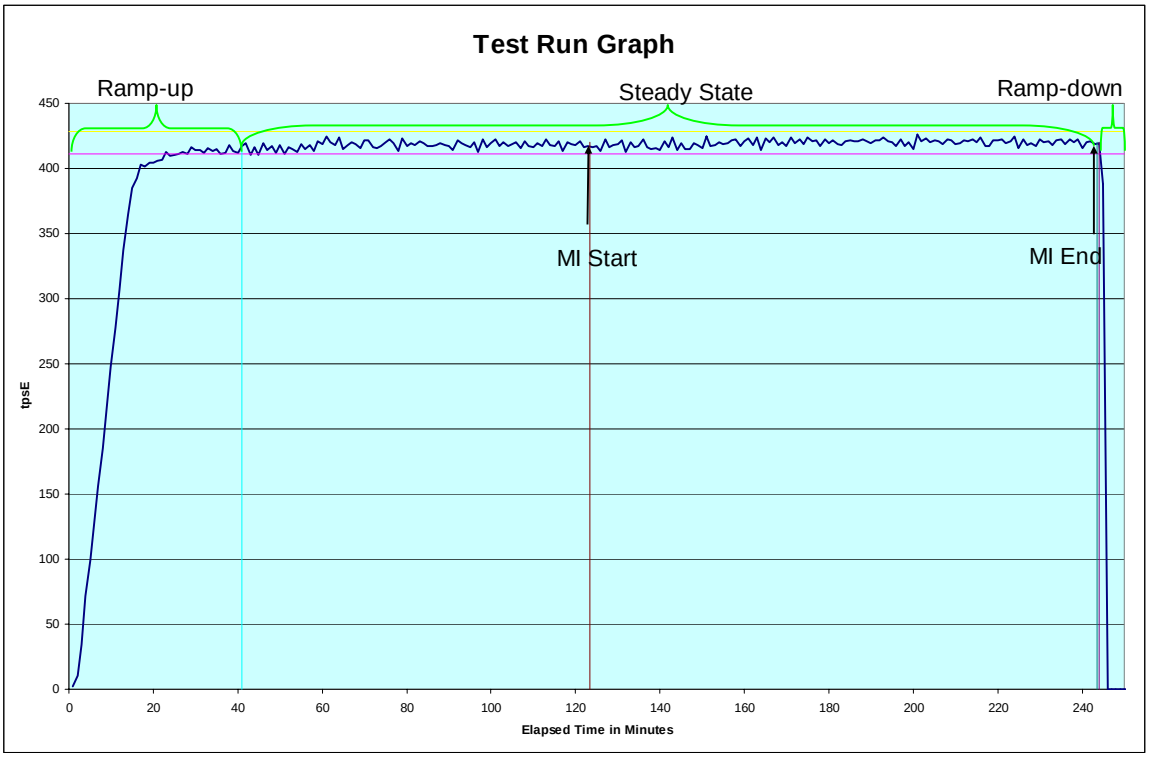


Figure 6-1. Test Run Graph

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. Calculating 60 minute average tpsE during the Steady State moving the time window 10 minutes each time. Then confirming 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 10 minute average tpsE during the Steady State moving the window 1 minute each time. Then confirming 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 seven and a half minutes. Data-Maintenance was run every 58 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. Transaction Statistics

Input Parameter	Value	Actul Pct	Required Range
Customer-Position			
by_tax_id	1	49.99%	48% to 52%
get_history	1	50.00%	48% to 52%
Market-Watch			
Securities chosen by	Watch list	60.02%	57% to 63%
	Account ID	34.96%	33% to 37%
	Industry	5.02%	4.5% to 5.5%
Security-Detail			
access_lob	1	1.00%	0.9% to 1.1%
Trade-Lookup			
frame_to_execute	1	29.98%	28.5% to 31.5%
	2	30.00%	28.5% to 31.5%
	3	30.00%	28% to 31.5%
	4	10.02%	9.5% to 10.5%
Trade-Order			
Transactions requested by a third party		10.02%	9.5% to 10.5%
Security chosen by company name and issue		40.06%	38% to 42%
type_is_margin	1	8.00%	7.5% to 8.5%
roll_it_back	1	1.01%	0.94% to 1.04% (*)
is_lifo	1	34.99%	33% to 37%
trade_qty	100	25.05%	24% to 26%
	200	24.99%	24% to 26%
	400	25.01%	24% to 26%
	800	24.95%	24% to 26%
trade_type	TMB	30.01%	29.7% to 30.3%
	TMS	30.06%	29.7% to 30.3%
	TLB	19.98%	19.8% to 20.2%
	TLS	9.95%	9.9% to 10.1%
	TSL	10.00%	9.9% to 10.1%
Trade-Update			
frame_to_execute	1	32.93%	31% to 35%
	2	33.11%	31% to 35%
	3	33.96%	32% to 36%

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.1.2.0\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 one through three 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.1.2.0\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.100\ACID\Isolation\Scripts\Isolation1_S1.sql in the Management Studio. When prompted, connect to you database server.
3. Click on **Query/Results To/Results to Text** in the menu bar.
4. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation1_S2.sql in the Management Studio. When prompted, connect to you database server.
5. Click on **Query/Results To/Results to Text** in the menu bar.
6. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation1_S3.sql in the Management Studio. When prompted, connect to you database server.
7. Click on **Query/Results To/Results to Text** in the menu bar.
8. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation1_S4.sql in the Management Studio. When prompted, connect to you database server.
9. Click on **Query/Results To/Results to Text** in the menu bar.
10. Execute Isolation1_S1.
11. Scroll to the bottom of the Results window and record the "Trade ID Returned."
12. Copy the Customer Account Used to the @acct_id variable near the top of Isolation1_S2.
13. Copy the Symbol Used to the @symbol variable near the top of Isolation1_S2.
14. Execute Isolation1_S2.
15. Scroll to the bottom of the Results window and record the "Trade ID Returned."
16. Copy the Trade ID Used in the Isolation1_S1 results window to the @trade_id variable near the top of Isolation1_S3.
17. Copy the Trade ID Used in the Isolation1_S2 results window to the @trade_id variable near the top of Isolation1_S4.
18. Execute Isolation1_S3 and then immediately execute Isolation1_S4. Note, the SQL code and the instrumented stored procedure will do the appropriate pausing as required in the specification.

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

1. Record the "Holding Summary After First Execution of Trade Result Frame 1": value of HS_QTY. This is found near the top of the results window of Isolation1_S3. Verify that this is set to 0.
2. Record the "Holding Summary After Second Execution of Trade Result Frame 1": value of HS_QTY. This is found near the top of the results window of Isolation1_S3. Verify that this is set to 0.
3. 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.100\ACID\Isolation\Scripts\Isolation2_S1.sql in the Management Studio. When prompted, connect to you database server.
3. Click on **Query/Results To/Results to Text** in the menu bar.
4. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation2_S2.sql in the Management Studio. When prompted, connect to you database server.
5. Click on **Query/Results To/Results to Text** in the menu bar.
6. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation2_S3.sql in the Management Studio. When prompted, connect to you database server.
7. Click on **Query/Results To/Results to Text** in the menu bar.
8. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation2_S4.sql in the Management Studio. When prompted, connect to you database server.
9. Click on **Query/Results To/Results to Text** in the menu bar.
10. Execute Isolation2_S1.
11. Scroll to the bottom of the Results window of Isolation2_S1 and record the "Holding Summary Quantity" and the "Trade ID Returned".
12. Copy the Customer Account Used from the Results window of Isolation2_S1 to the @acct_id variable near the top of Isolation2_S2.
13. Copy the Symbol Used from the Results window of Isolation2_S1 to the @symbol variable near the top of Isolation2_S2.
14. Execute Isolation2_S2.
15. Scroll to the bottom of the Results window of Isolation2_S2 and record the Trade ID Returned.
16. Copy the Trade ID Used in the Isolation2_S1 results window to the @trade_id variable near the top of Isolation2_S3.
17. Copy the Trade ID Used in the Isolation2_S2 results window to the @trade_id variable near the top of Isolation2_S4.
18. Execute Isolation2_S3 and then immediately execute Isolation2_S4. Note, the SQL code and the instrumented stored procedure will do the appropriate pausing as required in the specification

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

1. Record the "Holding Summary After First Execution of Trade Result Frame 1": value of HS_QTY. This is found near the top of the results window of Isolation2_S3.
2. Record the "Holding Summary After Second Execution of Trade Result Frame 1": value of HS_QTY. This is found near the top of the results window of Isolation2_S3. This value should match the value returned in number 1 above.
3. Record the "Holding Summary After Trade Result Frame 1": value of HS_QTY. This is found near the top of the results window of Isolation2_S4. This value should match the value returned in number 1 above.
4. The Trade-Result in S3 should run to completion. The Trade-Result in S4 may be 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.100\ACID\Isolation\Scripts\Isolation3_S1.sql in the Management Studio. When prompted, connect to you database server.
3. Click on **Query/Results To/Results to Text** in the menu bar.
4. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation3_S2.sql in the Management Studio. When prompted, connect to you database server.
5. Click on **Query/Results To/Results to Text** in the menu bar.
6. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation3_S3.sql in the Management Studio. When prompted, connect to you database server.
7. Click on **Query/Results To/Results to Text** in the menu bar.

8. Execute Isolation3_S1. This script will initiate the Customer Position and execute two Trade Orders for the remainder of this isolation test to access.
9. Scroll to the bottom of the Results window of Isolation3_S1 and record the "Customer ID Used" and the "Customer Account Balance."
10. Copy the first Trade ID Returned from Isolation3_S1 to the top of 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, 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)
5. Note, this verification deviates from the specification since the current specification does not take into account that the Trade Result in S3 WILL block waiting on the Trade Result in S2.

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.100\ACID\Isolation\Scripts\Isolation4_S1.sql in the Management Studio. When prompted, connect to you database server.
3. Click on **Query/Results To/Results to Text** in the menu bar.
4. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation4_S2.sql in the Management Studio. When prompted, connect to you database server.
5. Click on **Query/Results To/Results to Text** in the menu bar.
6. Open MSTPCE.100\ACID\Isolation\Scripts\Isolation4_S3.sql in the Management Studio. When prompted, connect to you database server.
7. Click on **Query/Results To/Results to Text** in the menu bar.
8. Execute Isolation4_S1. This script will initiate the Customer Position and execute a Trade Order for the remainder of this isolation test to access.
9. Scroll to the bottom of the Results window of Isolation4_S1 and record the "Customer ID Used," "Customer Account 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)
5. Note, this verification deviates from the specification since the current specification does not take into account that the Customer Position in S3 WILL block waiting on the Trade Result in S2.

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, and 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:

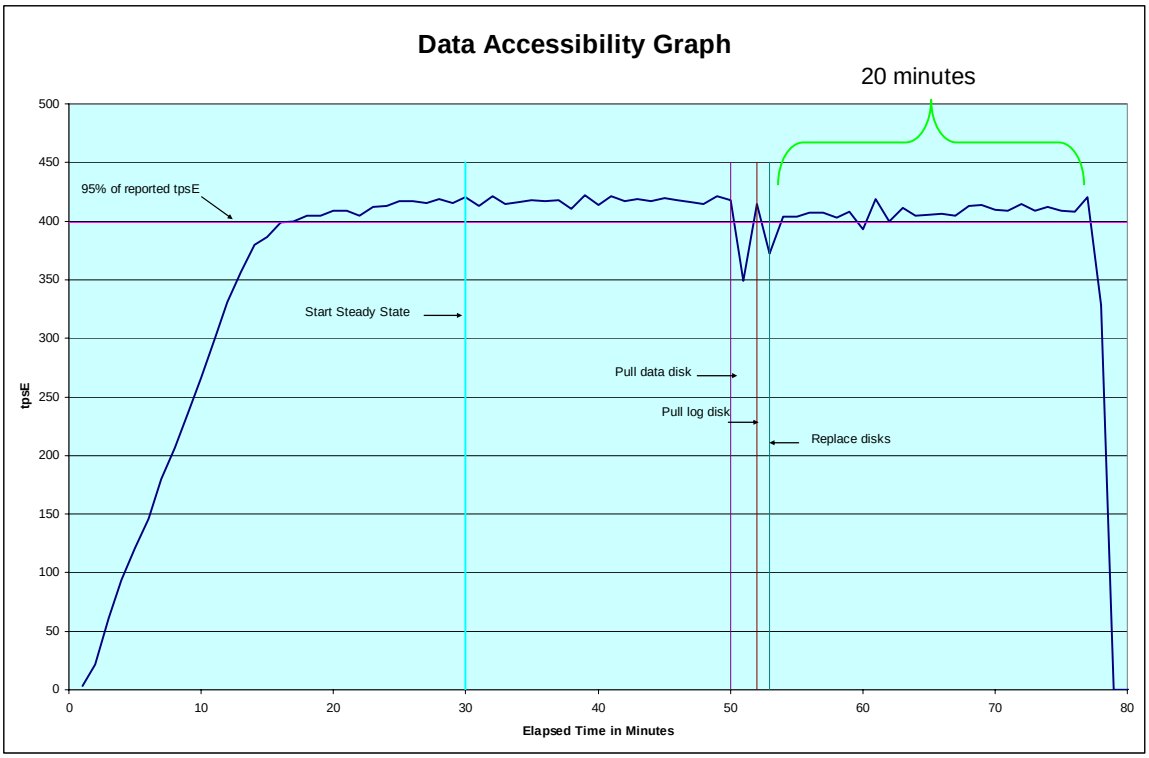


Figure 7-1. Data Accessibility Graph

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.

Note: A UPS has been priced for the log controller.

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

1. Determine the current number of completed trades in the database by running: *select count(*) as count1 from SETTLEMENT*
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes.
3. Induce all of the Catastrophic failures, in Clause 7.5.2.2, 7.5.2.3 and 7.5.2.4, by pulling the power cords from the x3850 M2. At the same time remove the power cord from the back of the two x3500s to fail the Tier A machines at the same time as the Tier B machine.
4. Stop the Driver.
5. Re-power and restart the x3850 M2. Re-power and restart the x3500s.
6. On the x3850 M2 when Windows has started run StartSQL.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 7.5.6.6).

9. Terminate the Driver gracefully.
10. Verify that no errors were reported by the Driver during steps 7 through 9.
11. Retrieve the new number of completed trades in the database by running: *select count(*) as count2 from SETTLEMENT*
12. Compare the number of completed Trade-Result Transactions on the Driver to (count2 – count1). Verify that (count2 - count1) is greater or equal to the aggregate number of successful Trade-Result Transaction records in the Driver log file for the runs performed in step 2 and step 7. If there is an inequality, the SETTLEMENT table must contain additional records and the difference must be less than or equal to the maximum number of Transactions which can be simultaneously in-flight from the Driver to the SUT. This number is specific to the implementation of the Driver and configuration settings at the time of the crash.
13. Verify consistency conditions as specified in Clause 7.3.1.1.

The Business Recovery Time was 01:17:48

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:

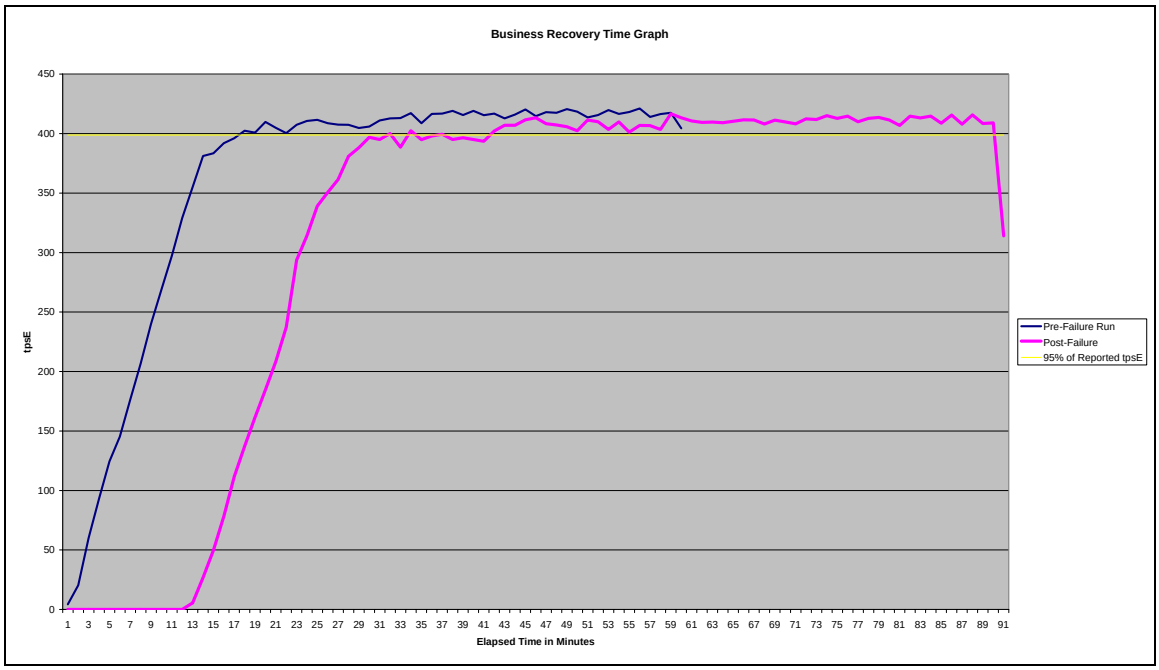


Figure 7-2. Business Recovery Time Graph

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

TPC-E Disk Space Requirements

Customers Used	230,000	Performance	419.80	TpsE

Broker File Group	Before Run	Data (KB)	Index size (KB)	Extra 5% (KB)	Total + 5% (KB)	After run (KB)	Growth (KB)
BROKER	2,300	256	312	28	596	568	-
CASH_TRANSACTION	3,657,602,682	363,468,856	1,330,392	18,239,962	383,039,210	374,487,632	9,688,384
CHARGE	15	8	8	1	17	16	-
COMMISSION_RATE	240	16	16	2	34	32	-
SETTLEMENT	3,975,681,453	197,007,752	761,744	9,888,475	207,657,971	206,968,520	9,199,024
TRADE	3,975,705,423	441,715,944	236,258,016	33,898,698	711,872,658	692,423,584	14,449,624
TRADE_HISTORY	9,541,707,403	273,750,336	714,216	13,723,228	288,187,780	275,568,392	1,103,840
TRADE_REQUEST	-	-	-	-	-	9,088	9,088
TRADE_TYPE	5	8	1,032	52	1,092	1,040	-
Customer File Group							
ACCOUNT_PERMISSION	1,633,287	163,392	1,008	8,220	172,620	164,400	-
CUSTOMER	230,000	38,960	10,288	2,462	51,710	49,256	8
CUSTOMER_ACCOUNT	1,150,000	106,816	127,144	11,698	245,658	233,960	-
CUSTOMER_TAXRATE	460,000	9,664	296	498	10,458	10,136	176
HOLDING	203,503,596	12,774,816	7,985,048	1,037,993	21,797,857	27,811,544	7,051,680
HOLDING_HISTORY	5,328,128,011	193,757,872	101,047,120	14,740,250	309,545,242	296,111,248	1,306,256
HOLDING_SUMMARY	11,444,320	501,096	3,048	25,207	529,351	773,776	269,632
WATCH_ITEM	23,015,902	623,824	2,416	31,312	657,552	626,608	368
WATCH_LIST	230,000	5,752	4,856	530	11,138	10,608	-
Market File Group							
COMPANY	115,000	25,016	7,136	1,608	33,760	32,176	24
COMPANY_COMPETITOR	345,000	9,296	7,696	850	17,842	16,992	-
DAILY_MARKET	205,602,750	10,491,392	4,400,616	744,600	15,636,608	14,893,632	1,624
EXCHANGE	4	8	8	1	17	16	-
FINANCIAL	2,300,000	270,680	984	13,583	285,247	272,032	368
INDUSTRY	102	8	40	2	50	48	-
LAST_TRADE	157,550	14,512	288	740	15,540	14,800	-
NEWS_ITEM	230,000	25,331,984	456	1,266,622	26,599,062	25,332,440	-
NEWS_XREF	230,000	5,744	272	301	6,317	6,016	-
SECTOR	12	8	24	2	34	32	-
SECURITY	157,550	24,712	10,992	1,785	37,489	35,720	16
STATUS_TYPE	5	8	8	1	17	16	-
Misc File Group							
ADDRESS	345,004	19,952	312	1,013	21,277	20,312	48
TAXRATE	320	40	16	3	59	56	-
ZIP_CODE	14,741	488	176	33	697	664	-
TOTALS (KB)		**1,520,119,216**	**352,675,984**	**93,639,760**	**1,966,434,960**		
Before Database Size (MB)		**1,828,902**	**1,786 GB**				

Db/Filegroups	LUN Count	Partition Size(KB)	MB allocated	MB Before	MB Before+5%	Ending size	8 Hours
misc_fg	0	-	-	-	-	-	-
broker_fg	23	102,400,000	2,300,000	1,479,501	1,553,476	1,513,143	1,548,054
market_fg	0	-	-	-	-	-	-
customer_fg	23	30,720,000	690,000	349,401	366,871	357,829	366,574

Settlements	**5,933,333**						
Before Growing Space (MB)	1,788,160						
Final Growing Space (MB)	1,830,228	**Data LUNS**	23	**Before Log size (MB)**	21,292	**Log LUNS**	1
Delta (MB)	42,068	**Disks per LUN**	16	**Final Log size (MB)**	83,419	**Log Disks**	16
Data Space per Trade (MB)	0.007090096	**Disk Capacity (MB)**	34,714	**Log Growth (MB)**	62,127	**Disk Capacity (MB)**	34,714
1 Day Data Growth (MB)	85,721	**RAID5 overhead**	86%	**Log Growth/trade (MB)**	0.010470879352	**RAID10 overhead**	50%

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

October 19, 2007

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

Platform: IBM System x3850 M2
Operating system: Microsoft Windows Server 2003 R2 Enterprise x64 Edition
Database Manager: Microsoft SQL Server 2005 Enterprise x64 Edition SP2

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 X7350 (2.93GHz)	128 GB (2 x 4 MB L2)	384 x 36.4 GB 15K 4Gbps	0.18 Seconds	419.80
Tier A, Two Clients: IBM System x3500				
1 x Intel Xeon E5345 (2.33 GHz)	4 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 v1.2.0.
- The transactions were correctly implemented.
- The database was properly scaled and populated for 230,000 customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met (see notes 1 and 2 below).

- 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:

1. During Isolation Test 1 Step 7, Session 3 was the deadlock victim. Therefore not all Frames completed successfully. This did not compromise the demonstration of the required isolation properties.
2. When inducing the required failures during the Business Recovery test, there was a 7 and 21 second delay between the failure of the Tier B database server and the failure of the two Tier A client machines. This did not compromise the demonstration of the durability properties since the client machines did not participate in the database portion of the transactions.

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/dataDisks.txt SupportingFiles/Introduction/Hardware/dblog.txt SupportingFiles/Introduction/Hardware/DS4800_EXP810diagram.ppt SupportingFiles/Introduction/Hardware/DS4800_setup.script SupportingFiles/Introduction/Hardware/firstDS4800.cfg SupportingFiles/Introduction/Hardware/formats.cmd SupportingFiles/Introduction/Hardware/input.txt SupportingFiles/Introduction/Hardware/mkmp.cmd SupportingFiles/Introduction/Hardware/secondDS4800.cfg SupportingFiles/Introduction/Hardware/StorageSetup.doc
	Tier B/x3850 M2 Configuration	SupportingFiles/Introduction/Hardware/TierB_x3850M2_setup.txt
	TierA/x3500 setup	SupportingFiles/Introduction/Hardware/TierA_x3500_setup.txt
	Database Tunable Parameters	SupportingFiles/Introduction/software/cdsql.bat SupportingFiles/Introduction/software/runconfig.sql SupportingFiles/Introduction/software/startSQL.bat
	Checkpoint Scripts	SupportingFiles/Introduction/software/runregularcheckpoints.bat SupportingFiles/Introduction/software/checkpoint.bat SupportingFiles/Introduction/software/checkpoint.sql
	Tier A Scripts	SupportingFiles/Introduction/software/CE1.bat SupportingFiles/Introduction/software/CE2.bat SupportingFiles/Introduction/software/MEE1.bat SupportingFiles/Introduction/software/MEE2.bat
	OS Tunable Parameters	SupportingFiles/Introduction/software/TierB_OSTune.doc SupportingFiles/Introduction/software/x3850M2_TierB_SysInfo.txt SupportingFiles/Introduction/software/sprucewood1_TierA_sysinfo.txt SupportingFiles/Introduction/software/sprucewood2_TierA_sysinfo.txt
Clause 2	Table creation scripts	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_TPCE_Types.sql SupportingFiles/Clause2/DDL/Drop_FK_Constraints.sql SupportingFiles/Clause2/DDL/Drop_Tables_and_Constraints_Fixed.sql SupportingFiles/Clause2/DDL/Drop_Tables_and_Constraints_Growing.sql SupportingFiles/Clause2/DDL/Drop_Tables_and_Constraints_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_Growing.sql SupportingFiles/Clause2/DDL/Create_NC_Indexes_Fixed.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/DML/Get_Next_T_ID.sql SupportingFiles/Clause2/DML/MarketFeed.sql SupportingFiles/Clause2/DML/MarketWatch.sql SupportingFiles/Clause2/DML/SecurityDetail.sql SupportingFiles/Clause2/DML/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/backup.sql SupportingFiles/Clause2/backupdev.sql SupportingFiles/Clause2/Count_Customers.sql SupportingFiles/Clause2/create_database.sql SupportingFiles/Clause2/Create_TID_Ranges_Tables.sql SupportingFiles/Clause2/CreateTimerTable.sql SupportingFiles/Clause2/Database_Options_1.sql SupportingFiles/Clause2/Database_Options_2.sql SupportingFiles/Clause2/Drop_and_Create_TPCE_INFO.sql SupportingFiles/Clause2/EndLoadTimer.sql SupportingFiles/Clause2/InstallLoadTimerProc.sql SupportingFiles/Clause2/MSTPCE Database Setup Reference.pdf SupportingFiles/Clause2/remove_database.sql SupportingFiles/Clause2/restore.sql SupportingFiles/Clause2/Set_Statistics.sql SupportingFiles/Clause2/setup_tpce.vbs SupportingFiles/Clause2/SQL_Server_Configuration.sql SupportingFiles/Clause2/StartLoadTimber.sql SupportingFiles/Clause2/tempdb.sql SupportingFiles/Clause2/TPCE_Setup.cmd SupportingFiles/Clause2/VerifyTPCELoad.sql SupportingFiles/Clause2/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/DB_Check.sql SupportingFiles/Clause2/audit_scripts/database/DB_Tables.sql SupportingFiles/Clause2/audit_scripts/database/Duplicate_Tests.sql SupportingFiles/Clause2/Audit_Scripts/Database/RI_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.ncb SupportingFiles/Clause3/SUT_CE_Server/SUTServer.sln SupportingFiles/Clause3/SUT_CE_Server/SUTServer.suo SupportingFiles/Clause3/SUT_CE_Server/SUTStructs.h SupportingFiles/Clause3/SUT_CE_Server/Visual Studio DLL.ism
	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/TxnHarnessDB.cpp SupportingFiles/Clause3/TransactionsSP/TxnHarnessDB.h 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/Clause5/230Kcust_2MEEs_v1.2.0.xml SupportingFiles/Clause5/run22_wholeRun_TxnReportE.xls
	EGenLoader Parameters	SupportingFiles/Clause5/EGenLoaderFlags.txt SupportingFiles/Clause5/EGenLoaderFrom1To14000.log SupportingFiles/Clause5/EGenLoaderFrom14001To28000.log SupportingFiles/Clause5/EGenLoaderFrom28001To43000.log SupportingFiles/Clause5/EGenLoaderFrom43001To57000.log SupportingFiles/Clause5/EGenLoaderFrom57001To71000.log SupportingFiles/Clause5/EGenLoaderFrom71001To86000.log SupportingFiles/Clause5/EGenLoaderFrom86001To100000.log SupportingFiles/Clause5/EGenLoaderFrom100001To115000.log SupportingFiles/Clause5/EGenLoaderFrom115001To129000.log SupportingFiles/Clause5/EGenLoaderFrom129001To143000.log SupportingFiles/Clause5/EGenLoaderFrom143001To158000.log SupportingFiles/Clause5/EGenLoaderFrom158001To172000.log SupportingFiles/Clause5/EGenLoaderFrom172001To186000.log SupportingFiles/Clause5/EGenLoaderFrom186001To201000.log SupportingFiles/Clause5/EGenLoaderFrom201001To215000.log SupportingFiles/Clause5/EGenLoaderFrom215001To230000.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.after230KDBLoad.txt SupportingFiles/Clause7/Consistency/consistency.afterBusinessRecovery.txt
	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

	Isolation 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/Consistency.AfterBusinessRecovery.txt SupportingFiles/Clause7/Durability/BusinessRecovery/CountAfter.sql SupportingFiles/Clause7/Durability/BusinessRecovery/CountAfter.BusinessRecovery.txt SupportingFiles/Clause7/Durability/BusinessRecovery/CountBefore.sql SupportingFiles/Clause7/Durability/BusinessRecovery/CountBefore.BusinessRecovery.txt SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryPart1_20minAt95percent_TxnReportE.xls SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryPart1_TxnStepReport.xlt SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryPart1_wholeRun_TxnReportE.xls SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryPart2_20minAt95percent_TxnReportE.xls SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryPart2_TxnStepReport.xlt SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryPart2_wholeRun_TxnReportE.xls SupportingFiles/Clause7/Durability/BusinessRecovery/BusinessRecoveryTimeGraph.xls SupportingFiles/Clause7/Durability/BusinessRecovery/SQLConsoleLog.BusinessRecoveryPart1.txt SupportingFiles/Clause7/Durability/BusinessRecovery/SQLConsoleLog.BusinessRecoveryPart2.txt SupportingFiles/Clause7/Durability/BusinessRecovery/TierA_sprucewood1.SystemEventLog.txt SupportingFiles/Clause7/Durability/BusinessRecovery/TierA_sprucewood2.SystemEventLog.txt SupportingFiles/Clause7/Durability/BusinessRecovery/TierB_x3850M2.SystemEventLog.txt
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/DataAccessbility/CountAfter.DataAccessibility.txt SupportingFiles/Clause7/Durability/DataAccessbility/CountAfter.sql SupportingFiles/Clause7/Durability/DataAccessbility/CountBefore.DataAccessibility.txt SupportingFiles/Clause7/Durability/DataAccessbility/CountBefore.sql SupportingFiles/Clause7/Durability/DataAccessbility/DataAccessibility_wholeRun_TxnReportE.xls SupportingFiles/Clause7/Durability/DataAccessbility/DataAccessibilityGraph.xls SupportingFiles/Clause7/Durability/DataAccessbility/rebuilt.bmp SupportingFiles/Clause7/Durability/DataAccessbility/pulledDisks.bmp SupportingFiles/Clause7/Durability/DataAccessbility/rebuilding.bmp SupportingFiles/Clause7/Durability/DataAccessbility/SQLConsoleLog.DataAccessibility.txt
	ACID Procedures Document	SupportingFiles/Clause7/MSTPCE ACID Procedures.doc
Clause 8	60-Day Space Calculations	SupportingFiles/Clause8/tpce_space.xls

Appendix A – Price Quotes

Compsat TECHNOLOGY

Protect Your Data - Grow Your Business

To: Chris King, IBM Corporation
Attention:
Phone:
Fax:
Email:

From: Alan Powers
Phone: (248)223-1020 x344
Fax: (248)223-1026
Email: apowers@compsat.com

QUOTE # : **DS4800_101607**
DATE: **October 16, 2007**

Part No.	Description	Qty	List Price (per unit) US Dollar	List Price (quantity x unit price) US Dollar	Compsat Discounted Price (per unit) US Dollar	Compsat Discounted Price (quantity x unit price) US Dollar	
IBM System Storage DS4800							
1815-82A	IBM System Storage DS4800 Midrange Disk Subsystem	2	$53,995	$107,990	$37,797	$75,593	
41C5953	3 YR onsite repair 24x7x4 hour (DS4800)	2	$3,200	$6,400	$2,816	$5,632	
1812-81A	IBM TotalStorage DS4000 EXP810 Storage Exp. Unit	24	$6,000	$144,000	$4,200	$100,800	
10N3651	3 YR onsite repair 24x7x4 hour (EXP810)	24	$960	$23,040	$845	$20,275	
40K6812	4Gbps FC 36.4GB 15K Hot-Swap HDD	384	$892	$342,528	$624	$239,770	
			TOTAL =	**$623,958**	**TOTAL =**	**$442,070**	29.15%

25330 Telegraph Road / Suite 200 Raleigh Officentre / Southfield, Michigan 48034
Phone: 248-223-1020 / Fax: 248-223-1026 / www.compsat.com

NOTE:
- This quote may include Compsat Technology consulting and configuration charges.
- Mfg. pricing is out of our control and could change without notice.
- Pricing good for 30 Days from date quoted.

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

October 16, 2007

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
810-03134	**SQL Server 2005 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
P73-01972	**Windows Server 2003 R2 Standard Edition** *Server License Only - No CALs* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 28% discount from the retail unit price of $999.*	$719	2	$1,438
P72-01684	**Windows Server 2003 R2 Enterprise x64 Edition** *Server License Only - No CALs* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 42% discount from the retail unit price of $3,999.*	$2,334	1	$2,334
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident)*	$245	1	$245

All products 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**

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: PEchki0710160000009824.
Please include this Reference ID in any correspondence regarding this price quote.

SHOPPING CART

You may make changes and review the items in your Shopping Cart before proceeding to the Checkout.

Items in your Shopping Cart:

Continue Shopping

Delete	Quantity	Description	Unit Price	Total
☐	1	D-Link 8 Port Rackmountable Gigabit Switch DGS-1008TL	$205.99	$205.99
UPDATE CART		Select Shipping Method: Ground Shipping-$9.99 Shipping charges shown are for orders shipped to the U.S. only, international shipping charges will vary and we will contact you, via email, with the new total.		$9.99
			Total	**$215.98**

PROCEED TO CHECK OUT

'pressCart

Add last minute items here. Just enter the SWH product # or manufacturer part #.

- We accept Visa, Master Card, American Express and Discover credit cards. We also accept Purchase Orders from Government Agencies, Accredited Educational Institutions, and qualifying Companies. If the above order is a Purchase Order.
- If you are ordering from APO addresses or International addresses shipping prices may vary, we will contact you after you complete your order.

BELKIN

BELKIN A3L791-10-BLK 10 ft. Cat 5E Black RJ45 CAT5e Patch Cable - Retail

Image Viewer


$3.99

3 Business Day Shipping $4.99
(Not available in HI, AK and PR)

In Stock

ADD TO CART
ADD TO WISH LIST
EMAIL THIS PAGE
PRINT THIS PAGE
PRICE ALERT

CUSTOMER REVIEWS | SPECIFICATIONS

Model

Brand	BELKIN
Model	A3L791-10-BLK

Spec

Cat	5E
Length	10 ft.
Color	Black

Features

Features	Exceeds the performa Category 5e. Perfect in conjunctior networks. 50-micron gold plate clean and clear trans This product is guara PowerSum tested

Special Offers

No Payments for 6 Months on purchases over $500 with your Newegg.com Preferred Account!
Click here for important disclosures

No Payments for 90 Days On purchases over $250with Bill Me Later®!
Click here for important disclosures

Similar Items

Not the product you're looking for? We can make some suggestions to help you decide on a product that fits your needs.
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MANUFACTURER INFO | RETURNS & REBATES

Manufacturer Warranty

Beyond any applicable Newegg return policy, this item is warranted independently by the product's Manufacturer. Below is a summary provided for convenience only and may not be accurate or current. Click here for full details.

Manufacturer Contact Info

- Manufacturer Product Page
- Website: http://www.belkin.com/index.asp
- Support Phone Number: 800-223-5546 X 2263
- Support Email: http://www.belkin.com/support/emailsupport.asp?pge=con
- Support Website
- View other products from Belkin