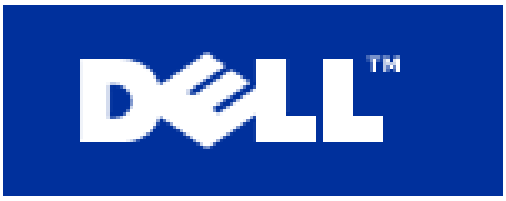

TPC Benchmark ™ E
Full Disclosure Report
DELL PowerEdge 2900
Using
Microsoft SQL Server 2005 Enterprise Edition x64 SP2
On
Microsoft Windows Server 2003 Enterprise x64 SP2

First Edition

Submitted for Review

December 11, 2007

Dell Computer Corp PowerEdge 2900 Server with Microsoft SQL Server 2005 Enterprise Edition x64 SP2 on Microsoft Windows Server 2003 Enterprise x64 SP2

First Printing December 2007

Printed in U.S.A.

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Abstract

This report documents the methodology and results of the TPC Benchmark E test conducted on a PowerEdge 2900 Server using SQL Server 2005 database in conformance with the requirements of the TPC-E Benchmark Specification. The operating system used for the server was Microsoft Windows Server 2003 Enterprise Edition x64. The operating system on the client was Microsoft Windows Server 2003 Enterprise Edition x64.
All tests were done in compliance with Revision 1.2.0 of the Transaction Processing Council's TPC Benchmark™ E Standard Specification. The standard TPC Benchmark™ E metrics, transactions per second (tpsE), price per tpsE ($/tpmE) and the availability date are reported and referred to in this document.

The results from the tests are summarized below:

Hardware	Software	Total System Cost	tpsE	$/tpsE	Availability Date
Dell PowerEdge 2900	Microsoft Windows 2003 Enterprise Ed. x64 SQL Server 2005 Enterprise Ed. x64	$213,115	268.00	$795.21	December 11,2007

Additional copies of this Full Disclosure Report can be obtained from either the Transaction Processing Performance Council or Dell at the following address:

Transaction Processing Performance Council (TPC)
c/o Adminstrator, TPC
Presidio of San Francisco
Bldg 572B Ruger St.
San Francisco, CA 94129-0920
Phone: (415) 561-6272, fax 415-561 6120
www.tpc.org

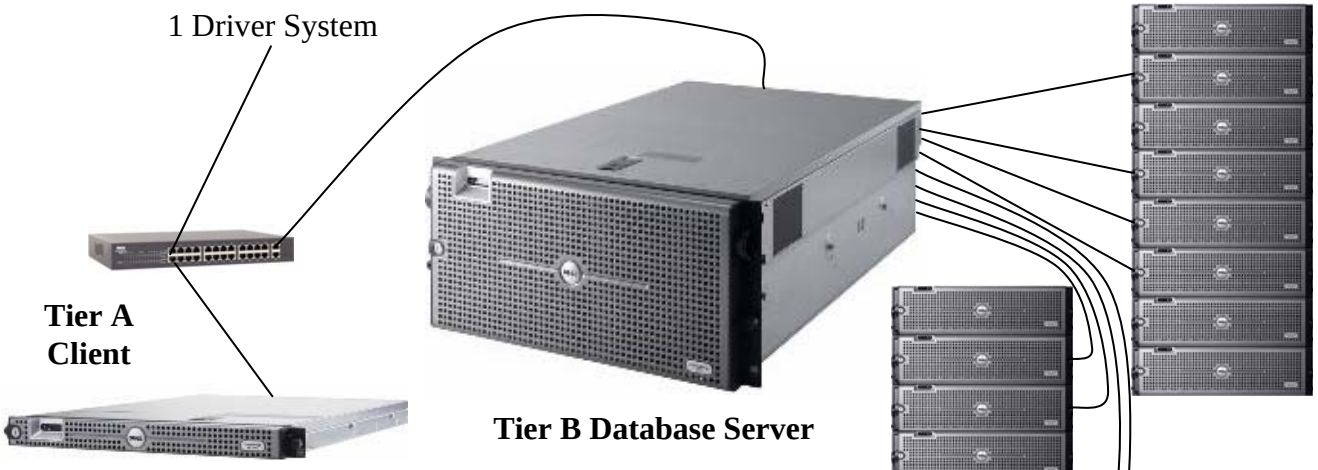
or

Dell
One Dell Way
Round Rock, TX 78682
Attention: Mike Molloy

Auditor

In order to verify compliance to the TPC-E benchmark specification, Lorna Livingtree, Performance Metrics, Inc., audited the benchmark configuration, environment and methodology used to produce and validate the test results, and the pricing model used to calculate the price/performance.

DELL™	**PowerEdge™ 2900 Server**		**TPC-E 1.2** **TPC Pricing 1.2** Report Date: December 11, 2007
TPC-E Throughput	Price/Performance	Availability Date	Total System Cost
268.00 tpsE	**$795.21 USD per tpsE**	**December 11, 2007**	**$213,115 USD**
Database Server Configuration			
Operating System **Microsoft Windows Server 2003 Enterprise x64 Edition™ SP2**	Database Manager **SQL Server 2005 Enterprise x64 Edition™ SP2**	Processors/Cores/ Threads **2/8/8**	Memory **48GB**



Client
1 PowerEdge SC 1430
2 Quad Core Intel 5140,4MB/2.33GHz,1333FSB
1GB Memory
2 Broadcom Internet Adapter
1 80GB SATA 7.2K Disk

Server
1 PowerEdge PE2900
2 X5460 Quad Core Intel Xeon 2x6MB cache, 3.16GHz, 1333MHz FSB
48GB 667MHz(12x4GB), Dual Ranked Fully Buffered DIMM
2 Broadcom NetExtreme II Gigabit Enternet NICs
1 PERC5i SAS RAID Controller
4 MegaRAID SAS 8888ELP Cntrs
8 73GB 15k SAS Disks

Storage
16 PowerVault MD1000 SAS Enclosures
224 73GB 15k 3GBPS SAS Disks

Initial Database Size **1,666GB**	Redundancy Level: **One**	Storage **8 x 73GB** **224 x 73GB**

	PowerEdge 2900	TPC-E 1.2.0 TPC Pricing 1.2 Report Date December 11, 2007 Revision Date December 11, 2007 Availability Date December 11, 2007

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3 yr. Maint. Price
Server Hardware						
PE2900,QC XEON X5460,12MB,3.16GHz	223-4504	1	1,842.00	1	$1,842.00	$320.00
& 2 Broadcom NICs						
X5460,2X6MB/3.16GHZ,1333FSB 2nd Proc	311-7937	1	1,549.00	1	$1,549.00	
48GB 667MHz(12x4GB),2R	311-6328	1	9,398.00	1	$9,398.00	
PERC5/I,Integrated	341-3018	1	$299.00	1	$299.00	
MegaRAID SAS 8888ELP, 2X4 EXTERNAL	LS-8888ELP	3	$803.40	6	$4,820.40	
73GB,3GBPS,SAS,3.5IN,15K	341-2818	1	$299.00	8	$2,392.00	
DELL E157FP,15 IN,15.0 VIS	320-5090	1	$189.00	1	$189.00	
				Subtotal	$20,489.40	$320.00
Server Storage						
PV MD1000,RACK,3U,15 BAY,LBZL	222-2299	1	2,680.00	16	$42,880.00	$26,368.00
SINGLE ENCL MGT MODULE, SAS ONLY	420-5927	1	$345.83	16	$5,533.28	
73GB,3GBPS,SAS,3.5IN,15K	341-2818	1	$299.00	224	$66,976.00	
RACK-111/24U/Dell	A0213544	1	$479.95	2	$959.90	
				Subtotal	$116,349.18	$26,368.00
Server Software						
SQL Server 2005 Enterprise x64 Edition **	810-03150	2	$23,911.00	2	$47,822.00	
Windows Server 2003 Enterprise x64 Server **	P72-01684	2	$2,334.00	1	$2,334.00	
Professional Support (1 Incident)			$245.00	1		$245.00
				Subtotal	$50,156.00	$245.00
Client Hardware						
Dell PowerEdge SC 1430, 2.33GHZ/4MB,1333 FSB	223-3196	1S	960.00	1	$960.00	$320.00
Additional processor, E5345,2X4MB,2.33GHz,1333FSB	311-7774	1S	749.00	1	$749.00	
4GB,667MHz,(2X2GB),2R,FBD	311-6254	1	$748.00	1	$748.00	
80GB,SATA,1IN,7.2K RPM,HD ,7.2K	341-3757	1	$99.00	1	$99.00	
BCOM NetX 5721,Gb,ETHERNET,NIC	430-1496	1	$59.00	1	$59.00	
				Subtotal	$2,615.00	$320.00
Client Software						
Windows Server 2003 Enterprise x64 Server **	P72-01684	2	$2,334.00	1	$2,334.00	
				Subtotal	$2,334.00	$0.00
Infastructure						
PowerConnect 2216, 16port Switch	222-2259	1	$69.00	1	$69.00	
1M SAS Cable MegaRAID SAS 8888ELP	HI-MS-1MSB	3	$35.00	8	$280.00	
2M SAS Cable, MD1000	310-7083	1	$40.00	8	$320.00	
				Subtotal	$669.00	$0.00
				Other Discounts*	($6,751.11)	
				Total	$185,861.47	$27,253.00

Notes:

One or more components of the measured configuration have been substituted in the Priced Configuration. See the FDR for details.

*All items from Dell(1) are discounted 5% based on total dollar volume of this config.

** All Microsoft maintenance is covered by the maint. costs of Microsoft SQL Server

Price Source: 1=Dell, 2=Microsoft, 3=eWiz, NIO = Not Immediately Orderable

Pricing may be verified by calling 1-800-BUY-DELL and referencing quote # 402860243 as a complex quote.

Audited by Lorna Livingtree, Performance Metrics Inc.

Three-Year Cost of Ownership:	**$213,115**	**USD**
TPC-E Throughput:	**268.00**	**tpsE**
Price/Performance:	**$795.21**	**tpsE/USD**

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 sections of the TPC benchmark specifications. If you find that the stated prices are not available according to these items, please inform the TPC at pricing@tpc.org.

Numerical Quantities Summary				
Reported Throughput: 268.00 tpsE		**Configured Customers: 134,000**		
Response Times (in seconds)	**Minimum**	**Average**	**90th%tile**	**Maximum**
Broker-Volume	0.01	0.04	0.06	0.36
Customer-Position	0.00	0.03	0.05	0.36
Market-Feed	0.00	0.03	0.07	4.81
Market-Watch	0.00	0.03	0.06	0.74
Security-Detail	0.00	0.01	0.03	0.49
Trade-Lookup	0.00	0.46	0.61	1.15
Trade-Order	0.00	0.09	0.13	0.57
Trade-Result	0.00	0.09	0.14	4.28
Trade-Status	0.00	0.02	0.04	4.77
Trade-Update	0.02	0.55	0.66	1.23
Data-Maintenance	0.01	0.07		0.66
Transaction Mix		**Transaction Count**		**Mix %**
Broker-Volume		962,100		4.899%
Customer-Position		2,552,923		13.001%
Market-Feed		196,373		1.000%
Market-Watch		3,534,639		18.000%
Security-Detail		2,749,147		14.000%
Trade-Lookup		1,570,878		8.000%
Trade-Order		1,983,406		10.100%
Trade-Result		1,963,708		10.000%
Trade-Status		3,731,098		19.000%
Trade-Update		392,733		2.000%
Data-Maintenance		120		
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)		00:10:23		
Measurement Interval (hh:mm:ss)		02:00:00		
Business Recovery Time (hh:mm:ss)		04:50:27		
Total number of Transactions Completed in Measurement Interval		19,637,005		

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Introduction

Document Structure

The TPC Benchmark™ E Standard Specification requires test sponsors to publish, submit to the TPC, and make available to the public, a full disclosure report (FDR) for any result to be considered compliant with the specification. The required contents of the full disclosure report are specified in Clause 9. This report is submitted to satisfy the specification's requirement for full disclosure. It documents the compliance of the benchmark implementation and execution reported for the Dell PE2900 server using Microsoft SQL Server 2005 Enterprise Edition SP2 (x64) on Microsoft Windows Server 2003 Enterprise Edition (x64).

Benchmark Overview

The Transaction Processing Performance Council (TPC) developed The TPC Benchmark™ E Standard Specification Revision 1.2.0.
TPC Benchmark™ E (TPC-E) is an Online 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 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 benchmark simulates the OLTP workload of a brokerage firm. The focus of the benchmark is the central database that exercises 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.

Clause 1: General Items

1.1: Order and Titles

The order and titles of sections in the Report and Supporting Files must correspond with the order and titles of sections from the TPC-E Standard Specification (i.e., this document). The intent is to make it as easy as possible for readers to compare and contrast material in different Reports.(9.1.1.1)

The order and titles in this report correspond to those in the specification.

1.2: Executive Summary Statement

The TPC Executive Summary Statement must be included near the beginning of the Report (9.2).

The Executive summary has been included near the beginning of this FDR.

1.3: Test Sponsor

A statement identifying the benchmark sponsor(s) and other participating companies must be provided (9.3.1.1).

Dell is the sponsor of this TPC Benchmark™ E result.

1.4: Configuration Diagram

Diagrams of both measured and Priced Configurations must be reported in the Report, accompanied by a description of the differences.(9.3.1.2)

The System Under Test (SUT) is depicted in the next diagram. The difference between the priced and measured system was as shown in Table 1

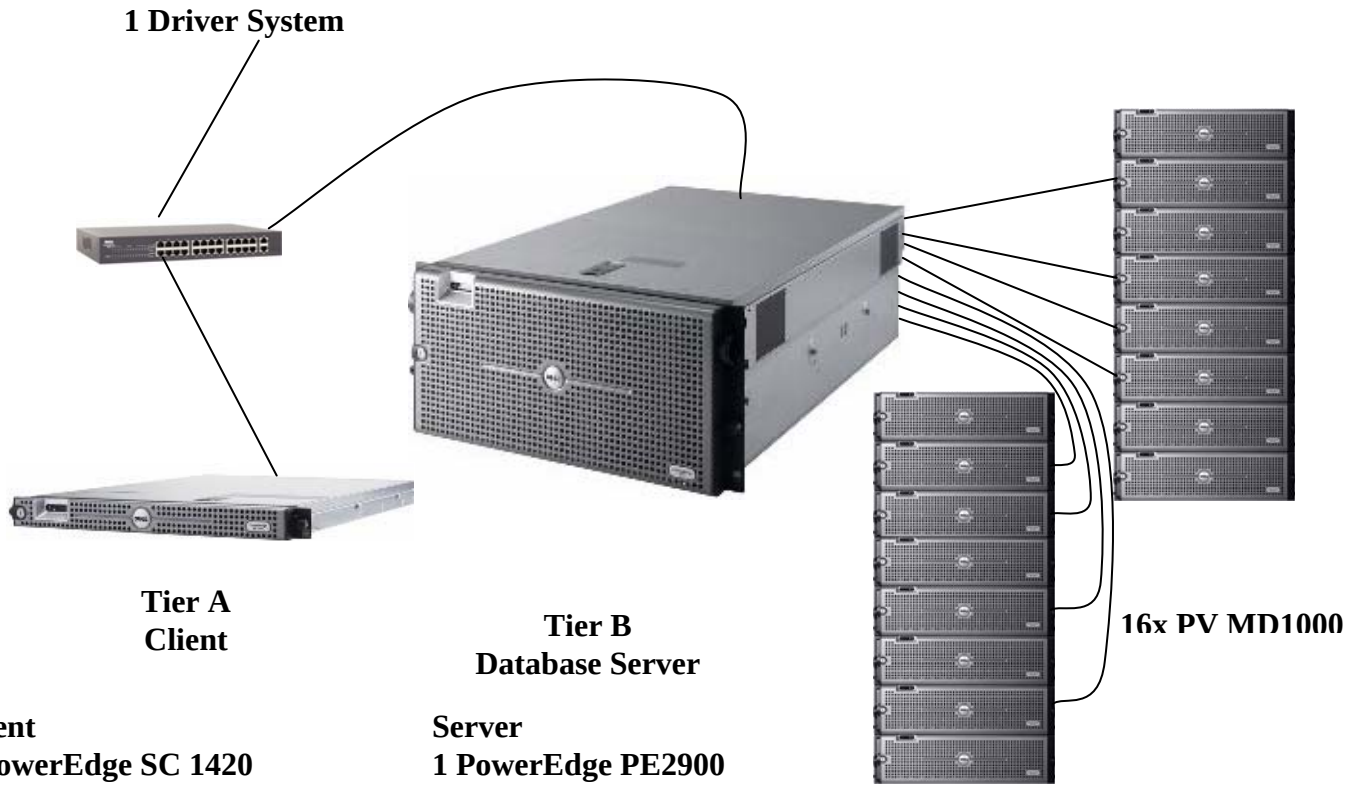
Table 1: *Difference between priced and measured configuration*

	Priced	**Measured**
Client Server	PE SC 1430	PE SC 1420
- FSB	1333MHz	800MHz
- Processors	Intel Quad-core Xeon 2.33 GHz/2x4MB-L2	Intel Xeon 3.2GHz/2x2MB-L2
- Memory	3GB	3GB
- OS drives	1x80GB	1x80GB

Measured Configuration

The measured and priced configurations have different client systems.

Figure 1: Measured Configuration



Client
1 PowerEdge SC 1420
2 Intel Xeon
2MB/3.2GHz,800FSB
1GB Memory
1 Intel Internet Adapter
1 80GB SATA 7.2K Disk

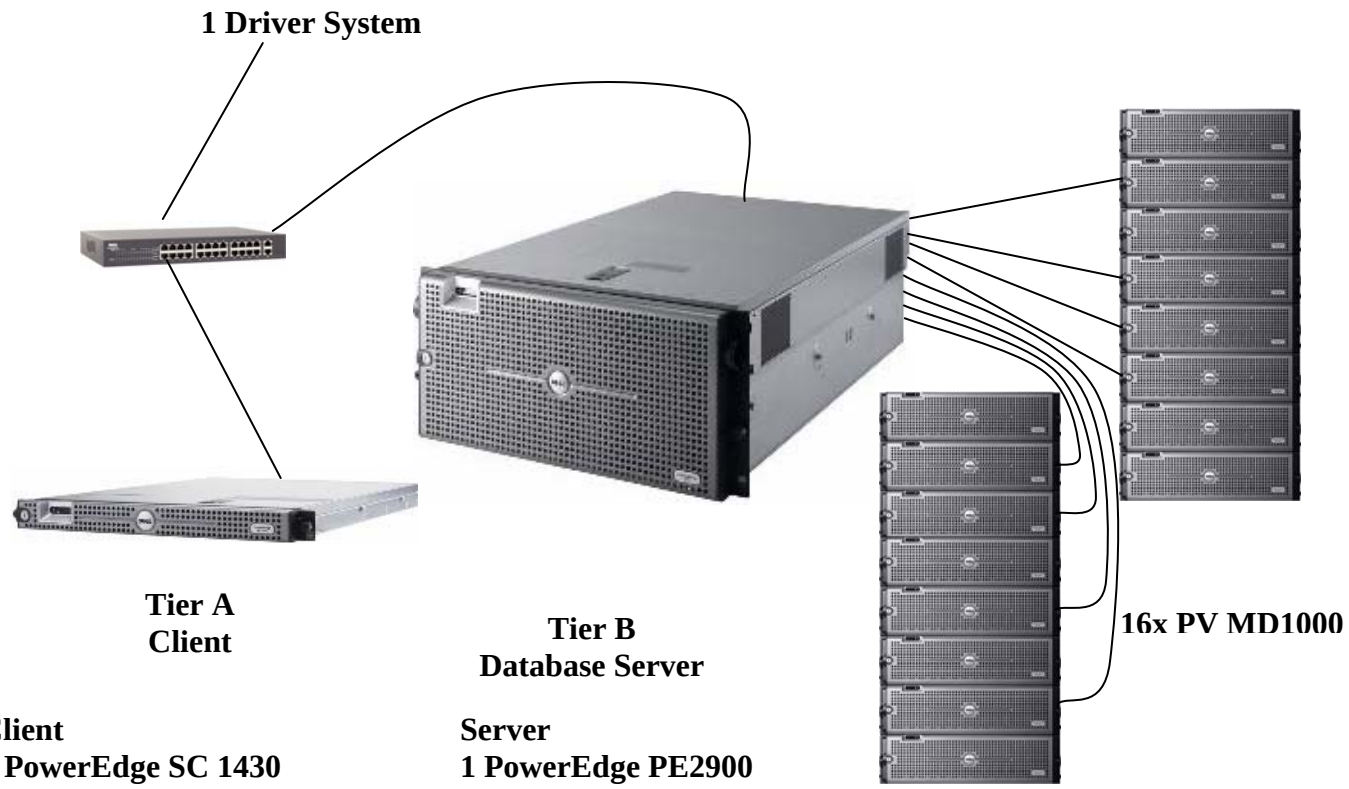
Server
1 PowerEdge PE2900
2 X5460 Quad Core Intel Xeon
2x4MB cache, 3.16GHz,
1333MHz FSB
48GB 667MHz(12x4GB), Dual
Ranked Fully Buffered DIMM
2 Broadcom NetExtreme II
Gigabit Enternet NICs
1 PERC5i SAS RAID Controller
4 MegaRAID SAS 8888ELP
Controllers
8 73GB 15k SAS Disks

Storage

16 PowerVault MD1000
224 73GB 15k SAS Disks

Priced Configuration

Figure 2: *Priced Configuration*



Tier A
Client

Client
1 PowerEdge SC 1430
2 Quad Core Intel 5140,4MB/2.33GHz,1333FSB
1GB Memory
2 Broadcom Internet Adapter
1 80GB SATA 7.2K Disk

Tier B
Database Server

Server
1 PowerEdge PE2900
2 X5460 Quad Core Intel Xeon 2x4MB cache, 3.16GHz, 1333MHz FSB
48GB 667MHz(12x4GB), Dual Ranked Fully Buffered DIMM
2 Broadcom NetExtreme II Gigabit Enternet NICs
1 PERC5i SAS RAID Controller
4 MegaRAID SAS 8888ELP Controllers
8 73GB 15k SAS Disks

Storage

16 PowerVault MD1000
224 73GB 15k SAS Disks

1.5: Hardware configuration

A description of the steps taken to configure all of the hardware must be reported in the Report. Any and all configuration scripts or step by step GUI instructions are reported in the Supporting Files (see Clause 9.4.1.1). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of computer systems and the TPC-E specification could recreate the hardware environment. (9.3.1.4)

The file ***PE2900_HardwareConfiguration.pdf*** in the *SupportingFiles* Directory ("Introduction") contains the hardware configuration used in running these TPC-E tests. The directory also contains the storage subsystem configuration in the file ***Storage_Hardware_config.pdf*** in the DiskSubsystem directory.

The hardware configuration used in this TPC-E test is a Dell PowerEdge 2900 server (tier B) driven by one Dell PowerEdge SC 1420 (tierA) client. The clients and server are networked together via a Dell PowerConnect 2216 10/100/1000 BaseT switch. One Dell PowerEdge 1600 server was the driver system that emulated 200 users executing the standard TPC-E workload. The driver system is connected to the client via the Dell Powerconnect network switch. Microsoft Windows 2003 Enterprise Server x64 SP2 was the operating system used on both the server and the client system. Microsoft SQL Server 2005 Enterprise Edition x64 was the database management system on the server machine.

The PowerEdge 2900 motherboard uses the Intel 8501 chipset and can hold up to two quad-core Intel Xeon DP processors (3.14 GHz with 12MB L2 cache each). The system has 4 PCI-e and 3 PCI-x I/O slots. The measured configuration used 48Gbytes of DDR RAM, which was achieved by using 12 4096Mbyte DIMMs.

The PowerEdge 2900 has an integrated PERC SAS controller to which was attached eight 73GB disk drives containing the operating system and databse logs. In addition, 4 MegaRAID SAS 8888ELP controllers were installed in 4 PCI-e slots and connected to 16 MD 1000 disk pods, which can hold 15 disks each. Each of the 4 controllers managed 4 RAID 10 LUNs. Each LUN had 14 physical drives. The total number of physical drives used for the database was 224 SAS disks. There were 3 empty PCI-X slots. Hyperthreading was not enabled on this server.

The PE sc 1430 client server has two Intel Quad-core Xeon processor with 2x4MB of L2 cache and a FSB rated at 1333MHz. The system had 3 Gbytes of RAM, two 73 GB hard disk, 2 intergrated Ethernet ports. The client connected to the driver machine and the DB server through a powerconnect switch. Hyperthreading was not enabled on this server.

1.6: Software Configuration

A description of the steps taken to configure all software must be reported in the Report. Any and all configuration scripts or step by step GUI instructions are reported in the Supporting Files (see Clause 9.4.1.2). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of computer systems and the TPC-E specification could recreate the software environment. (9.3.1.5)

The file ***SoftwareConfiguration.pdf*** in the *SupportingFiles* Directory (“Introduction”) contains the configuration and system parameters used in running these tests.

Clause 2: Database Design Scaling and Population

2.1: Physical Database Organization

The physical organization of tables and indices, within the database, must be reported in the Report. (9.3.2.1)

The **SupportingFiles/Clause2** folder contains the SQL definitions of all the required filegroups, tables and indexes.
The database tables and their indexes were divided into 3 file groups : Broker, Customer, market as shown in the table below :

***Table 2**: Physical database organization*

Broker File Group	Customer File Group	Market File Group
BROKER	ACCOUNT_PERMISSION	COMPANY
CASH_TRANSACTION	CUSTOMER	COMPANY_COMPETITOR
CHARGE	CUSTOMER_ACCOUNT	DAILY_MARKET
COMMISSION_RATE	CUSTOMER_TAXRATE	EXCHANGE
SETTLEMENT	HOLDING	FINANCIAL
TRADE	HOLDING_HISTORY	INDUSTRY
TRADE_HISTORY	HOLDING_SUMMARY	LAST_TRADE
TRADE_REQUEST	WATCH_ITEM	NEWS_ITEM
TRADE_TYPE	WATCH_LIST	NEWS_XREF
ADDRESS		SECTOR
TAXRATE		SECURITY
ZIP_CODE		STATUS_TYPE

2.2: Table and Row Partitioning

While few restrictions are placed upon horizontal or vertical partitioning of tables and rows in the TPC-E benchmark (see Clause 2.3.3), any such partitioning must be reported in the Report.(9.3.2.2)

No partitioning implemented in this configuration.

2.3: Replications, Duplications and Additions

Replication of tables, if used, must be reported in the Report (9.3.2.3)

No replication implemented in this configuration.

Additional and/or duplicated attributes in any table must be reported in the Report along with a statement on the impact on performance (9.3.2.4)

No additional or duplicated attributes.

2.4: Initial Cardinality of Tables

The cardinality (e.g. the number of rows) of each table, as it existed after database load (see Clause 2.6), must be reported in the Report.(9.3.2.5)

The database was configured for 134,000 customers. The cardinality of the tables is as shown in table 2.2 below:

***Table 3*: Table Cardinality**

Table	Cardinality after database load
Account_Permission	951708
Address	201004
Broker	1340
Cash_Transaction	2130273948
Charge	15
Commission_Rate	240
Company	67000
Company_Competitor	201000
Customer	134000
Customer_Account	670000
Customer_Taxrate	268000
Daily_Market	119785950
Exchange	4
Financial	1340000
Holding	118632130
Holding_History	3103184797
Holding_Summary	6669024
Industry	102
Last_Trade	91790
News_Item	134000
News_Xref	134000
Sector	12
Security	91790
Settlement	2315520000
Status_Type	5
Taxrate	320
Trade	2315520000
Trade_History	5557299926
Trade_Request	0
Trade_Type	5
Watch_Item	13396428
Watch_List	134000
Zip_Code	14741

2.5: Disk Configuration Data

The distribution of tables, partitions and logs across all media must be explicitly depicted for the measured and Priced Configurations. (9.3.2.6)

The Storage subsystem was configured as shown in Table 4. All database files were located on RAW file systems. Backup devices were setup up on NTFS filesystems. Junction points were used to map to the NTFS partitions that contained the backup devices. The OS (C:\)drive was formatted for NTFS.

***Table 4**: Disk Configuration*

HBA#	Slot#	Disk#	Drives Enclosure model RAID level	OS Partition	Size	Use
0	internal	0	8x73GB,15K,SAS onboard RAID10	C:\	20GB	OS
		1	8x73GB,15K,SAS onboard RAID10	E:\	120GB	Logs
1	1	2	14x73GB,15K,SAS MD1000 RAID10	F:\	86.75GB	Broker1
				C:\A\F	3.5GB	Customer1
				C:\B\F	17.5GB	Market1
				C:\C\F	117.86GB	Backup1
		3	14x73GB,15K,SAS MD1000 RAID10	G:\	86.75GB	Broker2
				C:\A\G	3.5GB	Customer2
				C:\B\G	17.5GB	Market2
				C:\C\G	117.86GB	Backup2
		4	14x73GB,15K,SAS MD1000 RAID10	H:\	86.75GB	Broker3
				C:\A\H	3.5GB	Customer3
				C:\B\G	17.5GB	Market3
				C:\C\G	117.86GB	Backup3
		5	14x73GB,15K,SAS MD1000 RAID10	I:\	86.75GB	Broker4
				C:\A\I	3.5GB	Customer4
				C:\B\I	17.5GB	Market4
				C:\C\I	117.86GB	Backup4
2	2	6	14x73GB,15K,SAS MD1000 RAID10	J:\	86.75GB	Broker5
				C:\A\J	3.5GB	Customer5
				C:\B\J	17.5GB	Market5
				C:\C\J	117.86GB	Backup5
		7	14x73GB,15K,SAS MD1000 RAID10	K:\	86.75GB	Broker6
				C:\A\K	3.5GB	Customer6
				C:\B\K	17.5GB	Market6
				C:\C\K	117.86GB	Backup6

		8	14x73GB,15K,SAS MD1000 RAID10	L:\	86.75GB	Broker7
				C:\A\L	3.5GB	Customer7
				C:\B\L	17.5GB	Market7
				C:\C\L	117.86GB	Backup7
		9	14x73GB,15K,SAS MD1000 RAID10	M:\	86.75GB	Broker8
				C:\A\M	3.5GB	Customer8
				C:\B\M	17.5GB	Market8
				C:\C\M	117.86GB	Backup8
3	3	2	14x73GB,15K,SAS MD1000 RAID10	N:\	86.75GB	Broker9
				C:\A\N	3.5GB	Customer9
				C:\B\N	17.5GB	Market9
				C:\C\N	117.86GB	Backup9
		3	14x73GB,15K,SAS MD1000 RAID10	O:\	86.75GB	Broker10
				C:\A\O	3.5GB	Customer10
				C:\B\O	17.5GB	Market10
				C:\C\O	117.86GB	Backup10
		4	14x73GB,15K,SAS MD1000 RAID10	P:\	86.75GB	Broker11
				C:\A\P	3.5GB	Customer11
				C:\B\P	17.5GB	Market11
				C:\C\P	117.86GB	Backup11
		5	14x73GB,15K,SAS MD1000 RAID10	Q:\	86.75GB	Broker12
				C:\A\Q	3.5GB	Customer12
				C:\B\Q	17.5GB	Market12
				C:\C\Q	117.86GB	Backup12
4	4	6	14x73GB,15K,SAS MD1000 RAID10	R:\	86.75GB	Broker13
				C:\A\R	3.5GB	Customer13
				C:\B\R	17.5GB	Market13
				C:\C\R	117.86GB	Backup13
		7	14x73GB,15K,SAS MD1000 RAID10	S:\	86.75GB	Broker14
				C:\A\S	3.5GB	Customer14
				C:\B\S	17.5GB	Market14
				C:\C\S	117.86GB	Backup14
		8	14x73GB,15K,SAS MD1000 RAID10	T:\	86.75GB	Broker15
				C:\A\T	3.5GB	Customer15
				C:\B\T	17.5GB	Market15
				C:\C\T	117.86GB	Backup15
		9	14x73GB,15K,SAS MD1000 RAID10	U:\	86.75GB	Broker16
				C:\A\U	3.5GB	Customer16
				C:\B\U	17.5GB	Market16
				C:\C\U	117.86GB	Backup16

C:\..\back1[2] - C:\backup\back1
C:\..\back2[2] - C:\backup\back2
C:\..\back3[2] - C:\backup\back3
C:\..\back4[2] - C:\backup\back4
C:\..\back5[2] - C:\backup\back5
C:\..\back6[2] - C:\backup\back6
C:\..\back7[2] - C:\backup\back7
C:\..\back8[2] - C:\backup\back8
C:\..\back9[2] - C:\backup\back9
C:\..\back10[2] - C:\backup\back10

2.6: Database Interface

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). (9.3.2.7)
The methodology used to load the database must be reported in the Report. (9.3.2.8)

This test deployed Microsft SQL Server 2005 which is a relational database.
The client software interfaced to SQL Server via Stored Procedures invoked through ODBC calls driven by the C++ application code.
The methodology used to load the database is described in **Clause2** of the *SupportingFiles* directory (***MSTPCE Database Setup Reference.pdf***)

Clause 3: Transaction Items

3.1: Code Functionality

A statement that vendor-supplied code is functionally equivalent to Pseudo-code in the specification (see Clause 3.2.1.6) must be reported in the Report.(9.3.3.1)

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

3.2: Database Requirements

A statement that the database footprint requirements (as described in Clause 3.3) were met must be reported in the Report.(9.3.3.2)

Database footprint requirements were met as described in the specification.

Clause 4: SUT, Driver and Network

4.1: EGenDriver Items

The number of EGenDriverMEE and EGenDriverCE instances used in the benchmark must be reported in the Report (9.3.4.1)

There was 1 instance of EGenDriverMEE and 1 instance of EGenDriverCE

4.2: Network Configuration

The Network configurations of both the measured and Priced Configurations must be described and reported in the Report. This includes the mandatory Network between the Driver and Tier A (see Clause 4.2.2) and any optional Database Server interface networks (9.3.4.2)

Figure 1 and Figure 2 show the network connections of the configuration. The PE2900 server has an inbuilt network Ethernet controller with 2 1000MB/s ports. One of the ports is used to connect to the client (tier A) system via a Dell PowerConnect switch. The Client system also has an inbuilt network controller with 2 1000MB/s ports. One of these ports is connected to the driver system via the PowerConnect switch and satisfies the requirement for a mandatory network between tier A and the driver system.

Clause 5: EGen Items

5.1: EGen Version

The version of EGen used in the benchmark must be reported (9.3.5.1)

The EGen version used was 1.2.0

5.2: EGen Code

A statement that all required TPC-provided EGen code was used in the benchmark must be reported (9.3.5.2)

All the required TPC-provided code was used in the benchmark.

5.3: EGen Modifications

If the Test Sponsor modified EGen, a statement EGen has been modified must be reported in the Report. All formal waivers from the TPC documenting the allowed changes to EGen must also be reported in the Report (see Clause 5.3.7.1). If any of the changes to EGen do not have a formal waiver that must also be reported (9.3.5.3)

There were no modifications to the EGen.

5.4: EGen Loader Extension Code

If the Test Sponsor extended EGenLoader (as described in Appendix A.6), the use of the extended EGenLoader and the audit of the extension code by an Auditor must be reported (9.3.5.4)

There was no use and no implementation of the EGenloader extension code.

Clause 6: Performance Metrics and Response time

6.1: Measured Throughput (tpsE)

The Measured Throughput must be reported (9.3.6.1)

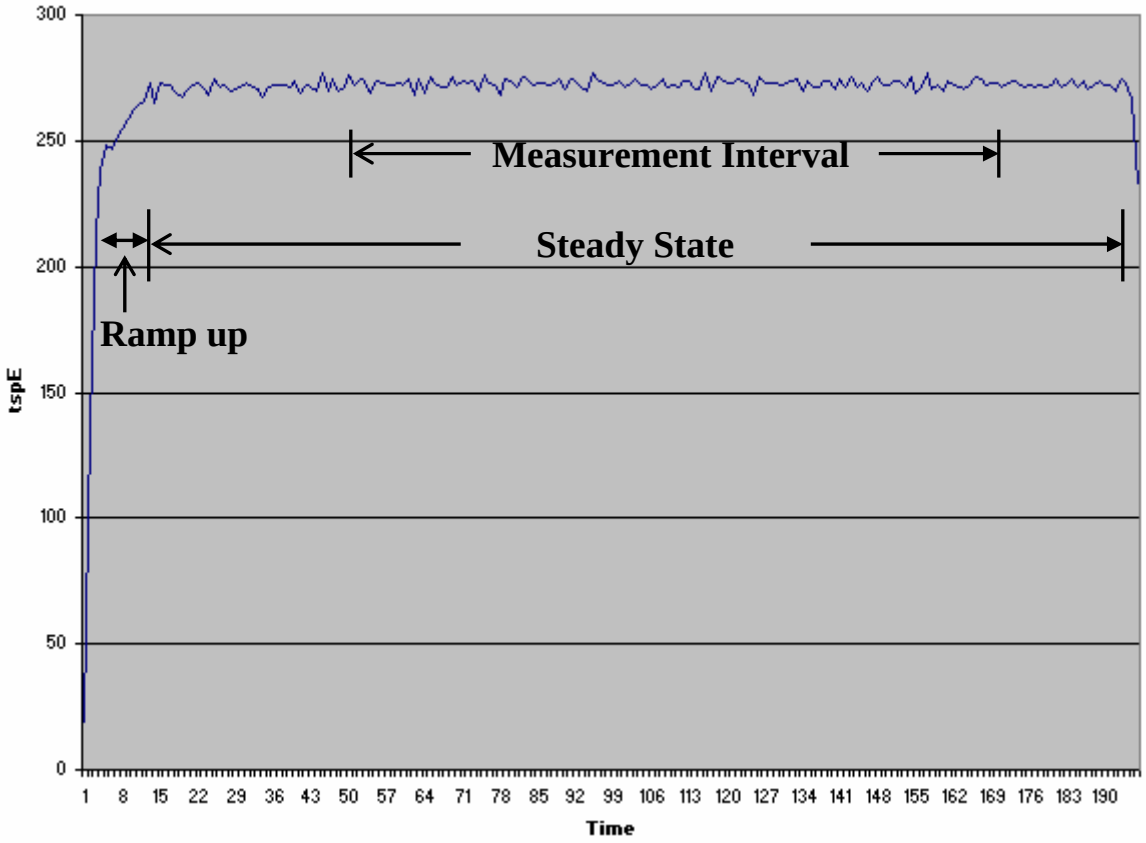
The measured tpsE was 272.74

6.2: Test Run times

A Test Run Graph of throughput versus elapsed wall clock time must be reported in the Report for the Trade-Result Transaction (see Clause 6.7.2). (9.3.6.2)

The transaction step report for the performance run was evaluated and drawn as shown in Figure 3.

***Figure 3**: Steady State graph*



6.3: Steady State Measurement

The method used to determine that the SUT had reached a Steady State prior to commencing the Measurement Interval must be reported. (9.3.6.3)

It can be seen that after ramp-up a steady state was maintained through outt the measurement interval and until the run was stopped.
A 1 hour window sliding by 10 mins in steady state was evaluated and was found to vary by 0.47%. A 10 min window sliding by 1 min was found to vary by 1.52%.

6.4: Work Measurements during Test Run

A description of how the work normally performed during a Test Run, actually occurred during the Measurement Interval must be reported in the Report (for example checkpointing, writing Undo/Redo Log records, etc.). (9.3.6.4)

The driver generated the required transactions and their input data. This data was timestamped. Response for the requested transaction was verified and time-stamped in the driver log files. Log file contents are consolidated for the reports.
The driver engine accessed the application processes running on the client system via an Ethernet network connection. The client application processes handled all requests to the database on the server. The applications communicated with the database server over an Ethernet connection using SQL Server ODBC library and RPC calls.
To perform checkpoints at specific intervals, the SQL Server recovery interval was set to 32767. Continuous checkpoints every 7.5 minutes were performed during steady state before and during the measurement interval by the driver engine. SQL Server was started with trace flag 3502, which caused it to log the occurrence of the checkpoints. This information was used to verify that the checkpoints occurred at the appropriate times during the test run.

6.5: Transaction Averages

The recorded averages over the Measurement Interval for each of the Transaction input parameters specified by clause 6.4.1 must be reported. (9.3.6.5)

The transaction averages were recorded as shown in Table 5.

***Table 5**: Transaction Averages*

Transaction	Overall	Parameter	Value	Range Check	Acceptable Range Min	Max
Customer Position	Ok	By Tax ID	50.04%	**Ok**	48.00%	52.00%
		Get history	49.97%	**Ok**	48.00%	52.00%
Trade Lookup	Ok	Frame 1	29.98%	**Ok**	28.50%	31.50%
		Frame 2	30.03%	**Ok**	28.50%	31.50%
		Frame 3	30.05%	**Ok**	28.50%	31.50%
		Frame 4	9.95%	**Ok**	9.50%	10.50%
Market Watch	Ok	By Watch List	60.01%	**Ok**	57.00%	63.00%

		By Customer Account	35.00%	**Ok**	33.00%	37.00%
		By Industry	5.00%	**Ok**	4.50%	5.50%
Trade Update	Ok	Frame 1	33.00%	**Ok**	31.00%	35.00%
		Frame 2	33.06%	**Ok**	31.00%	35.00%
		Frame 3	33.94%	**Ok**	32.00%	36.00%
Security Detail	Ok	Access LOB	1.01%	**Ok**	0.90%	1.10%
Trade Order	Ok	By Non-Owner	9.99%	**Ok**	9.50%	10.50%
		By Company Name	39.99%	**Ok**	38.00%	42.00%
		Buy on Margin	8.02%	**Ok**	7.50%	8.50%
		Rollback	0.99%	**Ok**	0.94%	1.04%
		LIFO	34.96%	**Ok**	33.00%	37.00%
		Trade Quantity 100	24.99%	**Ok**	24.00%	26.00%
		Trade Quantity 200	24.97%	**Ok**	24.00%	26.00%
		Trade Quantity 400	25.04%	**Ok**	24.00%	26.00%
		Trade Quantity 800	25.00%	**Ok**	24.00%	26.00%
		Market Buy	30.00%	**Ok**	29.70%	30.30%
		Market Sell	29.98%	**Ok**	29.70%	30.30%
		Limit buy	20.02%	**Ok**	19.80%	20.20%
		Limit sell	9.99%	**Ok**	9.90%	10.10%
		Stop Loss	10.01%	**Ok**	9.90%	10.10%

Clause 7: Transaction and System Properties

7.1 : Transaction Properties (ACID)

The results of the ACID tests must be reported in the Report along with a description of how the ACID requirements were met, and how the ACID tests were run. (9.3.7.1)

The benchmark specification requires that a system under test (SUT) must support a set of properties during the execution of the benchmark. Those properties are ACID and Redundancy.
This section defines each of these properties, describes the steps taken to ensure that they were present during the test and describes a series of tests done to demonstrate compliance with the specification. See file ***MSTPCE ACID Procedures.pdf*** in the *SupportingFiles* directory (Clause 7).

7.2: Redundancy Level

The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.5.7.1) and describe the test(s) used to demonstrate compliance. (9.3.7.2)

Redundancy level 1 was used for all storage systems.

7.3: Data Accessibility Tests

A description of the Data Accessibility tests run and the Redundancy Level they were demonstrating must be reported. (9.3.7.3)

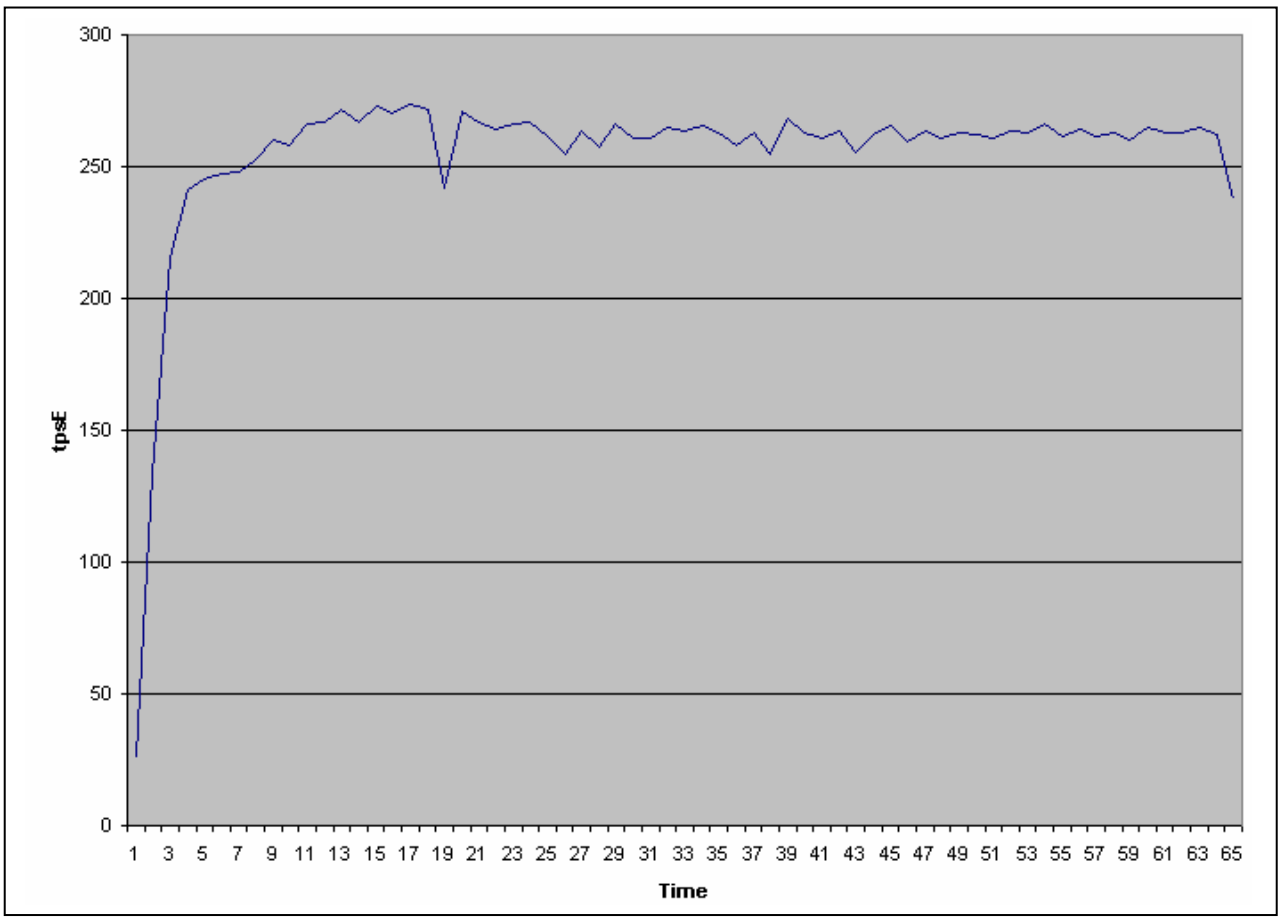
1. A restore was executed to yield a fresh database.
2. The rows in the Settlement table were counted to determine the initial count of completed trades present in the database (count-before).
3. A performance run was started with the same number of configured customers and driver load used for the measurement interval.
4. The test ramped up, and executed at or above 95% of the Reported Throughput for 30 mins.
5. After 30mins, a log disk drive was pulled from the disk pod.
6. The driver continued running normally for 5 mins.
7. After an additional 5mins, a data disk drive was pulled from the disk pod.
8. The drivers continued running normally with no errors logged in the SQL errorlog and OS logs.
9. After an additional 30mins the driver was stopped gracefully.
10. A transaction report for the test was generated and the number of Trade_Result transactions recorded during the run was noted.
11. The faulty log and data disk drives were replaced by spare disks of similar characteristics.
12. The Database was allowed to recover normally

13. Step 2 was repeated to determine the total number of completed trades present in the database (count-after)
14. count-after minus count-before was verified to be equal to the number of successful Trade-Result transaction records in the driver log file.
15. Consistency tests were run to ensure that the database was in a consistent state.

7.4: Data Accessibility Test Graph

A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported (9.3.7.4)

Figure 4: Data Accessibility Graph



7.5: Business Recovery Tests

The Test Sponsor must describe in the Report the test(s) used to demonstrate Business Recovery. (9.3.7.5)

Power to the SUT was removed as a way of demonstrating recovery from a system crash:

1. A restore was executed to yield a fresh database.
2. The rows in the Settlement table were counted to determine the initial count of completed trades present in the database (count-before).
3. A performance run (Run1) with the same number of configured customers and driver load was started and ramped up to steady state.
4. The test ran at 95% and above of reported throughput for 30mins.
5. Power to tier A and tier B systems was pulled.
6. After transaction failures were noted by the drivers, the drivers were stopped
7. Power to the SUT was returned.
8. Database recovery started. That marked the beginning of business recovery.
9. Database recovery was completed successfully
10. A performance run (Run2) was started.
11. The test ramped-up to steady state.
12. Business recovery ends when the test attains at least 95% of reported throughput and maintains that rate or above thereafter.
13. The test was allowed to run in steady-state for 2hrs 30mins.
14. The drivers were stopped gracefully.
15. Transaction reports for Run1 and Run2 were generated and the count of Trade_Results transactions for both runs were noted and summed.
16. Step 2 was repeated to determine the total number of completed trades present in the database (count-after)
17. count-after minus count-before was verified to be equal to the number of successful Trade-Result transaction (sum of Run1 and Run2) records in the driver log file.
18. Consistency tests were run to ensure that the database was in a consistent state.

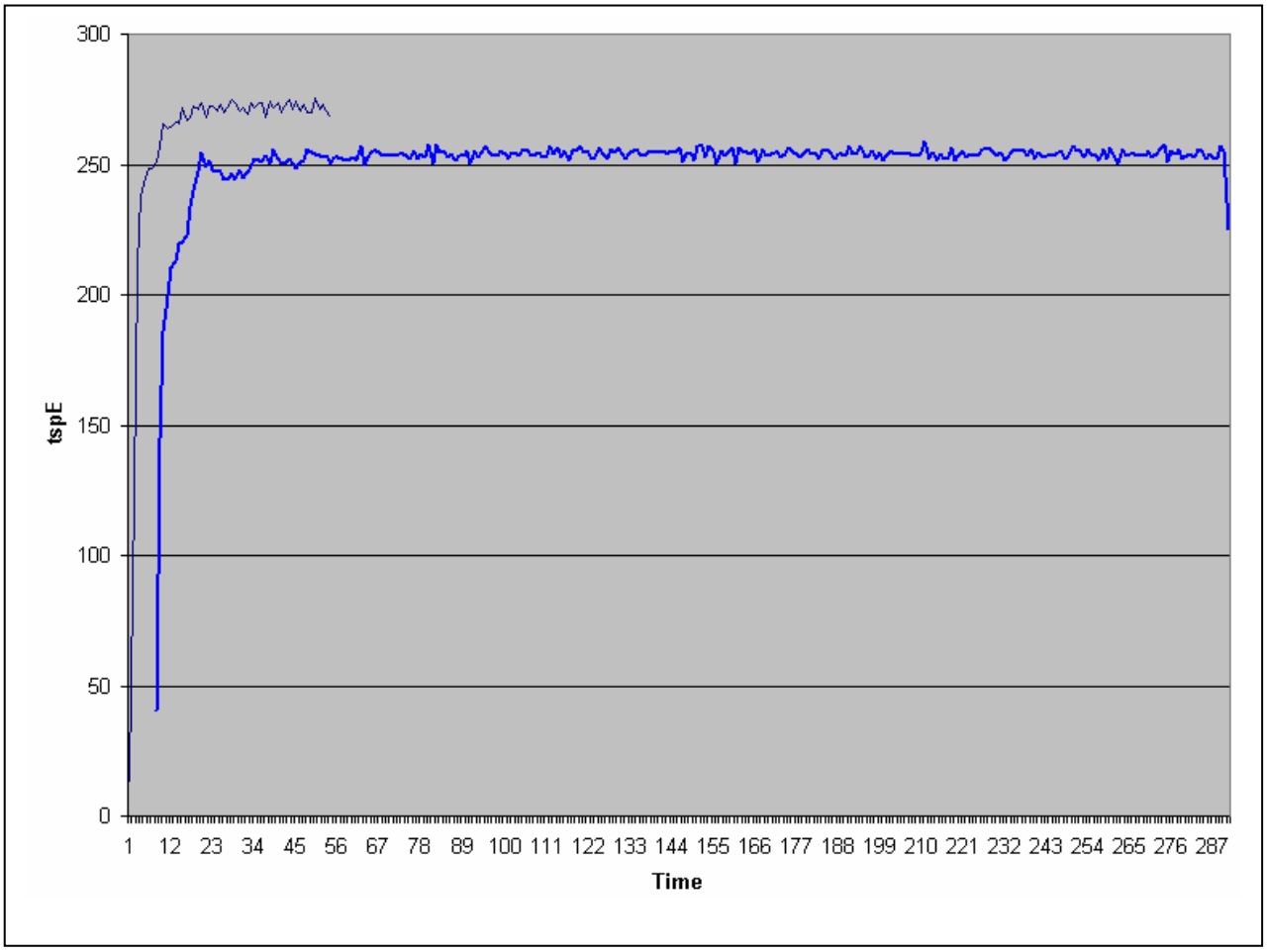
7.6: Business Recovery Time

The Business Recovery Time must be reported on the Executive Summary Statement and in the report.If the failures described in clauses 7.5.2.2, 7.5.2.3, and 7.5.2.4 were not combined into one Durability Test (Usually powering off the database during the run), then the Business Recovery Time for the failure described for instantaneous interruption is the Business Recovery Time that must be reported in the Executive Summary Statement. All the Business Recovery Times for each test requiring Business Recovery must be reported in the Report. (9.3.7.6)

A Business Recovery Graph (see clause 7.5.7.4) must be reported in the Report for all Business Recovery Tests. (9.3.7.7)

The Business Recovery Time was determined to be 4 hrs 50mins 27s. This is also recorded in the Executive Summary.

***Figure 5**: Business Recovery Tests Graph*



Clause 8: Pricing

8.1: 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. (9.3.8.1)

Table 6: *Space Requirements*

Space calculations for TPC-E		Customers:	134,000						
		TpsE:	268.00						
		TradeResult count:	3,155,626						
Table	**Rows**	**Data(KB)**	**Index(KB)**	**Total**	**Total + 5%**	**Rows After**	**Data After(KB)**	**Index After(KB)**	**Growth**
ACCOUNT_PERMISSION	951708	95208	632	95,840	100,632	951708	95208	632	0
ADDRESS	201004	11592	200	11,792	12,382	201004	11648	208	64
BROKER	1340	128	296	424	445	1340	192	296	64
CASH_TRANSACTION	2130273948	209664880	443152	210,108,032	220,613,434	2133177063	214724128	871472	5487568
CHARGE	15	8	8	16	17	15	8	8	0
COMMISSION_RATE	240	16	16	32	34	240	16	16	0
COMPANY	67000	14544	4160	18,704	19,639	67000	14552	4160	8
COMPANY_COMPETITOR	201000	5440	4584	10,024	10,525	201000	5440	4584	0
CUSTOMER	134000	22712	6024	28,736	30,173	134000	22720	6024	8
CUSTOMER_ACCOUNT	670000	62224	74184	136,408	143,228	670000	62224	74208	24
CUSTOMER_TAXRATE	268000	5600	184	5,784	6,073	268000	5720	192	128
DAILY_MARKET	119785950	6104328	2556328	8,660,656	9,093,689	119785950	6105376	2556512	1232
EXCHANGE	4	8	8	16	17	4	8	8	0
FINANCIAL	1340000	157680	552	158,232	166,144	1340000	157832	664	264
HOLDING	118632130	6271280	4634240	10,905,520	11,450,796	118713694	10363624	4799616	4257720
HOLDING_HISTORY	3103184797	112843120	58808240	171,651,360	180,233,928	3107439396	113219440	59062056	630136
HOLDING_SUMMARY	6669024	223800	928	224,728	235,964	6668879	447560	2536	225368
INDUSTRY	102	8	40	48	50	102	8	40	0
LAST_TRADE	91790	4232	160	4,392	4,612	91790	8440	176	4224
NEWS_ITEM	134000	14758848	264	14,758,912	15,496,858	134000	14758864	272	24
NEWS_XREF	134000	3328	160	3,488	3,662	134000	3328	160	0
SECTOR	12	8	24	32	34	12	8	24	0
SECURITY	91790	14352	6400	20,752	21,790	91790	14376	6400	24
SETTLEMENT	2315520000	113632480	239936	113,872,416	119,566,037	2318675626	118463328	478992	5069904
STATUS_TYPE	5	8	8	16	17	5	8	8	0
TAXRATE	320	24	16	40	42	320	40	16	16
TRADE	2315520000	255151320	136579712	391,731,032	411,317,584	2318691839	262174272	138574544	9017784
TRADE_HISTORY	5557299926	159349136	415432	159,764,568	167,752,796	5564880983	159932208	417728	585368
TRADE_REQUEST	0	0	0	-	-	16213	2040	3752	5792
TRADE_TYPE	5	8	1032	1,040	1,092	5	8	1032	0
WATCH_ITEM	13396428	362248	1408	363,656	381,839	13396429	362384	1552	280
WATCH_LIST	134000	3328	2848	6,176	6,485	134000	3328	2848	0
ZIP_CODE	14741	504	144	648	680	14741	504	144	0
Totals in KB	14741	504	144	1082543520	1136670696		900958640	206870880	25286000

						file size
Database File Groups	**Allocated size MB**	**Required size MB**	**Diff**			**# of files**
Customer_fg	275,968	191,910	84,058	OK		total in KB (*8)
Broker_fg	1,378,496	897,725	480,771	OK		
Market_fg	52,080	24,239	27,841	OK		
Total	1,706,544					
Total in GB	1,666.5					

Growing Space	25,279,640	KB				
per Trade Result	8.01	KB				
Data Growth	61,831,907	KB				
60 Day Space	3,709,915,068	KB				
60 Day Space	3,538	GB				
		%	size			
Log space before in MB	5,931	4.5885806	129263.99			
Log space after in MB	40,133	31.047377	129263.99			
per Trade Result	0.011					
Log Growth	83,655	MB				
Total 8 hours log space	89,586	MB				
Total 8 hours log space	87.49	GB				

	Count	Formatted size GB	Total GB Configured	Total Needed
Data Disks configured	0	33.37	-	
	224	67.75	15,176	
	0	135.49	-	
RAID 10 overhead 50%			(7,588)	
Data Disk space total			**7,588**	3,538
Log Disks configured	8	67.75	542	
RAID 10 overhead 50%			(271)	
Log Disk space total			271	87

8.2: Attestation Letter

The Auditor's Attestation Letter, which indicates compliance, must be included in the Report. (9.3.8.2)

This configuration and benchmark test was audited by a TPC certified auditor Lorna Livingtree as shown by the attestation letter shown below:

December 11, 2007

Mr. Gene Purdy
Dell Computer Corporation
One Dell Way
Round Rock, TX 78682

I have verified the TPC Benchmark™ E for the following configuration:

Platform: Dell PE 2900
Database Manager: Microsoft SQL Server 2005 Enterprise x64 Edition
Operating System: Microsoft Windows Sever 2003 Enterprise x64 Edition

Server (Tier B): PE6850			
CPU's	Memory	Disks (total)	tpsE
2 Intel quad core @ 3.2 Ghz	48 GB	232 @ 72 GB	**268.00**
Clients (Tier A): 1 PE SC 1420			
2 Intel @ 3.2 Ghz	3 GB	1 @ 80 GB	Na

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark. The following attributes of the benchmark were given special attention:

- All EGen components were verified to be version 1.2.0.
- The database files were properly sized and populated for 134,000 customers.
- The transaction components were properly implemented.
- The required network between the driver and the transaction harness was configured.
- The ACID properties were successfully demonstrated.

- The database was verified to have no Trade-Request rows prior to the start of the test run.
- The test run met all the requirements for timing, mix, and response times.
- Input data was generated according to the specified percentages.
- One and only one Data-Maintenance process was running during the test run.
- There were no inactive load units during the test run.
- Eight hours of mirrored log space was present on the measured system.
- Eight hours of growth space was present on the measured system.
- The data for the 60 day space calculation was verified.
- There were 200 user contexts present on the system.
- The steady state portion of the test was 120 minutes.
- One checkpoint was taken after steady state and before the measured interval.
- Checkpoint interval was verified to be equal to or less than 7.5 minutes.
- The system pricing was checked for major components and maintenance.
- Third party quotes were verified for compliance.
- The FDR was reviewed and verified as required.

Auditor Notes:
During the measured interval, there was one user context that was repeatedly constructed and destructed. This thread was demonstrated to be the checkpoint thread and displayed a steady 7 minutes 30 seconds between each new occurrence.

The Tier A client tested was a Power Edge SC 1420 which is no longer available. A Power Edge SC 1430 has been substituted in the priced configuration. The specifications were verified and meets the substitution requirements.
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.

Sincerely,

Lorna Livingtree
Auditor

Clause 9: Supporting Files

9.1: Supporting Files

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

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

If there are no Supporting Files provided then the description column must indicate that there is no supporting file and the path name column must be left blank. (9.3.9.1)

APPENDIX A: Third Party Price Quotations

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

December 4, 2007

Dell
Gene Purdy
1 Dell Way
Round Rock, TX 78664

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
810-03150	**SQL Server 2005 Enterprise x64 Edition** *Per Processor License* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 4% discount from the retail unit price of $24,999.*	$23,911	2	$47,822
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	2	$4,668
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident)*	$245	1	$245

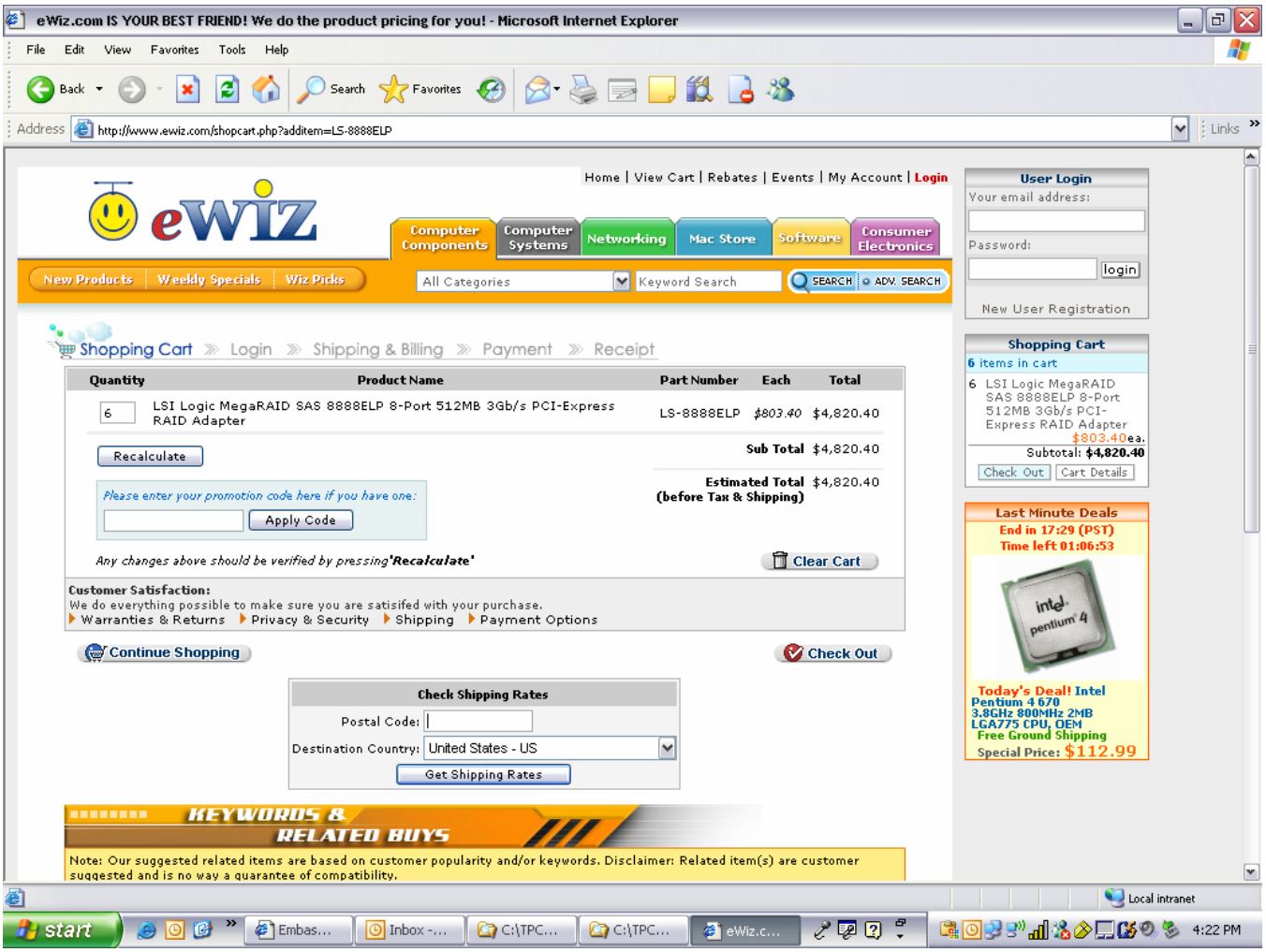
All products are currently orderable through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found at **http://www.microsoft.com/products/info/render.aspx?view=22&type=mnp&content=22/licensing**

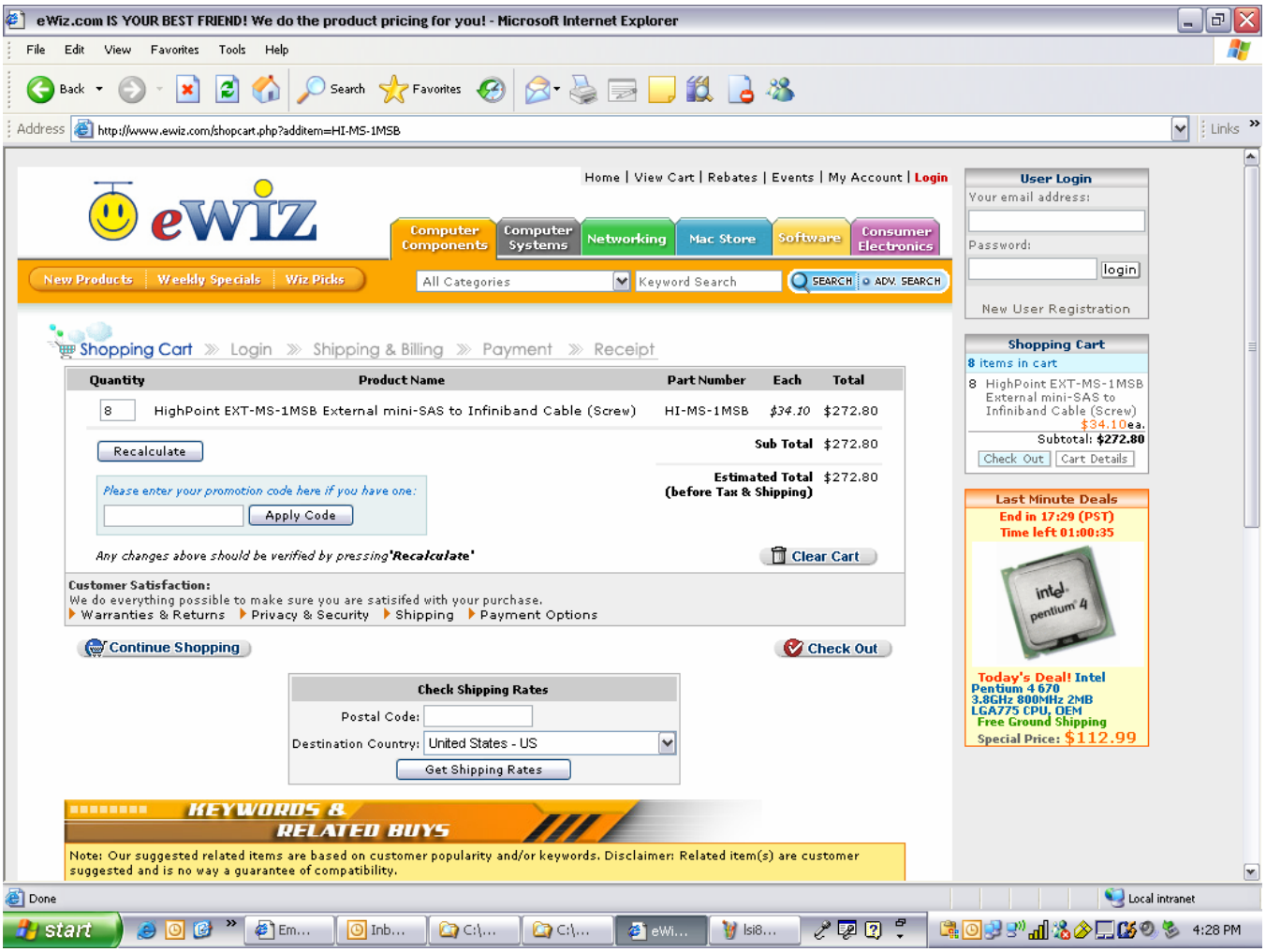
Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at $245 per call.

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: PEgepu0712040000007026.
Please include this Reference ID in any correspondence regarding this price quote.


eWiz.com IS YOUR BEST FRIEND! We do the product pricing for you! - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.ewiz.com/shopcart.php?additem=LS-8888ELP
Links
Home | View Cart | Rebates | Events | My Account | Login
eWiz
Computer Components
Computer Systems
Networking
Mac Store
Software
Consumer Electronics
New Products
Weekly Specials
Wiz Picks
All Categories
Keyword Search
SEARCH
ADV. SEARCH
User Login
Your email address:
Password:
login
New User Registration
Shopping Cart
Login
Shipping & Billing
Payment
Receipt
Shopping Cart
6 items in cart
6 LSI Logic MegaRAID SAS 8888ELP 8-Port 512MB 3Gb/s PCI-Express RAID Adapter
$803.40ea.
Subtotal: $4,820.40
Check Out
Cart Details
Quantity
Product Name
Part Number
Each
Total
6
LSI Logic MegaRAID SAS 8888ELP 8-Port 512MB 3Gb/s PCI-Express RAID Adapter
LS-8888ELP
$803.40
$4,820.40
Recalculate
Sub Total $4,820.40
Please enter your promotion code here if you have one:
Apply Code
Estimated Total (before Tax & Shipping) $4,820.40
Any changes above should be verified by pressing 'Recalculate'
Clear Cart
Customer Satisfaction:
We do everything possible to make sure you are satisifed with your purchase.
Warranties & Returns
Privacy & Security
Shipping
Payment Options
Continue Shopping
Check Out
Check Shipping Rates
Postal Code:
Destination Country: United States - US
Get Shipping Rates
Last Minute Deals
End in 17:29 (PST)
Time left 01:06:53
intel pentium 4
Today's Deal! Intel Pentium 4 670 3.8GHz 800MHz 2MB LGA775 CPU, OEM
Free Ground Shipping
Special Price: $112.99
KEYWORDS & RELATED BUYS
Note: Our suggested related items are based on customer popularity and/or keywords. Disclaimer: Related item(s) are customer suggested and is no way a guarantee of compatibility.
Local intranet
start
Embas...
Inbox -...
C:\TPC...
C:\TPC...
eWiz.c...
4:22 PM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