TPC Benchmark ™ E
Full Disclosure Report
DELL PowerEdge T610
Using
Microsoft SQL Server 2008 Enterprise Edition x64
On
Microsoft Windows Server 2008 Enterprise x64

Third Edition

Submitted for Review

June 8, 2010

Dell, Inc. PowerEdge T610 Server with Microsoft SQL Server 2008 Enterprise Edition x64 on Microsoft Windows Server 2008 Enterprise x64

Third Printing June 2010

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 T610 Server using SQL Server 2008 database in conformance with the requirements of the TPC-E Benchmark Specification. The operating system used for the server was Microsoft Windows Server 2008 Enterprise Edition x64. The operating system on the clients was Microsoft Windows Server 2008 Enterprise Standard Edition x64. All tests were done in compliance with Revision 1.7.0 of the Transaction Processing Council's TPC Benchmark™ E Standard Specification. The standard TPC Benchmark™ E metrics, transactions per second (tpsE), price per tpsE ($/tpsE) 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 T610	Microsoft Windows 2008 Enterprise Ed. x64 SQL Server 2008 Enterprise Ed. x64	$209,741	766.47	$273.65	March 30, 2009

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

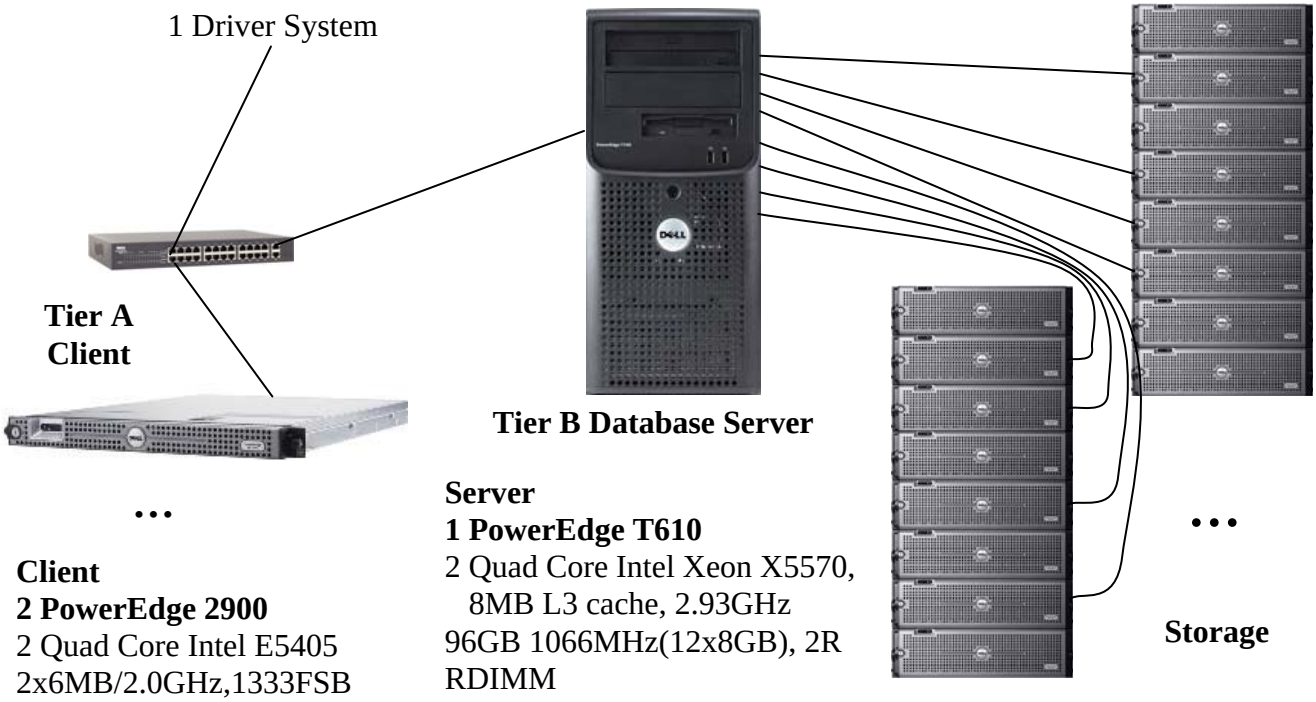
or

Dell, Inc
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™ T610 Server**		**TPC-E 1.7.0** **TPC Pricing 1.5** Report Date: March 30, 2009 Revision Date: June 8, 2010
TPC-E Throughput	Price/Performance	Availability Date	Total System Cost
766.47 tpsE	**$273.65 USD per tpsE**	**March 30, 2009**	**$209,741 USD**
Database Server Configuration			
Operating System **Microsoft Windows Server 2008 Enterprise x64 Edition™**	Database Manager **SQL Server 2008 Enterprise x64 Edition™**	Processors/Cores/ Threads **2/8/16**	Memory **96GB**



Client
2 PowerEdge 2900
2 Quad Core Intel E5405 2x6MB/2.0GHz,1333FSB
4GB Memory
2 Broadcom Ethernet
1 80GB SATA 7.2K Disk

Server
1 PowerEdge T610
2 Quad Core Intel Xeon X5570, 8MB L3 cache, 2.93GHz
96GB 1066MHz(12x8GB), 2R RDIMM
2 Broadcom NetExtreme II Gigabit Ethernet
1 PERC6i SAS RAID Controller
5 PERC6e SAS RAID Cntrs
8 73GB 15k 2.5" SAS Disks

Storage
16 PowerVault MD1120 SAS Enclosures
312 73GB 15k 2.5"
72 36GB 15k 2.5"
3GBPS SAS Disks

Initial Database Size **2,976.57GB**	Redundancy Level: 1 **RAID10 Log Data**	Storage **8 x 73GB, 312 x 73GB, 72 x 36GB**

	PowerEdge T610	TPC-E 1.7.0 TPC Pricing 1.5 Report Date March 30, 2009 Revision Date June 8, 2010 Availability Date March 30, 2009

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3 yr. Maint. Price
Server Hardware						
PEt610 Tower Chassis, Up to 8 2.5in HDD	244-4855	1	$521.00	1	$521.00	$540.00
& 2 Broadcom NICs						
X5570, 2.93GHz, 8M, XN, 6.40GT/S Processor	317-0254	1	$1,799.00	2	$3,598.00	
HO Pwr Sply,Non-Redundant,870W UPG	330-3550	1	$30.00	1	$30.00	
High Output Pwr Sply,Rdnt,870W	330-3549	1	$299.00	1	$299.00	
96GB,12x8GB,1066MH,2R RDIMM,2P,OPTIMIZED	317-3549	1	$5,597.00	1	$5,597.00	
PERC6i SAS RAID, Internal, Bat	341-5699	1	$299.00	1	$299.00	
PERC6E SAS RAID, 2X4 EXT 256	341-6488	1	$599.00	5	$2,995.00	
73GB,SAS,2.5-inch,15K RPM HD	341-8714	1S	$329.00	8	$2,632.00	
DELL E157FP,15 IN,15.0 VIS	320-5090	1	$189.00	1	$189.00	
				Subtotal	$16,160.00	$540.00
Server Storage						
PV MD1220,RACK,2U,24 BAY,LBZL	224-7093	1S	$2,794.00	16	$44,704.00	
PV MD1220,RACK,2U,24 BAY,LBZL (10% spares)	224-7093	1S	$2,794.00	2		$5,588.00
Enclosure Management Modules, PowerVault MD1220	330-6058	1	$0.00	16	$0.00	
EM Modules, PowerVault MD1220 (10% spares)	330-6058	1	$0.00	2		$0.00
73GB,SAS,2.5-inch,15K RPM HD	341-9888	1S	$329.00	384	$126,336.00	
73GB,SAS,2.5-inch,15K RPM HD (10% spares)	341-9888	1S	$329.00	39		$12,831.00
RACK-42U, CUST	340-4896	1	$239.99	1	$239.99	
				Subtotal	$171,279.99	$18,419.00
Server Software						
SQL Server 2008 Enterprise x64 Edition **	810-07509	2	$23,911.00	2	$47,822.00	
Windows Server 2008 Enterprise Edition (x64) **	P72-03195	2	$2,357.00	1	$2,357.00	
Professional Support (1 Incident)	N/A		$259.00	1		$259.00
				Subtotal	$50,179.00	$259.00
Client Hardware						
Dell PowerEdge 2900, E5405,2x6MB/2.0GHz,1333FSB	223-4719	1S	$413.00	2	$826.00	$492.00
Additional processor, E5405,2X6MB/2.0GHz,1333FSB	311-8025	1S	$369.00	2	$738.00	
4GB,667MHz,(2X2GB),2R,FBD	311-7168	1	$403.00	2	$806.00	
80G 7K SATA2,3G,3.5,HP	341-3034	1	$99.00	2	$198.00	
DUAL,OnBoard,Broadcom,GB,ENET NICs	430-1764	1	$0.00	2	$0.00	
				Subtotal	$2,568.00	$984.00
Client Software						
Windows Server 2008 Standard Edition (x64) **	P73-04190	2	$725.00	2	$1,450.00	
				Subtotal	$1,450.00	$0.00
Infastructure						
PowerConnect 2216, 16port Switch	222-2259	1	$69.00	1	$69.00	
1M SAS Cable, MD1000	310-7082	1	$30.00	15	$450.00	
				Subtotal	$519.00	$0.00
				Other Discounts*	($47,631.75)	($4,985.75)
				Total	$194,524.24	$15,216.25

Notes:
One or more components of the measured configuration have been substituted in the Priced Configuration. See the FDR for details.
*All hardware from Dell(1) is discounted 25% 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, NIO = Not Immediately Orderable
Pricing may be verified by calling 1-800-BUY-DELL and referencing quote #544155584 as a complex quote.
Audited by Lorna Livingtree, Performance Metrics Inc.

Three-Year Cost of Ownership:	**$209,741**	**USD**
TPC-E Throughput:	**766.47**	**tpsE**
Price/Performance:	**$273.65**	**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: 766.47 tpsE	**Configured Customers: 385,000**			
Response Times (in seconds)	**Minimum**	**Average**	**90th%tile**	**Maximum**
Broker-Volume	0.03	0.17	0.26	0.89
Customer-Position	0.03	0.17	0.24	5.37
Market-Feed	0.02	0.13	0.22	5.20
Market-Watch	0.01	0.12	0.22	1.43
Security-Detail	0.00	0.08	0.12	1.00
Trade-Lookup	0.05	0.84	1.08	2.67
Trade-Order	0.03	0.38	0.49	3.62
Trade-Result	0.16	0.47	0.61	4.03
Trade-Status	0.01	0.10	0.16	2.60
Trade-Update	0.08	0.98	1.16	2.69
Data-Maintenance	0.06	0.34		5.19
Transaction Mix		**Transaction Count**		**Mix %**
Broker-Volume		2,703,741		4.900%
Customer-Position		7,173,334		13.000%
Market-Feed		551,888		1.000%
Market-Watch		9,932,795		18.000%
Security-Detail		7,725,850		14.001%
Trade-Lookup		4,413,687		7.998%
Trade-Order		5,573,117		10.100%
Trade-Result		5,518,633		10.001%
Trade-Status		10,484,832		19.001%
Trade-Update		1,103,570		2.000%
Data-Maintenance		120		
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)		00:11:07		
Measurement Interval (hh:mm:ss)		02:00:00		
Business Recovery Time (hh:mm:ss)		00:34:11		
Total number of Transactions Completed in Measurement Interval		55,181,447		

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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 T610 server using Microsoft SQL Server 2008 Enterprise Edition (x64) on Microsoft Windows Server 2008 Enterprise Edition (x64).

Benchmark Overview

The Transaction Processing Performance Council (TPC) developed The TPC Benchmark™ E Standard Specification Revision 1.7.0.
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, Inc. 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

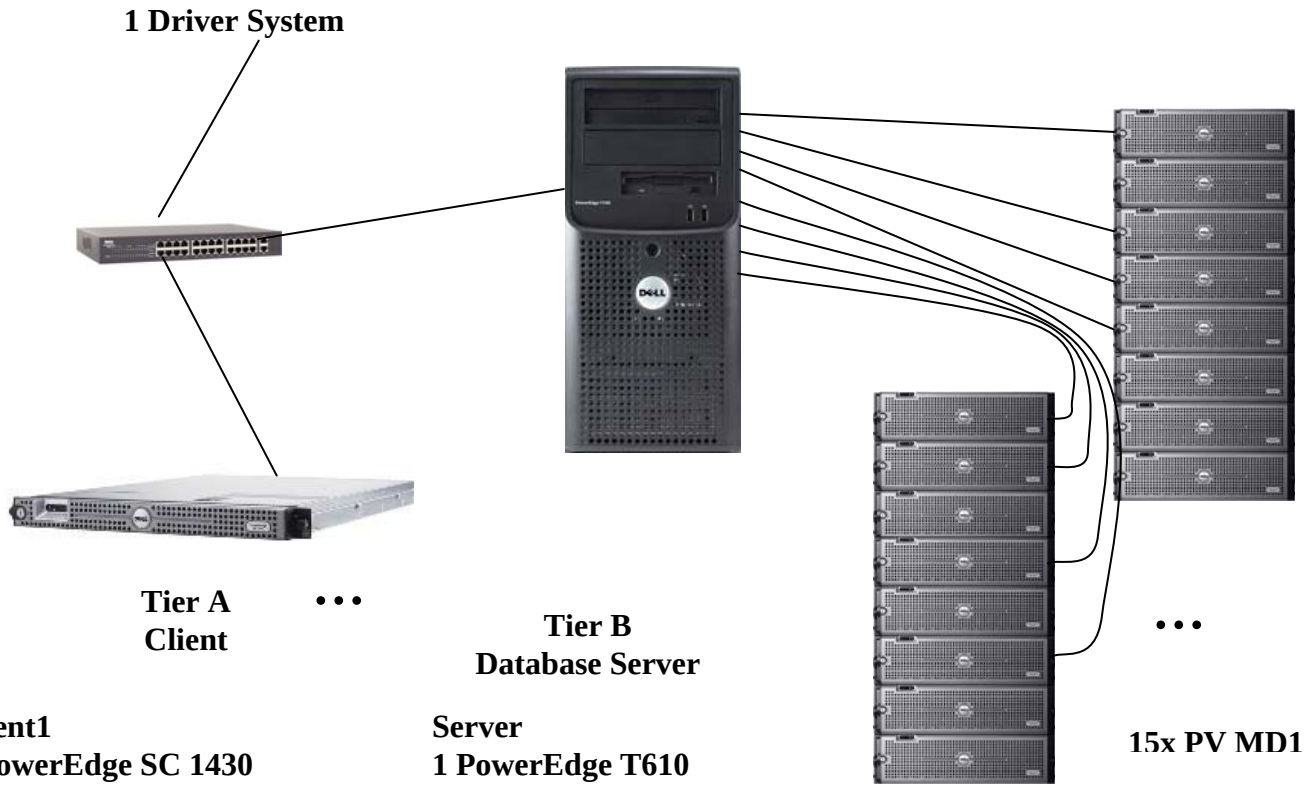
Table 1: *Difference between priced and measured configuration*

	Priced	**Measured**	
Client Server	2 PE2900	PE SC 1430	PE SC 1420
- FSB	1333MHz	1066MHz	800MHz
- Processors	Intel Quad-core Xeon 2.0 GHz/2x6MB-L2	Intel Quad-core Xeon 1.60 GHz/2x4MB-L2	Intel Xeon 3.2GHz/2x2MB-L2
- Memory	4GB	4GB	3GB
- OS drives	1x80GB	1x80GB	1x80GB
Server Storage	16 PowerVault MD1220	16 PowerVault MD1120	
- SAS Drives	392 x 73GB 6gbs 15k	320 x 73GB 3gbs 15k 72 x 36GB 3gbs 15k	

Measured Configuration

The measured and priced configurations are identical.

Figure 1: Measured Configuration



Client1
1 PowerEdge SC 1430
2 Quad Core Intel E5310
2x4MB/1.60GHz,1066FSB
4GB Memory
2 Broadcom Ethernet
1 80GB SATA 7.2K Disk

Client2
1 PowerEdge SC 1420
2 Intel Xeon
2MB/3.2GHz,800FSB
3GB Memory
1 Intel Internet Adapter
1 80GB SATA 7.2K Disk

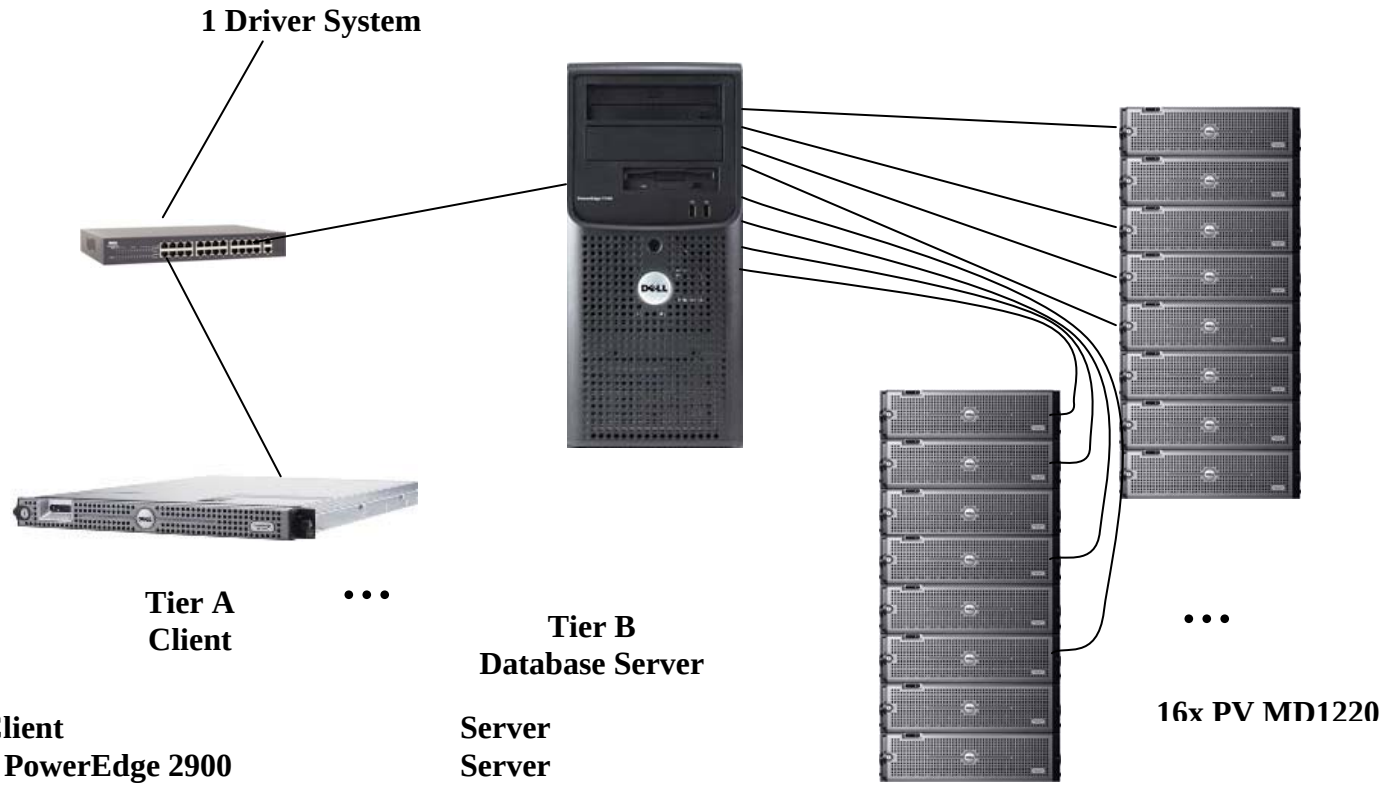
Server
1 PowerEdge T610
2 Quad Core Intel Xeon X5570,
8MB L3 cache, 2.93GHz
96GB 1066MHz(12x8GB), 2R
RDIMM
2 Broadcom NetExtreme II
Gigabit Ethernet
1 PERC6i SAS RAID Controller
5 PERC6e SAS RAID Cntrs
8 73GB 15k 2.5" SAS Disks

Storage

Storage
15 PowerVault MD1120
SAS Enclosures
288 73GB 15k 2.5"
72 36GB 15k 2.5" 3GBPS
SAS Disks

Priced Configuration

Figure 2: *Priced Configuration*



Client
2 PowerEdge 2900
2 Quad Core Intel E5405
2x6MB/2.0GHz,1333FSB
4GB Memory
2 Broadcom Ethernet
1 80GB SATA 7.2K Disk

Server
Server
1 PowerEdge T610
2 Quad Core Intel Xeon X5570,
8MB L3 cache, 2.93GHz
96GB 1066MHz(12x8GB), 2R RDIMM
2 Broadcom NetExtreme II Gigabit Ethernet
1 PERC6i SAS RAID Controller
5 PERC6e SAS RAID Cntrs
8 73GB 15k 2.5" 6GBS SAS Disks

Storage

Storage
16 PowerVault MD1220
SAS Enclosures
384 73GB 15k 2.5"
6GBPS 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 ***PEt610_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 T610 server (tier B) driven by two Dell PowerEdge 2900 (tierA) clients. The clients and server are networked together via a Dell PowerConnect 2216 10/100/1000 BaseT switch. One Dell PowerEdge 6950 server was the driver system that emulated 896 users executing the standard TPC-E workload. The driver system is connected to the client via the Dell Powerconnect network switch. Microsoft Windows 2008 Enterprise Server x64 was the operating system used on the server. Microsoft Windows 2008 Standard Server x64 was the operating system used on the client systems. Microsoft SQL Server 2008 Enterprise Edition x64 was the database management system on the server machine.

The PowerEdge T610 uses the Intel 5520 chipset and can hold up to two quad core Intel Xeon X5570 processors (2.93 GHz with 8MB L3 cache each). The system has 5 PCI-e I/O slots. The measured configuration used 96GB of 1066MH, 2R RDIMM, 2P, which was achieved by using 12 8192Mbyte DIMMs.

The PowerEdge T610 has an internal PERC SAS controller to which was attached eight 73GB disk drives containing the operating system and databse logs. In addition, 5 PERC6e SAS RAID controllers were installed in 5 PCI-e slots and connected to 15 MD 1120 disk pods, which can hold 24 disks each. Each of the 5 controllers managed 6 RAID 10 LUNs. Each LUN had 12 physical drives. The total number of physical drives used for the database was 360 SAS disks. There were no empty PCI-e slots. Hyperthreading was enabled on this server.

The PE2900 client server has two Intel Quad-core Xeon processor with 2x6MB of L2 cache and a FSB rated at 1333MHz. The system had 4 Gbytes of RAM, one 80 GB hard disk, 2 intergrated Ethernet ports. The clients connected to the driver machine and the DB server through a powerconnect switch. Hyperthreading was not enabled on this client.

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 385,000 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	2733485
Address	577504
Broker	3850
Cash_Transaction	6120529488
Charge	15
Commission_Rate	240
Company	192500
Company_Competitor	577500
Customer	385000
Customer_Account	1925000
Customer_Taxrate	770000
Daily_Market	344161125
Exchange	4
Financial	3850000
Holding	340674625
Holding_History	8915850619
Holding_Summary	19154292
Industry	102
Last_Trade	263725
News_Item	385000
News_Xref	385000
Sector	12
Security	263725
Settlement	6652800000
Status_Type	5
Taxrate	320
Trade	6652800000
Trade_History	15966717776
Trade_Request	0
Trade_Type	5
Watch_Item	38561011
Watch_List	385000
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:\	40GB	OS
			8x73GB,15K,SAS onboard RAID10	E:\	231GB	Logs
1	1	1	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A1	129GB	Broker1
				C:\B\B1	5GB	Customer1
				C:\C\C1	26GB	Market1
				C:\D\D1	255.59GB	Backup1
		2	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A2	129GB	Broker2
				C:\B\B2	5GB	Customer2
				C:\C\C2	26GB	Market2
				C:\D\D2	255.59GB	Backup2
		3	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A3	129GB	Broker3
				C:\B\B3	5GB	Customer3
				C:\C\C3	26GB	Market3
				C:\D\D3	255.59GB	Backup3
		4	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A4	129GB	Broker4
				C:\B\B4	5GB	Customer4
				C:\C\C4	26GB	Market4
				C:\D\D4	255.59GB	Backup4
		5	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A5	129GB	Broker5
				C:\B\B5	5GB	Customer5
				C:\C\C5	26GB	Market5
				C:\D\D5	255.59GB	Backup5
		6	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A6	129GB	Broker6
				C:\B\B6	5GB	Customer6
				C:\C\C6	26GB	Market6
				C:\D\D6	255.59GB	Backup6

2	2	7	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A7	129GB	Broker7
				C:\B\B7	5GB	Customer7
				C:\C\C7	26GB	Market7
				C:\D\D7	255.59GB	Backup7
		8	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A8	129GB	Broker8
				C:\B\B8	5GB	Customer8
				C:\C\C8	26GB	Market8
				C:\D\D8	255.59GB	Backup8
		9	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A9	129GB	Broker9
				C:\B\B9	5GB	Customer9
				C:\C\C9	26GB	Market9
				C:\D\D9	255.59GB	Backup9
		10	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A10	129GB	Broker10
				C:\B\B10	5GB	Customer10
				C:\C\C10	26GB	Market10
				C:\D\D10	255.59GB	Backup10
		11	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A11	129GB	Broker11
				C:\B\B11	5GB	Customer11
				C:\C\C11	26GB	Market11
				C:\D\D11	255.59GB	Backup11
		12	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A12	129GB	Broker12
				C:\B\B12	5GB	Customer12
				C:\C\C12	26GB	Market12
				C:\D\D12	255.59GB	Backup12
3	3	13	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A13	129GB	Broker13
				C:\B\B13	5GB	Customer13
				C:\C\C13	26GB	Market13
				C:\D\D13	255.59GB	Backup13
		14	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A14	129GB	Broker14
				C:\B\B14	5GB	Customer14
				C:\C\C14	26GB	Market14
				C:\D\D14	255.59GB	Backup14
		15	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A15	129GB	Broker15
				C:\B\B15	5GB	Customer15
				C:\C\C15	26GB	Market15
				C:\D\D15	255.59GB	Backup15
		16	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A16	129GB	Broker16
				C:\B\B16	5GB	Customer16
				C:\C\C16	26GB	Market16
				C:\D\D16	255.59GB	Backup16

		17	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A17	129GB	Broker17
				C:\B\B17	5GB	Customer17
				C:\C\C17	26GB	Market17
				C:\D\D17	255.59GB	Backup17
		18	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A18	129GB	Broker18
				C:\B\B18	5GB	Customer18
				C:\C\C18	26GB	Market18
				C:\D\D18	255.59GB	Backup18
4	4	19	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A19	129GB	Broker19
				C:\B\B19	5GB	Customer19
				C:\C\C19	26GB	Market19
				C:\D\D19	255.59GB	Backup19
		20	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A20	129GB	Broker20
				C:\B\B20	5GB	Customer20
				C:\C\C20	26GB	Market20
				C:\D\D20	255.59GB	Backup20
		21	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A21	129GB	Broker21
				C:\B\B21	5GB	Customer21
				C:\C\C21	26GB	Market21
				C:\D\D21	255.59GB	Backup21
		22	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A22	129GB	Broker22
				C:\B\B22	5GB	Customer22
				C:\C\C22	26GB	Market22
				C:\D\D22	255.59GB	Backup22
		23	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A23	129GB	Broker23
				C:\B\B23	5GB	Customer23
				C:\C\C23	26GB	Market23
				C:\D\D23	255.59GB	Backup23
		24	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A24	129GB	Broker24
				C:\B\B24	5GB	Customer24
				C:\C\C24	26GB	Market24
				C:\D\D24	255.59GB	Backup24
5	5	25	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A25	129GB	Broker25
				C:\B\B25	5GB	Customer25
				C:\C\C25	26GB	Market25
				C:\D\D25	255.59GB	Backup25
		26	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A26	129GB	Broker26
				C:\B\B26	5GB	Customer26
				C:\C\C26	26GB	Market26
				C:\D\D26	255.59GB	Backup26

		27	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A27	129GB	Broker27
				C:\B\B27	5GB	Customer27
				C:\C\C27	26GB	Market27
				C:\D\D27	255.59GB	Backup27
		28	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A28	129GB	Broker28
				C:\B\B28	5GB	Customer28
				C:\C\C28	26GB	Market28
				C:\D\D28	255.59GB	Backup28
		29	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A29	129GB	Broker29
				C:\B\B29	5GB	Customer29
				C:\C\C29	26GB	Market29
				C:\D\D29	255.59GB	Backup29
		30	12x73GB,15K,2.5",SAS MD1120 RAID10	C:\A\A30	129GB	Broker30
				C:\B\B30	5GB	Customer30
				C:\C\C30	26GB	Market30
				C:\D\D30	255.59GB	Backup30

BackupDev1 'C:\D\D1\TPCHbackup1'
BackupDev2 'C:\D\D2\TPCHbackup2'
BackupDev3 'C:\D\D3\TPCHbackup3'
BackupDev4 'C:\D\D4\TPCHbackup4'
BackupDev5 'C:\D\D5\TPCHbackup5'
BackupDev6 'C:\D\D6\TPCHbackup6'
BackupDev7 'C:\D\D7\TPCHbackup7'
BackupDev8 'C:\D\D8\TPCHbackup8'
BackupDev9 'C:\D\D9\TPCHbackup9'
BackupDev10 'C:\D\D10\TPCHbackup10'
BackupDev11 'C:\D\D11\TPCHbackup11'
BackupDev12 'C:\D\D12\TPCHbackup12'
BackupDev13 'C:\D\D13\TPCHbackup13'
BackupDev14 'C:\D\D14\TPCHbackup14'
BackupDev15 'C:\D\D15\TPCHbackup15'
BackupDev16 'C:\D\D16\TPCHbackup16'
BackupDev17 'C:\D\D17\TPCHbackup17'
BackupDev18 'C:\D\D18\TPCHbackup18'
BackupDev19 'C:\D\D19\TPCHbackup19'
BackupDev20 'C:\D\D20\TPCHbackup20'
BackupDev21 'C:\D\D21\TPCHbackup21'
BackupDev22 'C:\D\D22\TPCHbackup22'
BackupDev23 'C:\D\D23\TPCHbackup23'
BackupDev24 'C:\D\D24\TPCHbackup24'

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 2008 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 16 instances of EGenDriverMEE and 16 instances 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 PE T610 server has an inbuilt network Ethernet controller with 4 1000MB/s ports. One of the ports is used to connect to the client (tier A) system via a Dell PowerConnect switch. The Client systems also have inbuilt network controllers 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 1.7.0

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)

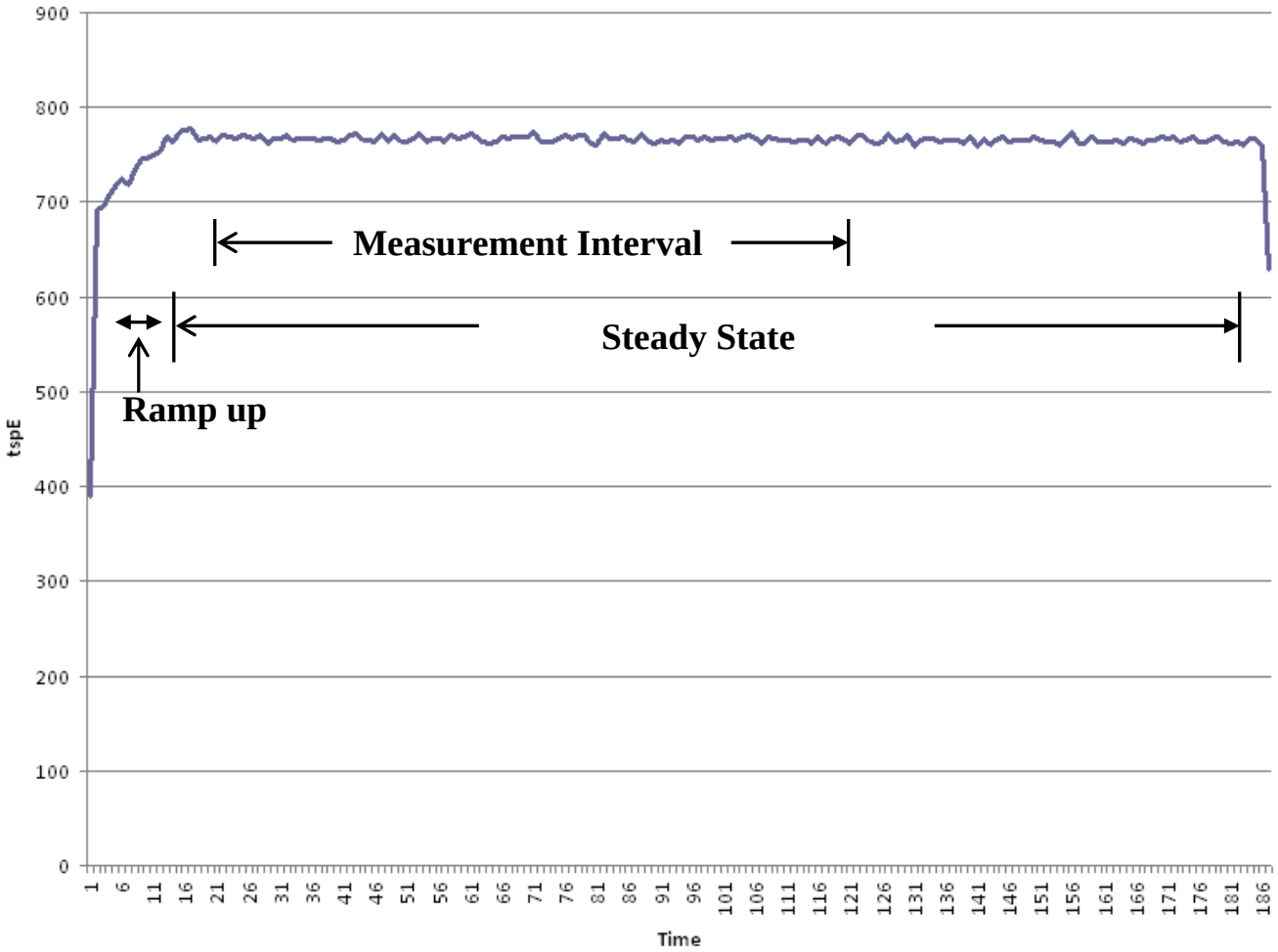
The measured tpsE was 766.47

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 out 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 0.15%. A 10 min window sliding by 1 min was found to vary by .45%.

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	50.03%	**Ok**	48.00%	52.00%
		Get history	50.03%	**Ok**	48.00%	52.00%
Trade Lookup	Ok	Frame 1	30.00%	**Ok**	28.50%	31.50%
		Frame 2	30.02%	**Ok**	28.50%	31.50%
		Frame 3	30.00%	**Ok**	28.50%	31.50%
		Frame 4	9.98%	**Ok**	9.50%	10.50%
Market Watch	Ok	By Watch List	60.00%	**Ok**	57.00%	63.00%

		By Customer Account	35.01%	**Ok**	33.00%	37.00%
		By Industry	4.99%	**Ok**	4.50%	5.50%
Trade Update	Ok	Frame 1	32.91%	**Ok**	31.00%	35.00%
		Frame 2	33.06%	**Ok**	31.00%	35.00%
		Frame 3	34.02%	**Ok**	32.00%	36.00%
Security Detail	Ok	Access LOB	1.00%	**Ok**	0.90%	1.10%
Trade Order	Ok	By Non-Owner	10.01%	**Ok**	9.50%	10.50%
		By Company Name	39.97%	**Ok**	38.00%	42.00%
		Buy on Margin	8.01%	**Ok**	7.50%	8.50%
		Rollback	0.98%	**Ok**	0.94%	1.04%
		LIFO	35.00%	**Ok**	33.00%	37.00%
		Trade Quantity 100	25.02%	**Ok**	24.00%	26.00%
		Trade Quantity 200	24.98%	**Ok**	24.00%	26.00%
		Trade Quantity 400	25.01%	**Ok**	24.00%	26.00%
		Trade Quantity 800	25.00%	**Ok**	24.00%	26.00%
		Market Buy	29.95%	**Ok**	29.70%	30.30%
		Market Sell	30.01%	**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	10.03%	**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 data, log and OS 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)

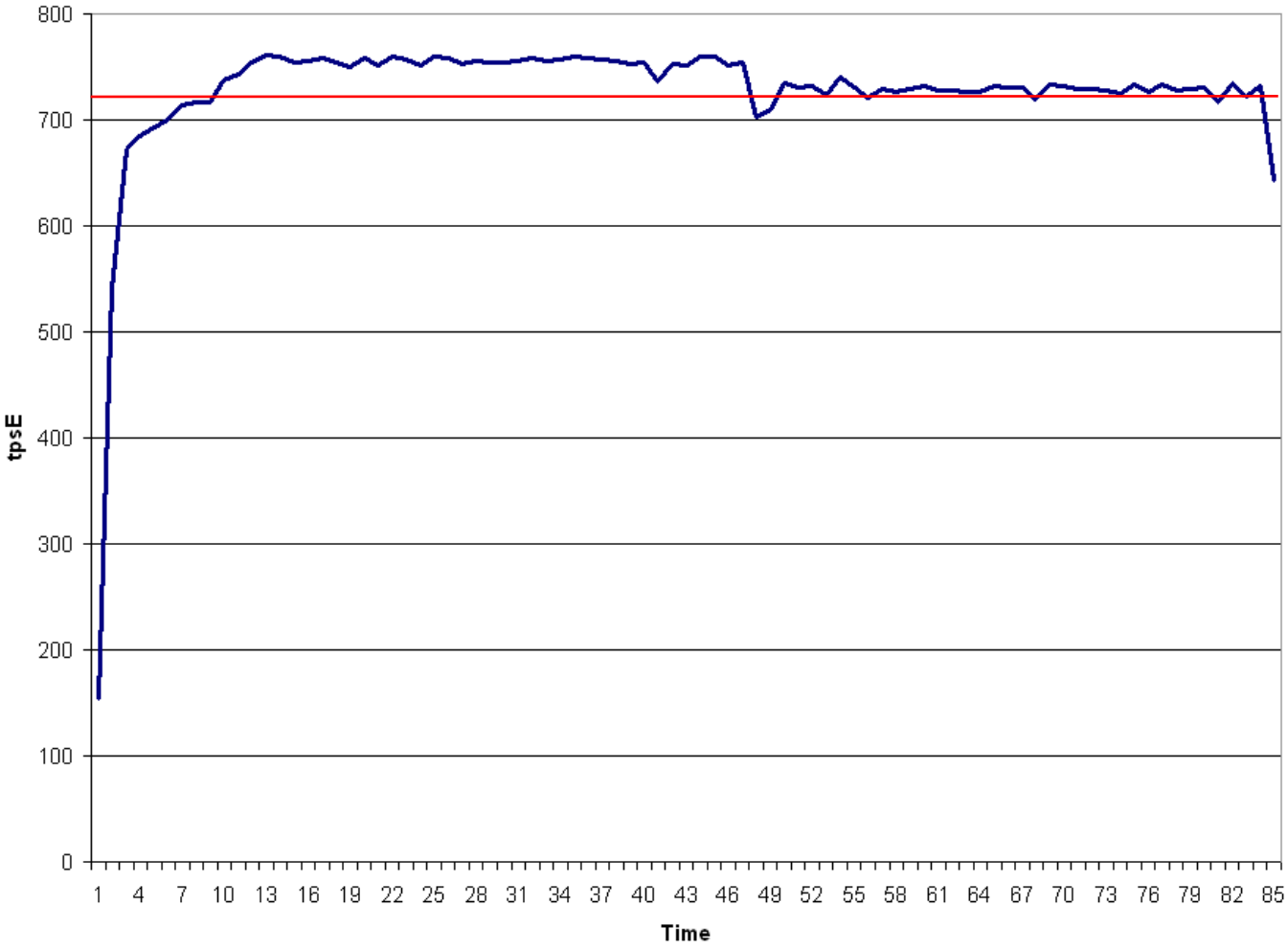
1. A restore was executed to yield a fresh database.
2. The rows in the Settlement table were counted to determine the initial count of completed trades present in the database (count-before).
3. A performance run was started with the same number of configured customers and driver load used for the measurement 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 57mins.
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. Transaction cleanup was executed on the database.
11. A performance run (Run2) was started.
12. The test ramped-up to steady state.
13. Business recovery ends when the test attains at least 95% of reported throughput and maintains that rate or above thereafter.
14. The test was allowed to run in steady-state for 20mins.
15. The drivers were stopped gracefully.
16. Transaction reports for Run1 and Run2 were generated and the count of Trade_Results transactions for both runs were noted and summed.
17. Step 2 was repeated to determine the total number of completed trades present in the database (count-after)
18. 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.
19. Consistency tests were run to ensure that the database was in a consistent state.

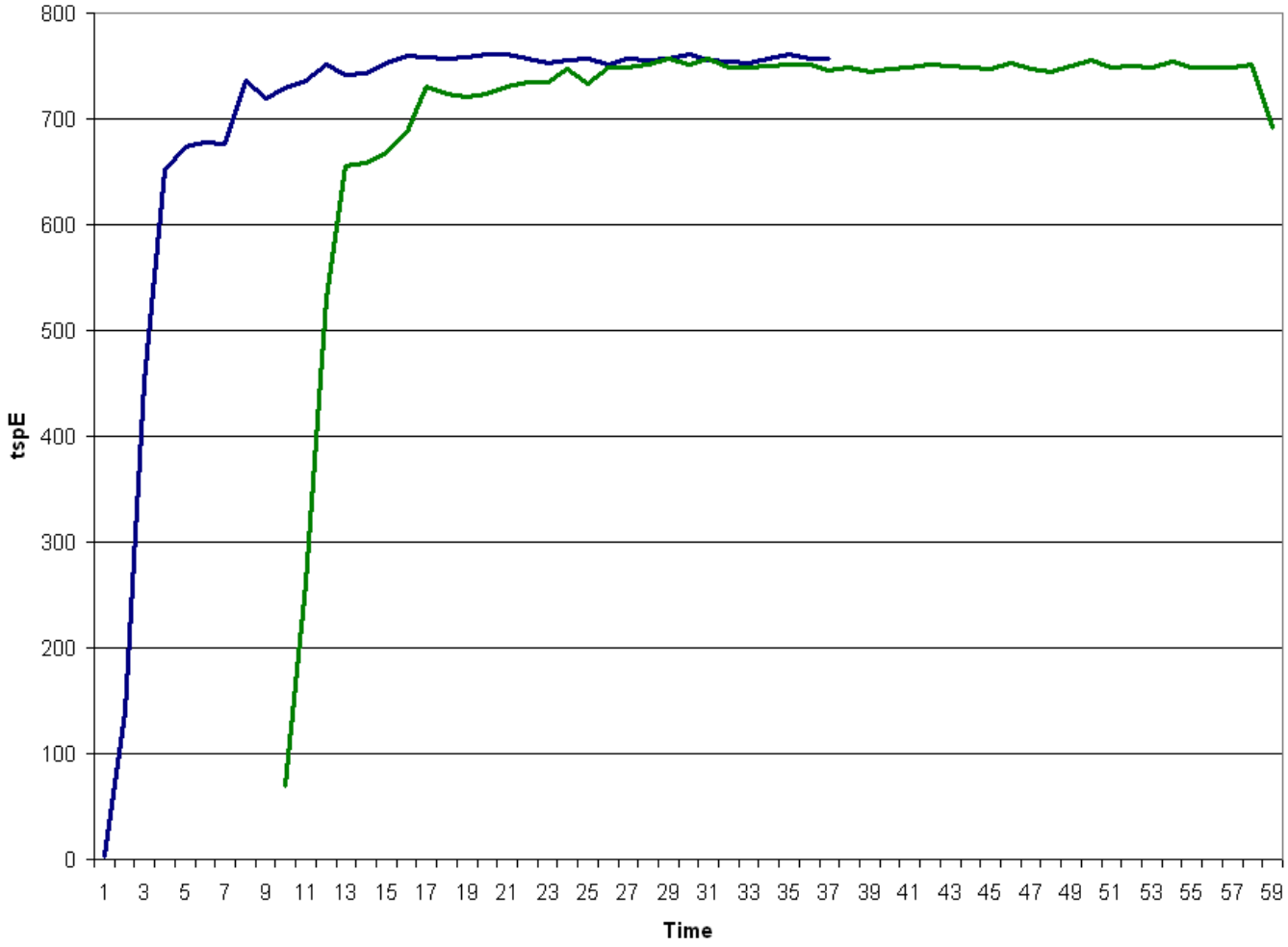
7.6: Business Recovery Time

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 34mins 11s. 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 calulcations for TPC-E		Customers:	385,000						
		TpsE:	766.47						
		TradeResult count:	8,570,080						
Table	**Rows**	**Data(KB)**	**Index(KB)**	**Total**	**Total + 5%**	**Rows After**	**Data After(KB)**	**Index After(KB)**	**Growth**
ACCOUNT_PERMISSION	2733485	232696	1640	234,336	246,053	2733485	232840	1800	304
ADDRESS	577504	33328	504	33,832	35,524	577504	33376	504	48
BROKER	3850	256	1560	1,816	1,907	3850	384	1568	136
CASH_TRANSACTION	6120529488	606293400	1278720	607,572,120	637,950,726	6128413314	620059632	2511512	14999024
CHARGE	15	8	8	16	17	15	8	8	0
COMMISSION_RATE	240	16	16	32	34	240	16	16	0
COMPANY	192500	41872	12072	53,944	56,641	192500	41880	12072	8
COMPANY_COMPETITOR	577500	15512	13040	28,552	29,980	577500	15512	13040	0
CUSTOMER	385000	65208	17416	82,624	86,755	385000	65224	17424	24
CUSTOMER_ACCOUNT	1925000	178768	213136	391,904	411,499	1925000	178768	213136	0
CUSTOMER_TAXRATE	770000	16064	504	16,568	17,396	770000	16192	512	136
DAILY_MARKET	344161125	17670584	7481552	25,152,136	26,409,743	344161125	17671608	7481768	1240
EXCHANGE	4	8	8	16	17	4	8	8	0
FINANCIAL	3850000	453008	1696	454,704	477,439	3850000	453136	1800	232
HOLDING	340674625	18144072	13449608	31,593,680	33,173,364	340892977	29328824	13659168	11394312
HOLDING_HISTORY	8915850619	324212824	168963616	493,176,440	517,835,262	8927406708	325249160	169677352	1750072
HOLDING_SUMMARY	19154292	650576	2872	653,448	686,120	19154372	1301040	7560	655152
INDUSTRY	102	8	40	48	50	102	8	40	0
LAST_TRADE	263725	12272	504	12,776	13,415	263725	24448	520	12192
NEWS_ITEM	385000	41741224	896	41,742,120	43,829,226	385000	41741264	912	56
NEWS_XREF	385000	9592	504	10,096	10,601	385000	9592	504	0
SECTOR	12	8	24	32	34	12	8	24	0
SECURITY	263725	41464	18512	59,976	62,975	263725	41464	18512	0
SETTLEMENT	6652800000	326480976	688912	327,169,888	343,528,382	6661370080	339621288	1375664	13827064
STATUS_TYPE	5	8	8	16	17	5	8	8	0
TAXRATE	320	128	384	512	538	320	136	384	8
TRADE	6652800000	737478152	395141496	1,132,619,648	1,189,250,630	6661428038	747520104	400335304	15235760
TRADE_HISTORY	15966717776	457827112	1193616	459,020,728	481,971,764	15987334491	459477280	1200152	1656704
TRADE_REQUEST	0	8	40	48	50	46097	5648	8712	14312
TRADE_TYPE	5	8	1032	1,040	1,092	5	8	1032	0
WATCH_ITEM	38561011	1057800	4224	1,062,024	1,115,125	38561011	1057920	4352	248
WATCH_LIST	385000	9608	8304	17,912	18,808	385000	9608	8304	0
ZIP_CODE	14741	536	504	1,040	1,092	14741	536	504	0
Totals in KB	45063961669	2532667104	588496968	3121164072	3277222276		2584156928	596554176	59547032

										file size
Database File Groups	**Allocated size MB**	**Required size MB**	**Diff**							# of files
Customer_fg	792,540	550,808	241,732	OK						total in KB (*8)
Broker_fg	3,961,080	2,590,582	1,370,498	OK						
Market_fg	147,780	69,240	78,540	OK						
Total	4,901,400									
Total in GB	4,786.5									

Growing Space	59,532,400	KB								
per Trade Results	6.95	KB								
Data Growth	153,340,249	KB								
60 Day Space	12,321,579,007	KB								
60 Day Space	11,751	GB								
		%	size							
Log space before in MB	70	2.95E-02	236000							
Log space after in MB	86,136	36.498234	236000							
per Trade Results	0.010									
Log Growth	221,684	MB								
Total 8 hours log space	221,754	MB								
Total 8 hours log space	216.56	GB								

	Count	Formatted size GB	Total GB Configured	Total Needed
Data Disks configured	72	33.37	2,403	
	312	67.75	21,138	
	0	135.49	-	
RAID 10 overhead 50%			(11,770)	
Data Disks space total			**11,770**	11,751
Log Disks configured	8	67.75	542	
RAID 10 overhead 50%			(271)	
Log Disk space total			271	217

8.2: Orderability Date

For each of the components that are not orderable on the report date of the FDR, the following information must be included in the FDR:

- *Name and part number of the item that is not orderable*
- *The date when the component can be ordered (on or before the Availability Date)*
- *The method to be used to order the component (at or below the quoted price) when the date arrives*
- *The method for verifying the price*

All components used in this benchmark are orderable at the time of this publication. These items will be orderable on or before the stated Availability Date in this submission. For specific information regarding the orderable dates and prices of these items, please refer to the table below:

Orderable Information

Description	Part #	Order Date	Order Method	Price Verification
NA	NA	NA	1-800-BUY-DELL	Note 1
NA	NA	NA	1-800-BUY-DELL	Note 1

Note 1: These parts are not yet immediately orderable. For price verification before the stated Availability Date, please contact the Dell COC Pricing Department at: (512) 724-8493.

8.3: 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:

March 27, 2009

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

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

Platform: Dell PowerEdge T610
Database Manager: Microsoft SQL Server 2008 Enterprise x64 Edition
Operating System: Microsoft Windows Sever 2008 Enterprise x64 Edition

Server (Tier B): T610			
CPU's	Memory	Disks (total)	TpsE
2 Intel quad core Xeon @ 2.93 Ghz	96 GB	320 @ 73 GB 72 @ 36 GB	**766.47**
Clients (Tier A): 1 PE SC 1430			
2 Intel quad core @ 1.60 Ghz	4 GB	1 @ 80 GB	Na
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 1.7.0
- The database files were properly sized and populated for 385,000 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.
- 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:
The two tested Tier A clients were PowerEdge SC 1420 and PowerEdge SC 1430. Both of these systems are no longer available. Two PowerEdge 2900's have been substituted in the priced configuration. The specifications were verified and this change meets the substitution requirements.

Sincerely,

Lorna Livingtree
Auditor

June 7, 2010

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

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

Platform:	Dell PowerEdge T610
Database Manager:	Microsoft SQL Server 2008 Enterprise x64 Edition
Operating System:	Microsoft Windows Sever 2008 Enterprise x64 Edition

This benchmark is being repriced with substituted disk drives. I have reviewed the technical specifications for the original and the substituted drives. This substitution is compliant with the substitution requirements. The details follow:

Property	Old drives	Substituted drives
Formatted capacity	73GB	73GB
Interface type	SAS	SAS
Track to track seek time	0.2/0.4	0.2/0.4
Average seek time	2.9/3.3	2.9/3.3
Interface speed	3-Gb/s	6-Gb/s
On disk buffer size	16 MB	16 MB
Rotational speed	15,000 RPM	15,000 RPM
Media density	Not specified	Not specified
Number of drives	392	392

This disk substitution requires a substitution of the disk enclosures as well. I have verified the technical specifications of the original and substituted enclosures. They are identical in all documented properties, except the substituted enclosures have a 6-Gb/s transfer rate.

Sincerely,

Lorna Livingtree

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)

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

June 7, 2010

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
810-07509	**SQL Server 2008 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
P73-04190	**Windows Server 2008 Standard Edition (x64)** *Server License with 5 CALs* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 27% discount from the retail unit price of $999.*	$725	2	$1,450
P72-03195	**Windows Server 2008 Enterprise Edition (x64)** *Server License with 25 CALs* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 41% discount from the retail unit price of $3,999.*	$2,357	1	$2,357
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident)*	$259	1	$259

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

All products listed above are currently orderable and available.

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at $259 per call.

This quote is valid for the next 90 days.

Reference ID: PEgepu0910200000009563.