TPC Benchmark ™ E
Full Disclosure Report
DELL PowerEdge T710
Using
Microsoft SQL Server 2008 R2 Enterprise Edition x64
On
Microsoft Windows Server 2008 R2 Enterprise x64

First Edition

Submitted for Review

June 21, 2010

Dell, Inc. PowerEdge T710 Server with Microsoft SQL Server 2008 R2 Enterprise Edition x64 on Microsoft Windows Server 2008 R2 Enterprise x64

First Printing June 2010

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Abstract

This report documents the methodology and results of the TPC Benchmark E test conducted on a PowerEdge T710 Server using SQL Server 2008 R2 database in conformance with the requirements of the TPC-E Benchmark Specification. The operating system used for the server was Microsoft Windows Server 2008 R2 Enterprise Edition x64. The operating system on the clients was Microsoft Windows Server 2008 R2 Standard Edition x64. All tests were done in compliance with Revision 1.10.0 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 T710	Microsoft Windows 2008 R2 Enterprise Ed. x64 SQL Server 2008 R2 Enterprise Ed. x64	$283,914	1074.14	$264.32	June 21, 2010

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: Gene Purdy

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.

PowerEdge™ T710 Server

TPC-E 1.10.0
TPC Pricing 1.5

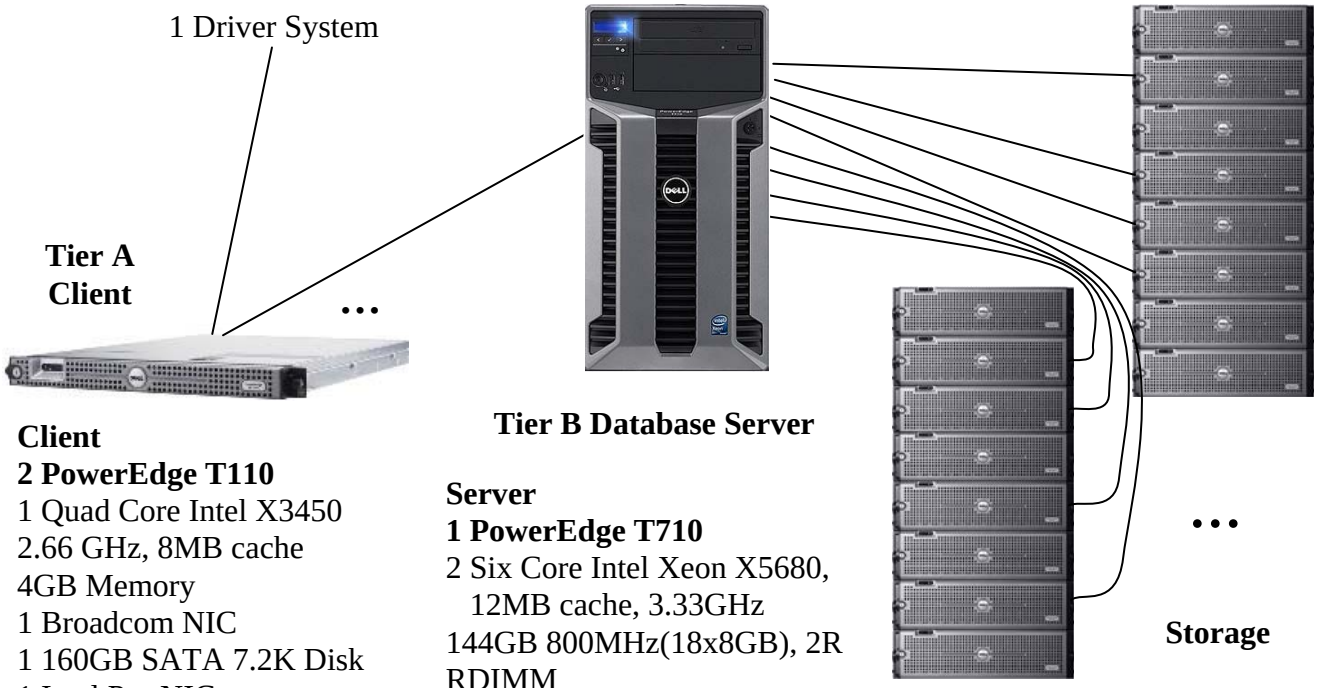
Report Date:
June 21, 2010

Revision Date:
June 21, 2010

TPC-E Throughput	Price/Performance	Availability Date	Total System Cost
1074.14 tpsE	**264.32 USD per tpsE**	**June 21, 2010**	**$283,914 USD**

Database Server Configuration

Operating System	Database Manager	Processors/Cores/ Threads	Memory
Microsoft Windows Server 2008 R2 Enterprise x64 Edition™	**SQL Server 2008 R2Enterprise x64 Edition™**	**2/12/24**	**144GB**



Client
2 PowerEdge T110
1 Quad Core Intel X3450
2.66 GHz, 8MB cache
4GB Memory
1 Broadcom NIC
1 160GB SATA 7.2K Disk
1 Intel Pro NIC

Server
1 PowerEdge T710
2 Six Core Intel Xeon X5680,
12MB cache, 3.33GHz
144GB 800MHz(18x8GB), 2R RDIMM
4 Broadcom NetExtreme II Gigabit Ethernet
1 PERC H700 SAS RAID Cntlr
6 PERC H800 SAS RAID Cntrs
8 146GB 15k 2.5" SAS Disks

Storage
4 PowerVault MD1220
20 PowerVault MD1120
SAS Enclosures
96 73GB 15k 6gbs 2.5"
480 73GB 15k 3gbs 2.5"
SAS Disks

Initial Database Size	Redundancy Level: 1	Storage
4,457.21GB	**RAID10 Log Data**	**8 x 146GB, 576 x 73GB**

	PowerEdge T710	TPC-E 1.10.0 TPC Pricing 1.5 Report Date June 21, 2010 Revision Date June 21, 2010 Availability Date June 21, 2010

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3 yr. Maint. Price
Server Hardware						
T710 Tower Chassis for up to 16 2.5" HDs 6gbs	224-9716	1	$672.00	1	$672.00	$540.00
Intel Xeon X5680, 3.33Ghz, 12M Cache, Turbo, HT	317-4104	1	$2,299.00	1	$2,299.00	
2nd Intel Xeon X5680, 3.33Ghz, 12M Cache, Turbo, HT	317-4116	1	$2,299.00	1	$2,299.00	
1100 Watt Non-Redundant Power Supply	330-4330	1	$299.00	1	$299.00	
144GB Memory (18x8GB) 800 MHz Dual Ranked RDIMMs	317-0243	1	$8,352.00	1	$8,352.00	
PERC H700 Integrated RAID Controller, 512MB Cache	342-0738	1	$499.00	1	$499.00	
PERC H800 RAID Adapter for External JBOD, 512MB	341-9869	1	$649.00	6	$3,894.00	
146GB,SAS,2.5-inch,15K RPM HD	341-9157	1	$479.00	8	$3,832.00	
DELL E157FP,15 IN,15.0 VIS	320-5090	1	$189.00	1	$189.00	
				Subtotal	$22,335.00	$540.00
Server Storage						
PV MD1220,RACK,2U,24 BAY,LBZL	224-7093	1	$2,794.00	4	$11,176.00	
PV MD1220,RACK,2U,24 BAY,LBZL	224-7093	1s	$2,794.00	20	$55,880.00	
PV MD1120,RACK,2U,24 BAY,LBZL (10% Spares)	224-7093	1s	$2,794.00	3		$8,382.00
Enclosure Management Modules, PowerVault MD1220	330-6058	1	$0.00	4	$0.00	
Enclosure Management Modules, PowerVault MD1220	330-6058	1s	$0.00	20	$0.00	
EM Modules, PowerVault MD1120 (10% Spares)	330-6058	1s	$0.00	3		$0.00
73GB,SAS,2.5-inch,15K RPM HD	341-4727	1	$329.00	96	$31,584.00	
73GB,SAS,2.5-inch,15K RPM HD	341-4727	1s	$329.00	480	$157,920.00	
73GB,SAS,2.5-inch,15K RPM HD (10% Spares)	341-4727	1s	$329.00	58		$19,082.00
RACK-42U, CUST	340-4896	1	$239.99	1	$239.99	
				Subtotal	$256,799.99	$27,464.00
Server Software						
SQL Server 2008 Enterprise x64 Edition **	N/A	2	$23,358.00	2	$46,716.00	
Windows Server 2008 Enterprise Edition (x64) **	P72-03868	2	$2,320.00	1	$2,320.00	
Professional Support (1 Incident)	N/A		$259.00	1		$259.00
				Subtotal	$49,036.00	$259.00
Client Hardware						
Dell PowerEdge T110 Chasis	224-6816	1	$108.00	2	$216.00	$984.00
X3450 Xeon Proc, 2.66 GHz 8M Cache, Turbo, HT	317-2042	1	$450.00	2	$900.00	
4GB,1033MHz,(2X2GB),2R,UDIMM	317-2042	1	$187.00	2	$374.00	
160G 7K SATA2,3G,3.5,HP	341-6084	1	$99.00	2	$198.00	
Intel Gigabit ET NIC PCI-e	430-0643	1	$199.00	2	$398.00	
				Subtotal	$2,086.00	$984.00
Client Software						
Windows Server 2008 Standard Edition (x64) **	P73-04754	2	$711.00	2	$1,422.00	
				Subtotal	$1,422.00	$0.00
Infastructure						
1M SAS Cable, MDXX00	310-6061	1	$30.00	24	$720.00	
				Subtotal	$720.00	$0.00
				Other Discounts*	($70,485.25)	($7,247.00)
				Total	$261,913.74	$22,000.00

Notes:

None of the 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 # 546153287 as a complex quote.

Audited by Lorna Livingtree, Performance Metrics Inc.

Three-Year Cost of Ownership:	**$283,914**	**USD**
TPC-E Throughput:	**1,074.14**	**tpsE**
Price/Performance:	**$264.32**	**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.

Quantities Summary				
Reported Throughput: 1074.14 tpsE	**Configured Customers: 550,000**			
Response Times (in seconds)	**Minimum**	**Average**	**90th%tile**	**Maximum**
Broker-Volume	0.00	0.04	0.06	1.74
Customer-Position	0.00	0.04	0.06	2.86
Market-Feed	0.00	0.04	0.10	3.90
Market-Watch	0.00	0.02	0.05	2.60
Security-Detail	0.00	0.02	0.03	2.75
Trade-Lookup	0.00	0.62	0.80	3.88
Trade-Order	0.00	0.09	0.15	2.83
Trade-Result	0.00	0.10	0.16	4.06
Trade-Status	0.00	0.03	0.05	2.91
Trade-Update	0.01	0.69	0.81	3.79
Data-Maintenance	0.01	0.09		0.52
Transaction Mix		**Transaction Count**		**Mix %**
Broker-Volume		3,789,441		4.900%
Customer-Position		10,053,088		13.000%
Market-Feed		773,389		1.000%
Market-Watch		13,920,209		18.000%
Security-Detail		10,826,289		14.000%
Trade-Lookup		6,186,193		7.999%
Trade-Order		7,810,858		10.100%
Trade-Result		7,733,824		10.001%
Trade-Status		14,692,781		18.999%
Trade-Update		1,546,419		2.000%
Data-Maintenance		120		
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)		00:12:13		
Measurement Interval (hh:mm:ss)		02:00:00		
Business Recovery Time (hh:mm:ss)		05:04:41		
Total number of Transactions Completed in Measurement Interval		77,332,491		

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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 T710 server using Microsoft SQL Server 2008 R2 Enterprise Edition (x64) on Microsoft Windows Server 2008 R2 Enterprise Edition (x64).

Benchmark Overview

The Transaction Processing Performance Council (TPC) developed The TPC Benchmark™ E Standard Specification Revision 1.9.0.
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

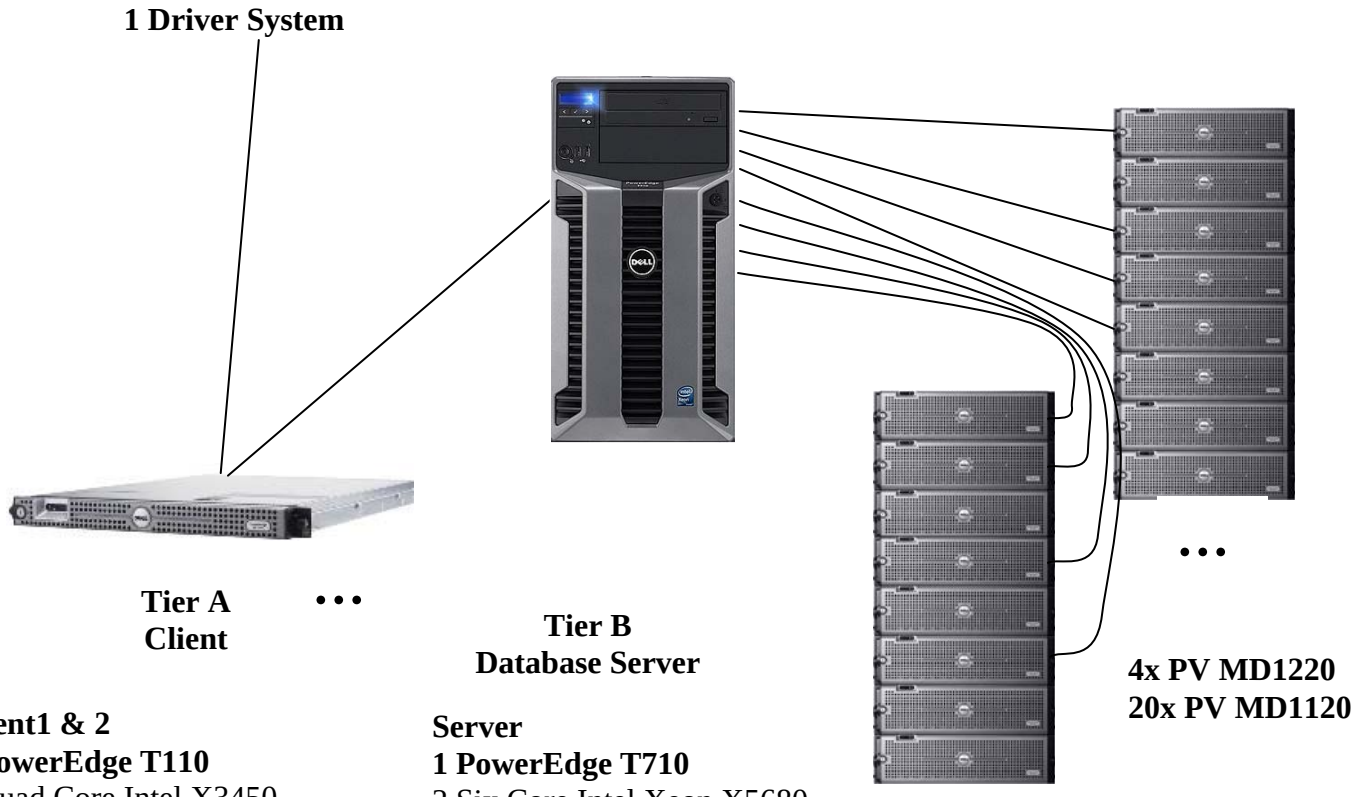
Table 1: *Difference between priced and measured configuration*

	Priced	**Measured**	
Server Storage - SAS Drives	20 PowerVault MD1220 480 x 73GB 6gbs 15k	20 PowerVault MD1120 480 x 73GB 3gbs 15k	N/A

Measured Configuration

The measured and priced configurations are identical.

Figure 1: Measured Configuration



Client1 & 2
2 PowerEdge T110
1 Quad Core Intel X3450
2.66GHz, 8MB cache
32GB Memory
1 Broadcom NIC
1 160GB SATA 7.2K Disk
1 Intel Pro NIC

Server
1 PowerEdge T710
2 Six Core Intel Xeon X5680,
12MB cache, 3.33GHz
144GB 800MHz(18x8GB), 2R
RDIMM
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Gigabit Ethernet
1 PERC H700 SAS RAID Cntlr
6 PERC H800 SAS RAID Cntrs
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Storage

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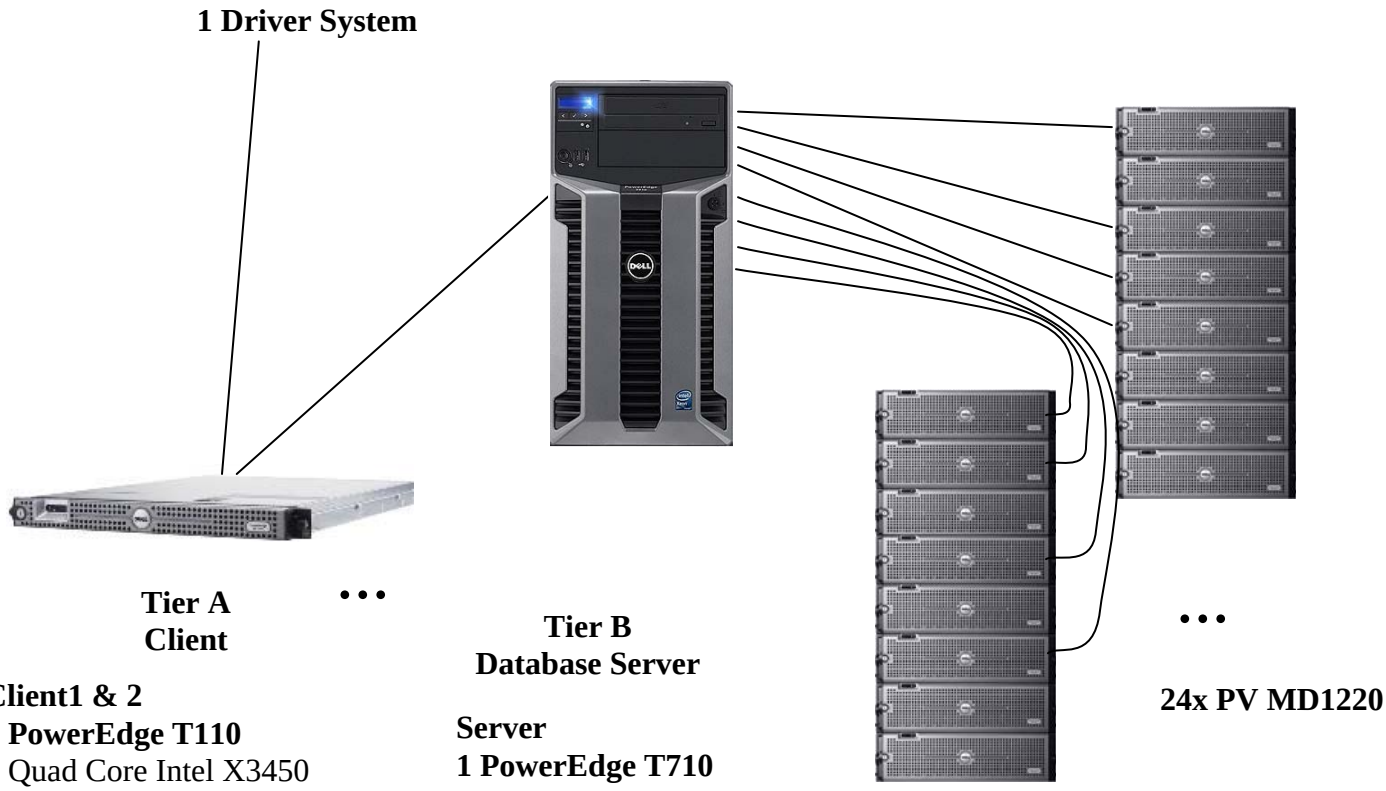
20 PowerVault MD1120
SAS Enclosures
96 73GB 15k 6gbs 2.5"
480 73GB 15k 3gbs 2.5"
SAS Disks

Priced Configuration

Figure 2: *Priced Configuration*



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1 PERC H700 SAS RAID Cntlr
6 PERC H800 SAS RAID Cntrs
8 146GB 15k 2.5” SAS Disks

Storage

Storage
24 PowerVault MD1220 SAS Enclosures
576 73GB 15k 6gbs 2.5” 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 ***PE T710_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 T710 server (tier B) driven by 2 Dell PowerEdge (tierA) clients. The clients and server are networked together via a Dell PowerConnect 2216 10/100/1000 BaseT switch. One Dell PowerEdge T710 server was the driver system that emulated 984 users executing the standard TPC-E workload. The driver system is connected to the client via a Dell PowerConnect 2216 10/100/1000 BaseT switch. Microsoft Windows 2008 R2 Enterprise Server x64 was the operating system used on the server. Microsoft Windows 2008 R2 Standard Server x64 was the operating system used on the client systems. Microsoft SQL Server 2008 R2 Enterprise Edition x64 was the database management system on the server machine.

The PowerEdge T710 uses the Intel 5520 chipset and can hold up to 2 - six core Intel Xeon X5620 processors (3.33 GHz with 12MB cache each). The system was configured with 6 PCI-e I/O slots. The measured configuration used 144GB of 800MH, 2R RDIMM, which was achieved by using 18 8192Mbyte DIMMs.

The PowerEdge T710 has an internal PERC H700 SAS controller to which was attached 8 - 146GB disk drives containing the operating system and databse logs. In addition, 6 PERC H800 SAS RAID controllers were installed in 6 PCI-e slots and connected to 4 MD 1220 disk pods and 20 MD 1120 disk pods, which can hold 24 disks each. Each of the 6 controllers managed 8 RAID 10 LUNs. Each LUN had 12 physical drives. The total number of physical drives used for the database was 576 SAS disks. There were no empty PCI-e slots. Hyperthreading was enabled on this server.

The PE T110 client servers have one Intel Quad-core Xeon processor with 8MB of Smart Cache and a FSB rated at 1333MHz. The systems have 4 Gbytes of RAM, one 160 GB hard disk, 1 intergrated Ethernet port and one Intel Pro NIC.

The clients connected to the driver machine and the DB server via a Dell PowerConnect 2216 10/100/1000 BaseT switch. Hyperthreading was enabled on these clients.

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 : fixed, scaling, growing as shown in the table below :

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

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

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 550,000 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	3904610
Address	825004
Broker	5500
Cash_Transaction	8743662474
Charge	15
Commission_Rate	240
Company	275000
Company_Competitor	825000
Customer	550000
Customer_Account	2750000
Customer_Taxrate	1100000
Daily_Market	491658750
Exchange	4
Financial	5500000
Holding	486627784
Holding_History	12736944168
Holding_Summary	27357063
Industry	102
Last_Trade	376750
News_Item	550000
News_Xref	550000
Sector	12
Security	376750
Settlement	9504000000
Status_Type	5
Taxrate	320
Trade	9504000000
Trade_History	22809658831
Trade_Request	0
Trade_Type	5
Watch_Item	55082183

Watch_List	550000
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	0	0	8x146GB,15K,SAS Onboard RAID10	C:\	40GB	OS
			8x146GB,15K,SAS Onboard RAID10	E:\	776.75GB	Logs
1	1	1	12x73GB,15K,SAS	C:\A\A1	1MB	Fixed_1
			MD1220	C:\B\B1	3.5GB	Scaling_1
			RAID10	C:\C\C1	122GB	Growing_1
				C:\D\D1	281.81GB	Backup_1
		2	12x73GB,15K,SAS	C:\A\A2	1MB	Fixed_2
			MD1220	C:\B\B2	3.5GB	Scaling_2
			RAID10	C:\C\C2	122GB	Growing_2
				C:\D\D2	281.81GB	Backup_2
		3	12x73GB,15K,SAS	C:\A\A3	1MB	Fixed_3
			MD1220	C:\B\B3	3.5GB	Scaling_3
			RAID10	C:\C\C3	122GB	Growing_3
				C:\D\D3	281.81GB	Backup_3
		4	12x73GB,15K,SAS	C:\A\A4	1MB	Fixed_4
			MD1220	C:\B\B4	3.5GB	Scaling_4
			RAID10	C:\C\C4	122GB	Growing_4
				C:\D\D4	281.81GB	Backup_4
		5	12x73GB,15K,SAS	C:\A\A5	1MB	Fixed_5
			MD1220	C:\B\B5	3.5GB	Scaling_5
			RAID10	C:\C\C5	122GB	Growing_5
				C:\D\D5	281.81GB	Backup_5
		6	12x73GB,15K,SAS	C:\A\A6	1MB	Fixed_6
			MD1220	C:\B\B6	3.5GB	Scaling_6
			RAID10	C:\C\C6	122GB	Growing_6
				C:\D\D6	281.81GB	Backup_6
		7	12x73GB,15K,SAS	C:\A\A7	1MB	Fixed_7
			MD1220	C:\B\B7	3.5GB	Scaling_7
			RAID10	C:\C\C7	122GB	Growing_7

				C:\D\D7	281.81GB	Backup_7
		8	12x73GB,15K,SAS	C:\A\A8	1MB	Fixed_8
			MD1220	C:\B\B8	3.5GB	Scaling_8
			RAID10	C:\C\C8	122GB	Growing_8
				C:\D\D8	281.81GB	Backup_8
2	2	9	12x73GB,15K,SAS	C:\A\A9	1MB	Fixed_9
			MD1220	C:\B\B9	3.5GB	Scaling_9
			RAID10	C:\C\C9	122GB	Growing_9
				C:\D\D9	281.81GB	Backup_9
		10	12x73GB,15K,SAS	C:\A\A10	1MB	Fixed_10
			MD1220	C:\B\B10	3.5GB	Scaling_10
			RAID10	C:\C\C10	122GB	Growing_10
				C:\D\D10	281.81GB	Backup_10
		11	12x73GB,15K,SAS	C:\A\A11	1MB	Fixed_11
			MD1220	C:\B\B11	3.5GB	Scaling_11
			RAID10	C:\C\C11	122GB	Growing_11
				C:\D\D11	281.81GB	Backup_11
		12	12x73GB,15K,SAS	C:\A\A12	1MB	Fixed_12
			MD1220	C:\B\B12	3.5GB	Scaling_12
			RAID10	C:\C\C12	122GB	Growing_12
				C:\D\D12	281.81GB	Backup_12
		13	12x73GB,15K,SAS	C:\A\A13	1MB	Fixed_13
			MD1220	C:\B\B13	3.5GB	Scaling_13
			RAID10	C:\C\C13	122GB	Growing_13
				C:\D\D13	281.81GB	Backup_13
		14	12x73GB,15K,SAS	C:\A\A14	1MB	Fixed_14
			MD1220	C:\B\B14	3.5GB	Scaling_14
			RAID10	C:\C\C14	122GB	Growing_14
				C:\D\D14	281.81GB	Backup_14
		15	12x73GB,15K,SAS	C:\A\A15	1MB	Fixed_15
			MD1220	C:\B\B15	3.5GB	Scaling_15
			RAID10	C:\C\C15	122GB	Growing_15
				C:\D\D15	281.81GB	Backup_15
		16	12x73GB,15K,SAS	C:\A\A16	1MB	Fixed_16
			MD1220	C:\B\B16	3.5GB	Scaling_16
			RAID10	C:\C\C16	122GB	Growing_16
				C:\D\D16	281.81GB	Backup_16
3	3	17	12x73GB,15K,SAS	C:\A\A17	1MB	Fixed_17
			MD1220	C:\B\B17	3.5GB	Scaling_17
			RAID10	C:\C\C17	122GB	Growing_17
				C:\D\D17	281.81GB	Backup_17
		18	12x73GB,15K,SAS	C:\A\A18	1MB	Fixed_18
			MD1220	C:\B\B18	3.5GB	Scaling_18
			RAID10	C:\C\C18	122GB	Growing_18
				C:\D\D18	281.81GB	Backup_18
		19	12x73GB,15K,SAS	C:\A\A19	1MB	Fixed_19
			MD1220	C:\B\B19	3.5GB	Scaling_19
			RAID10	C:\C\C19	122GB	Growing_19
				C:\D\D19	281.81GB	Backup_19
		20	12x73GB,15K,SAS	C:\A\A20	1MB	Fixed_20
			MD1220	C:\B\B20	3.5GB	Scaling_20
			RAID10	C:\C\C20	122GB	Growing_20

				C:\D\D20	281.81GB	Backup_20
			21	12x73GB,15K,SAS	C:\A\A21	1MB	Fixed_21
				MD1220	C:\B\B21	3.5GB	Scaling_21
				RAID10	C:\C\C21	122GB	Growing_21
					C:\D\D21	281.81GB	Backup_21
			22	12x73GB,15K,SAS	C:\A\A22	1MB	Fixed_22
				MD1220	C:\B\B22	3.5GB	Scaling_22
				RAID10	C:\C\C22	122GB	Growing_22
					C:\D\D22	281.81GB	Backup_22
			23	12x73GB,15K,SAS	C:\A\A23	1MB	Fixed_23
				MD1220	C:\B\B23	3.5GB	Scaling_23
				RAID10	C:\C\C23	122GB	Growing_23
					C:\D\D23	281.81GB	Backup_23
			24	12x73GB,15K,SAS	C:\A\A24	1MB	Fixed_24
				MD1220	C:\B\B24	3.5GB	Scaling_24
				RAID10	C:\C\C24	122GB	Growing_24
4		4			C:\D\D24	281.81GB	Backup_24
			25	12x73GB,15K,SAS	C:\A\A25	1MB	Fixed_25
				MD1220	C:\B\B25	3.5GB	Scaling_25
				RAID10	C:\C\C25	122GB	Growing_25
					C:\D\D25	281.81GB	Backup_25
			26	12x73GB,15K,SAS	C:\A\A26	1MB	Fixed_26
				MD1220	C:\B\B26	3.5GB	Scaling_26
				RAID10	C:\C\C26	122GB	Growing_26
					C:\D\D26	281.81GB	Backup_26
			27	12x73GB,15K,SAS	C:\A\A27	1MB	Fixed_27
				MD1220	C:\B\B27	3.5GB	Scaling_27
				RAID10	C:\C\C27	122GB	Growing_27
					C:\D\D27	281.81GB	Backup_27
			28	12x73GB,15K,SAS	C:\A\A28	1MB	Fixed_28
				MD1220	C:\B\B28	3.5GB	Scaling_28
				RAID10	C:\C\C28	122GB	Growing_28
					C:\D\D28	281.81GB	Backup_28
			29	12x73GB,15K,SAS	C:\A\A29	1MB	Fixed_29
				MD1220	C:\B\B29	3.5GB	Scaling_29
				RAID10	C:\C\C29	122GB	Growing_29
					C:\D\D29	281.81GB	Backup_29
			30	12x73GB,15K,SAS	C:\A\A30	1MB	Fixed_30
				MD1220	C:\B\B30	3.5GB	Scaling_30
				RAID10	C:\C\C30	122GB	Growing_30
					C:\D\D30	281.81GB	Backup_30
			31	12x73GB,15K,SAS	C:\A\A31	1MB	Fixed_31
				MD1220	C:\B\B31	3.5GB	Scaling_31
				RAID10	C:\C\C31	122GB	Growing_31
					C:\D\D31	281.81GB	Backup_31
			32	12x73GB,15K,SAS	C:\A\A32	1MB	Fixed_32
				MD1220	C:\B\B32	3.5GB	Scaling_32
				RAID10	C:\C\C32	122GB	Growing_32
					C:\D\D32	281.81GB	Backup_32
			33	12x73GB,15K,SAS	C:\A\A33	1MB	Fixed_33
				MD1220	C:\B\B33	3.5GB	Scaling_33
				RAID10	C:\C\C33	122GB	Growing_33

				C:\D\D33	281.81GB	Backup_33
		34	12x73GB,15K,SAS	C:\A\A34	1MB	Fixed_34
			MD1220	C:\B\B34	3.5GB	Scaling_34
			RAID10	C:\C\C34	122GB	Growing_34
				C:\D\D34	281.81GB	Backup_34
		35	12x73GB,15K,SAS	C:\A\A35	1MB	Fixed_35
			MD1220	C:\B\B35	3.5GB	Scaling_35
			RAID10	C:\C\C35	122GB	Growing_35
				C:\D\D35	281.81GB	Backup_35
		36	12x73GB,15K,SAS	C:\A\A36	1MB	Fixed_36
			MD1220	C:\B\B36	3.5GB	Scaling_36
			RAID10	C:\C\C36	122GB	Growing_36
				C:\D\D36	281.81GB	Backup_36
5	5	37	12x73GB,15K,SAS	C:\A\A37	1MB	Fixed_37
			MD1220	C:\B\B37	3.5GB	Scaling_37
			RAID10	C:\C\C37	122GB	Growing_37
				C:\D\D37	281.81GB	Backup_37
		38	12x73GB,15K,SAS	C:\A\A38	1MB	Fixed_38
			MD1220	C:\B\B38	3.5GB	Scaling_38
			RAID10	C:\C\C38	122GB	Growing_38
				C:\D\D38	281.81GB	Backup_38
		39	12x73GB,15K,SAS	C:\A\A39	1MB	Fixed_39
			MD1220	C:\B\B39	3.5GB	Scaling_39
			RAID10	C:\C\C39	122GB	Growing_39
				C:\D\D39	281.81GB	Backup_39
		40	12x73GB,15K,SAS	C:\A\A40	1MB	Fixed_40
			MD1220	C:\B\B40	3.5GB	Scaling_40
			RAID10	C:\C\C40	122GB	Growing_40
				C:\D\D40	281.81GB	Backup_40
		41	12x73GB,15K,SAS	C:\A\A41	1MB	Fixed_41
			MD1220	C:\B\B41	3.5GB	Scaling_41
			RAID10	C:\C\C41	122GB	Growing_41
				C:\D\D41	281.81GB	Backup_41
		42	12x73GB,15K,SAS	C:\A\A42	1MB	Fixed_42
			MD1220	C:\B\B42	3.5GB	Scaling_42
			RAID10	C:\C\C42	122GB	Growing_42
				C:\D\D42	281.81GB	Backup_42
		43	12x73GB,15K,SAS	C:\A\A43	1MB	Fixed_43
			MD1220	C:\B\B43	3.5GB	Scaling_43
			RAID10	C:\C\C43	122GB	Growing_43
				C:\D\D43	281.81GB	Backup_43
		44	12x73GB,15K,SAS	C:\A\A44	1MB	Fixed_44
			MD1220	C:\B\B44	3.5GB	Scaling_44
			RAID10	C:\C\C44	122GB	Growing_44
				C:\D\D44	281.81GB	Backup_44
6	6	45	12x73GB,15K,SAS	C:\A\A45	1MB	Fixed_45
			MD1220	C:\B\B45	3.5GB	Scaling_45
			RAID10	C:\C\C45	122GB	Growing_45
				C:\D\D45	281.81GB	Backup_45
		46	12x73GB,15K,SAS	C:\A\A46	1MB	Fixed_46
			MD1220	C:\B\B46	3.5GB	Scaling_46
			RAID10	C:\C\C46	122GB	Growing_46

				C:\D\D46	281.81GB	Backup_46
		47	12x73GB,15K,SAS	C:\A\A47	1MB	Fixed_47
			MD1220	C:\B\B47	3.5GB	Scaling_47
			RAID10	C:\C\C47	122GB	Growing_47
				C:\D\D47	281.81GB	Backup_47
		48	12x73GB,15K,SAS	C:\A\A48	1MB	Fixed_48
			MD1220	C:\B\B48	3.5GB	Scaling_48
			RAID10	C:\C\C48	122GB	Growing_48
				C:\D\D48	281.81GB	Backup_48

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'
…
BackupDev48 'C:\D\D48\TPCHbackup48'

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 R2 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 12 instances of EGenDriverMEE and 12 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 T710 server has an inbuilt network Ethernet controller with 4 1000MB/s ports. One of the ports is used to connect directly to the Dell PowerConnect 2216 10/100/1000 BaseT switch.The other 3 ports are unused. The Client systems also have inbuilt network controllers with 1 1000MB/s port1. This port is connected to the Dell PowerConnect 2216 10/100/1000 BaseT switch. This 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 1.10.0

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)

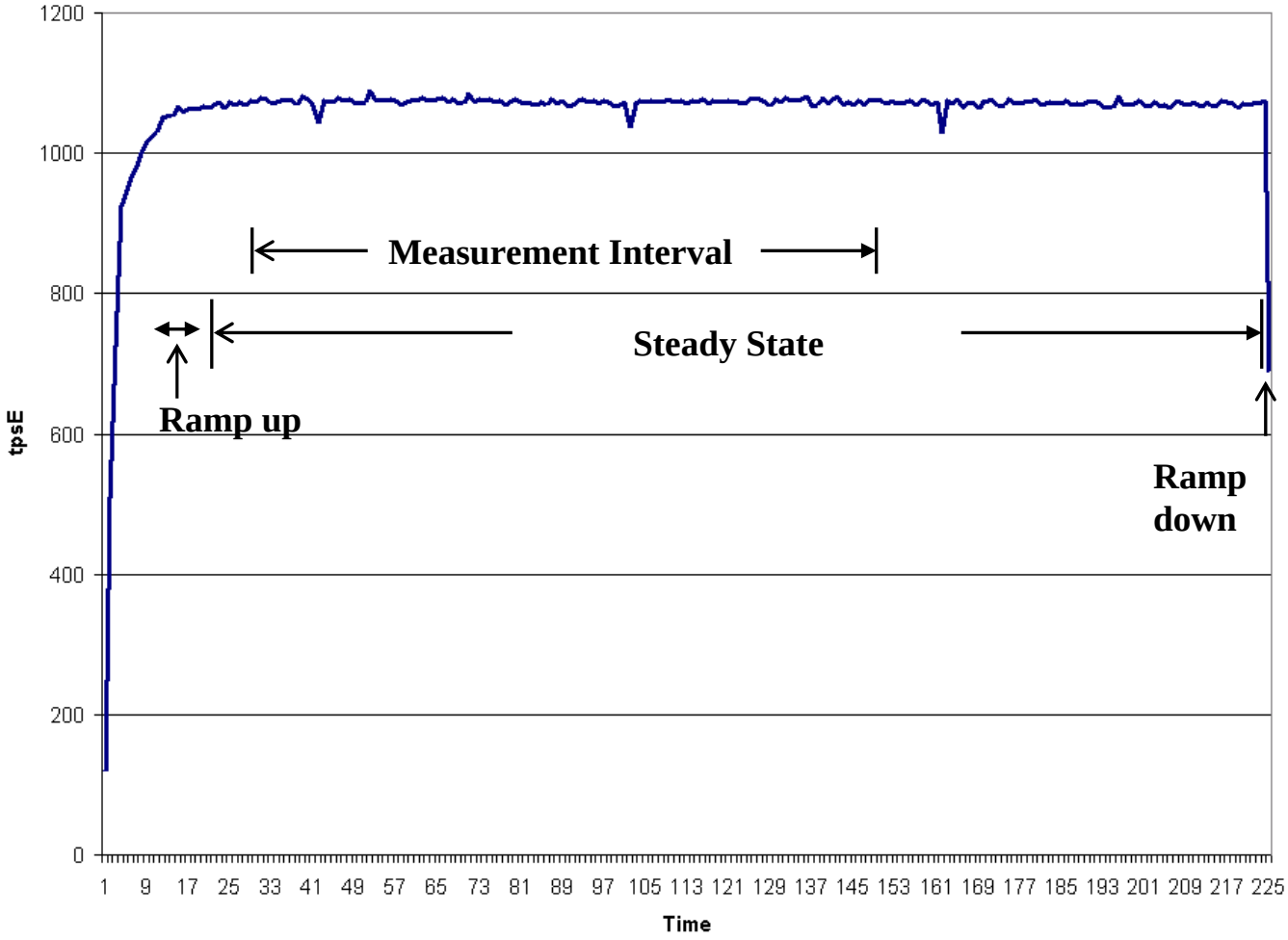
The measured tpsE was 1074.14

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 0.39%. A 10 min window sliding by 1 min was found to vary by 1.06%.

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	50.00%	Ok	48.00%	52.00%
		Get history	49.98%	Ok	48.00%	52.00%
Trade Lookup	Ok	Frame 1	30.03%	Ok	28.50%	31.50%
		Frame 2	29.98%	Ok	28.50%	31.50%
		Frame 3	30.00%	Ok	28.50%	31.50%
		Frame 4	9.99%	Ok	9.50%	10.50%
Market Watch	Ok	By Watch List	60.01%	Ok	57.00%	63.00%

		By Customer Account	34.98%	Ok	33.00%	37.00%
		By Industry	5.01%	Ok	4.50%	5.50%
Trade Update	Ok	Frame 1	32.98%	Ok	31.00%	35.00%
		Frame 2	33.01%	Ok	31.00%	35.00%
		Frame 3	34.01%	Ok	32.00%	36.00%
Security Detail	Ok	Access LOB	1.00%	Ok	0.90%	1.10%
Trade Order	Ok	By Non-Owner	9.99%	Ok	9.50%	10.50%
		By Company Name	40.00%	Ok	38.00%	42.00%
		Buy on Margin	8.01%	Ok	7.50%	8.50%
		Rollback	0.99%	Ok	0.94%	1.04%
		LIFO	35.02%	Ok	33.00%	37.00%
		Trade Quantity 100	25.01%	Ok	24.00%	26.00%
		Trade Quantity 200	25.00%	Ok	24.00%	26.00%
		Trade Quantity 400	25.02%	Ok	24.00%	26.00%
		Trade Quantity 800	24.98%	Ok	24.00%	26.00%
		Market Buy	30.01%	Ok	29.70%	30.30%
		Market Sell	29.99%	Ok	29.70%	30.30%
		Limit buy	20.02%	Ok	19.80%	20.20%
		Limit sell	10.01%	Ok	9.90%	10.10%
		Stop Loss	9.97%	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)

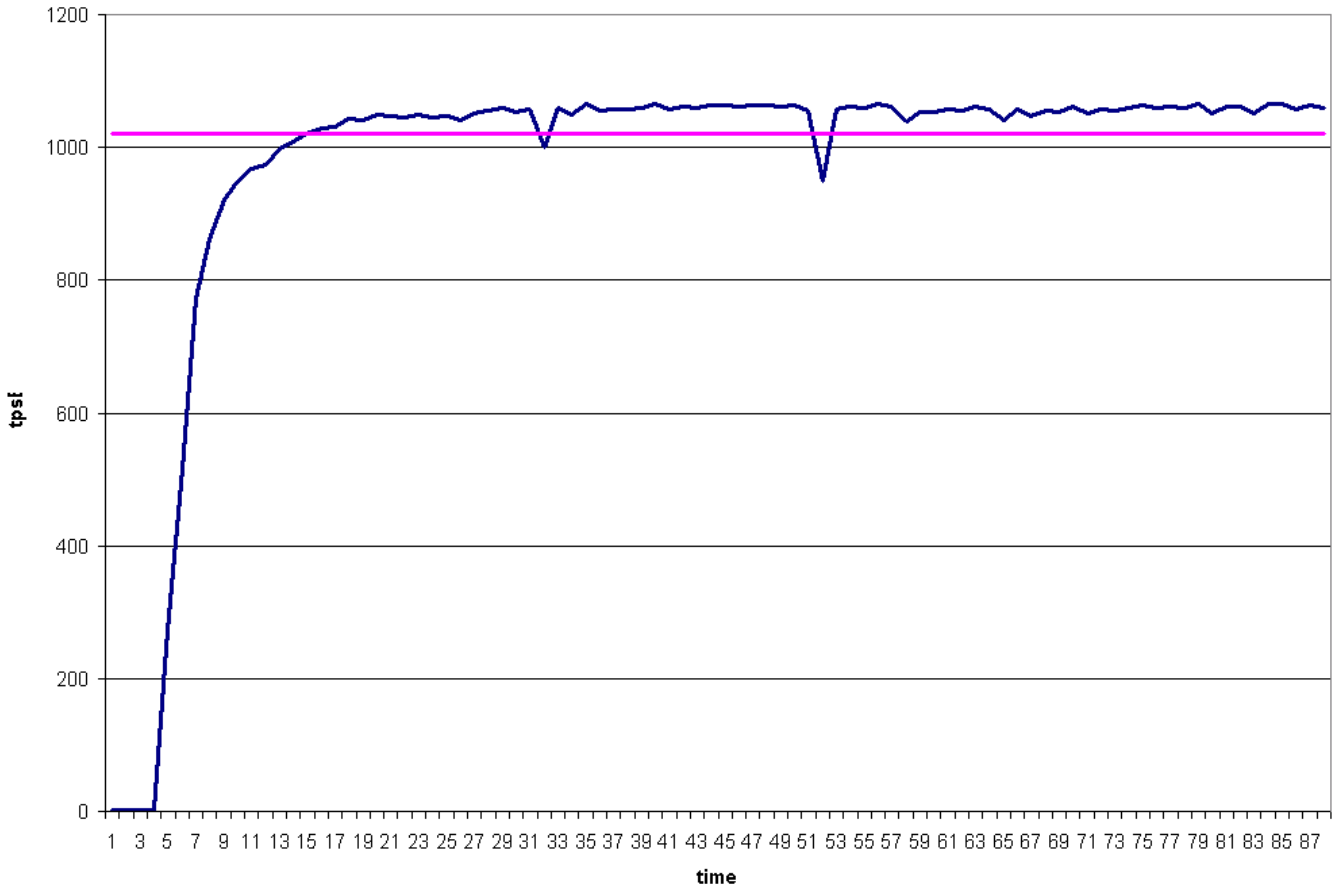
1. A restore was executed to yield a fresh database.
2. The rows in the Settlement table were counted to determine the initial count of completed trades present in the database (count-before).
3. A performance run was started with the same number of configured customers and driver load used for the measurement 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 25mins.
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 25mins.
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.

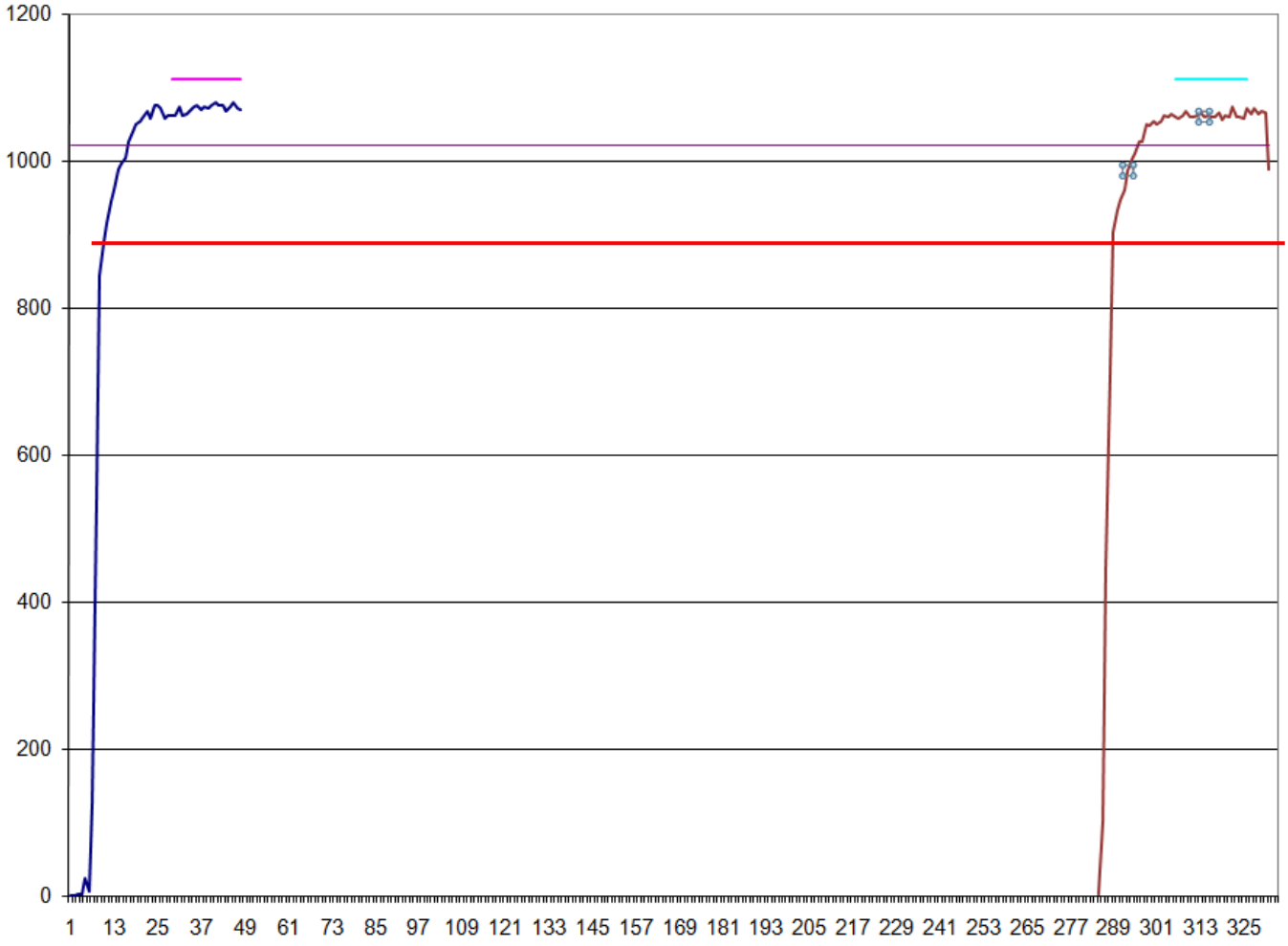
7.6: Business Recovery Time

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 5 hours 4mins 41s. 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:	550,000						
		TpsE:	1,074.14						
		TradeResult count:	14,267,731						
Table	**Rows**	**Data(KB)**	**Index(KB)**	**Total**	**Total + 5%**	**Rows After**	**Data After(KB)**	**Index After(KB)**	**Growth**
ACCOUNT_PERMISSION	3904610	332424	2432	334,856	351,599	3904610	332576	2584	304
ADDRESS	825004	47616	776	48,392	50,812	825004	47672	776	56
BROKER	5500	576	2360	2,936	3,083	5500	576	2360	0
CASH_TRANSACTION	8744503563	901571536	1904240	903,475,776	948,649,565	8757629455	904196920	1912408	2633552
CHARGE	15	8	8	16	17	15	8	8	0
COMMISSION_RATE	240	16	16	32	34	240	16	16	0
COMPANY	275000	59864	17424	77,288	81,152	275000	59864	17424	0
COMPANY_COMPETITOR	825000	22168	18832	41,000	43,050	825000	22168	18832	0
CUSTOMER	550000	93184	25000	118,184	124,093	550000	93200	25000	16
CUSTOMER_ACCOUNT	2750000	249200	53928	303,128	318,284	2750000	249200	53928	0
CUSTOMER_TAXRATE	1100000	22960	776	23,736	24,923	1100000	23112	776	152
DAILY_MARKET	491658750	25349352	89144	25,438,496	26,710,421	491658750	25350608	89360	1472
EXCHANGE	4	8	8	16	17	4	8	8	0
FINANCIAL	5500000	647160	2496	649,656	682,139	5500000	647344	2640	328
HOLDING	486651848	32357848	20416624	52,774,472	55,413,196	487019291	33223472	20421848	870848
HOLDING_HISTORY	12738176825	463207560	267788392	730,995,952	767,545,750	12757414263	465026432	268940040	2970520
HOLDING_SUMMARY	27356935	1184432	5000	1,189,432	1,248,904	27357076	1184432	5000	0
INDUSTRY	102	8	24	32	34	102	8	24	0
LAST_TRADE	376750	23296	776	24,072	25,276	376750	23296	776	0
NEWS_ITEM	550000	59630352	1360	59,631,712	62,613,298	550000	59630360	1368	16
NEWS_XREF	550000	13712	776	14,488	15,212	550000	13712	776	0
SECTOR	12	8	24	32	34	12	8	24	0
SECURITY	376750	59384	14344	73,728	77,414	376750	59408	14352	32
SETTLEMENT	9504914721	503918904	1063280	504,982,184	530,231,293	9519182452	505471424	1068032	1557272
STATUS_TYPE	5	8	8	16	17	5	8	8	0
TAXRATE	320	192	584	776	815	320	192	584	0
TRADE	9504978509	1131872912	572115936	1,703,988,848	1,789,188,290	9519310498	1133679144	572562720	2253016
TRADE_HISTORY	22812006775	686189232	1790824	687,980,056	722,379,059	22846275268	688837848	1800872	2658664
TRADE_REQUEST	0	0	0	-	-	64258	9320	12352	21672
TRADE_TYPE	5	8	1032	1,040	1,092	5	8	1032	0
WATCH_ITEM	55082183	1523400	6184	1,529,584	1,606,063	55082183	1523544	6328	288
WATCH_LIST	550000	13696	11992	25,688	26,972	550000	13696	11992	0
ZIP_CODE	14741	592	776	1,368	1,436	14741	592	776	0
Totals in KB	64383484167	3808391616	865335376	4673726992	4907413342		3819720176	866975024	12968208

Database File Groups	Allocated size MB	Required size MB	Diff		file size # of files
growing	6,107,040	4,701,834	1,405,206	OK	total in KB (*8)
fixed	36	3	33	OK	
scaling	163,632	90,580	73,052	OK	
Total	6,270,708	4,792,417			
Total in GB	6,123.7	4,680.1			

Growing Space	12,965,544	KB		
per Trade Results	0.91	KB		
Data Growth	28,111,836	KB		
60 Day Space	6,360,437,142	KB		
60 Day Space	6,066	GB		
		%	size	
Log space before in MB	13,619	3.4245644	397692	
Log space after in MB	105,518	26.532679	397692	
per Trade Results	0.006			
Log Growth	199,255	MB		
Total 8 hours log space	212,874	MB		
Total 8 hours log space	207.89	GB		

	Count	Formatted size GB	Total GB Configured	Total Needed
Data Disks configured	0	33.37	-	
	576	67.75	39,024	
	0	135.49	-	
RAID 10 overhead 50%			(19,512)	
Data Disks space total			**19,512**	6,066
Log Disks configured	8	135.49	1,084	
RAID 10 overhead 50%			(542)	
Log Disk space total			542	208

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

Microsoft SQL Server 2008 R2 Ent Edition will be orderable and available by June 21, 2010. Please refer to the Microsoft quote at the end of the FDR.

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:

June 21, 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 T710
Database Manager:	Microsoft SQL Server 2008 Enterprise x64 Edition
Operating System:	Microsoft Windows Sever 2008 Enterprise x64 Edition

Server (Tier B): T710			
CPU's	Memory	Disks (total)	TpsE
2 Inte 6 core Xeon @ 3.33 Ghz	144 GB	576 @ 73 GB 8 @ 146 GB	**1,074.14**
Clients (Tier A): 2PowerEdge T110			
1 Intel quad core @ 2.67 Ghz	4 GB	1 @ 160 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 1.10.0
- The database files were properly sized and populated for 550,000 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: None.

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)

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

May 6, 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
*	**SQL Server 2008 R2 Enterprise Edition** *Per Processor License* *Discount Schedule: Open Program – No Level* *Unit Price reflects a 19% discount from the retail unit price of $28,749.*	$23,358	2	$46,716
P72-03868	**Windows Server 2008 R2 Enterprise Edition** *Server License with 25 CALs* *Discount Schedule: Open Program – No Level* *Unit Price reflects a 42% discount from the retail unit price of $3,999.*	$2,320	1	$2,320
P73-04754	**Windows Server 2008 R2 Standard Edition** *Server License with 5 CALs* *Discount Schedule: Open Program – Level C* *Unit Price reflects a 30% discount from the retail unit price of $1,029.*	$711	2	$1,422
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident).*	$259	1	$259

SQL Server 2008 R2 Enterprise Edition, Windows Server 2008 R2 Enterprise Edition and Windows Server 2008 R2 Standard Edition are currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found at the Microsoft Product Information Center at
http://www.microsoft.com/products/info/render.aspx?view=22&type=how

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at $250 per call.

This quote is valid for the next 90 days.

Reference ID: TPCE_g3wOpiq6ZAsO5Qbmmd7N9UpVMs7c4+6d_V1.0.0.