



**TPC Benchmark™ E
Full Disclosure Report
DELL PowerEdge R905
Using
Microsoft SQL Server 2008 Enterprise Edition x64
On
Microsoft Windows Server 2008 Enterprise x64**

Second Edition

Submitted for Review

February 20, 2009

Dell, Inc. PowerEdge R905 Server with Microsoft SQL Server 2008 Enterprise Edition x64 on Microsoft Windows Server 2008 Enterprise x64

Second Printing February 2009

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Abstract

This report documents the methodology and results of the TPC Benchmark E test conducted on a PowerEdge R905 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 R905	Microsoft Windows 2008 Enterprise Ed. x64 SQL Server 2008 Enterprise Ed. x64	\$256,625	635.43	\$403.87	February 19, 2009

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

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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.



PowerEdge™ R905 Server

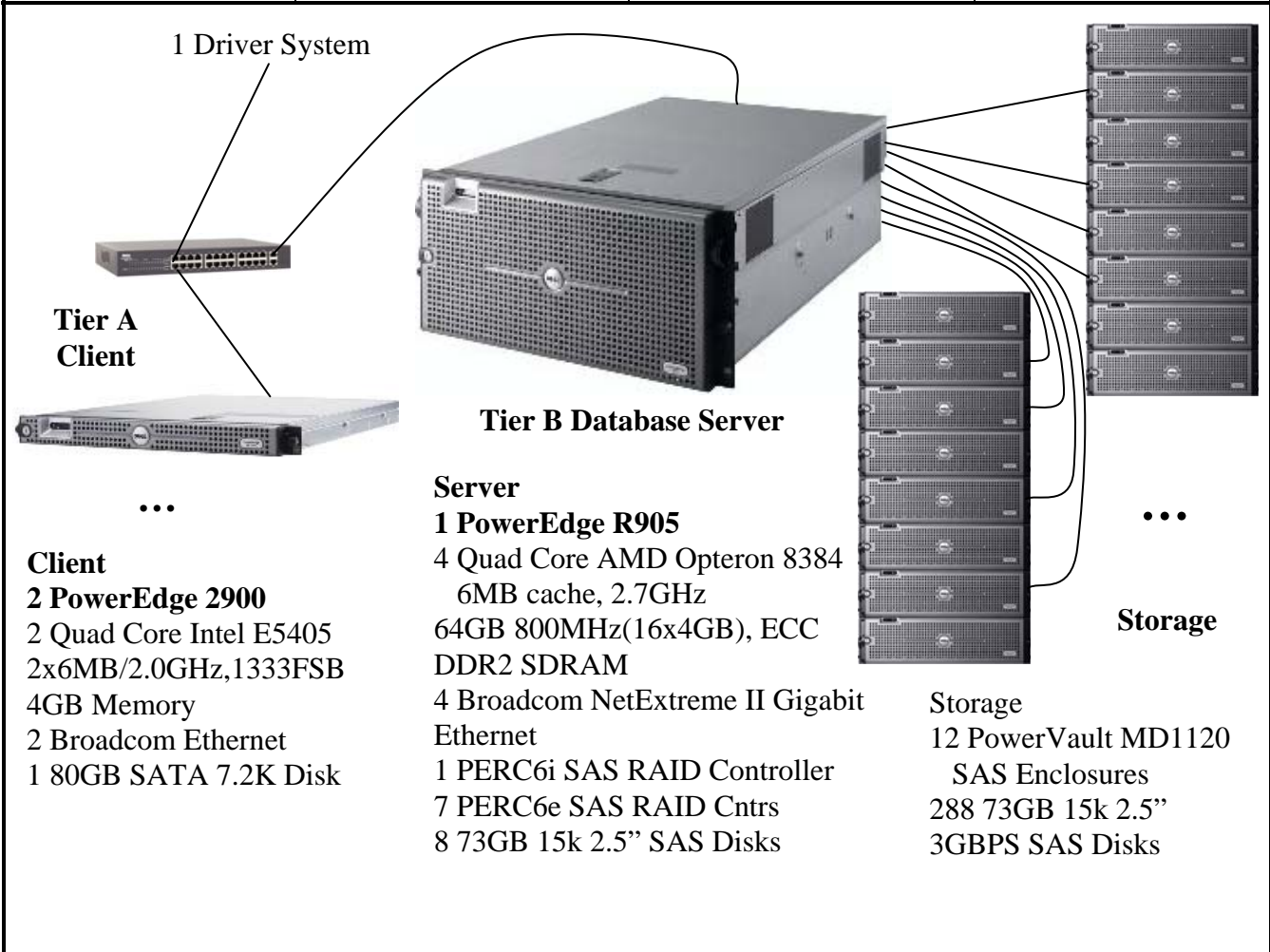
**TPC-E 1.7.0
TPC Pricing 1.3**

Report Date:
February 19, 2009

TPC-E Throughput	Price/Performance	Availability Date	Total System Cost
635.43 tpsE	\$403.87 USD per tpsE	February 19, 2009	\$256,625 USD

Database Server Configuration

Operating System	Database Manager	Processors/Cores/ Threads	Memory
Microsoft Windows Server 2008 Enterprise x64 Edition™	SQL Server 2008 Enterprise x64 Edition™	4/16/16	64GB



Initial Database Size 2,471.58GB	Redundancy Level: 1 RAID10 Log + RAID5 Data	Storage 8 x 73GB, 288 x 73GB
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PowerEdge R905

TPC-E 1.7.0 TPC Pricing 1.3

Report Date
February 19, 2009
Revision Date
February 19, 2009
Availability Date
February 19, 2009

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3 yr. Maint. Price
Server Hardware						
PER905, 2x QuadCore Opteron 8384 2.7Gz & 2 Broadcom NICs	224-3101	1	\$7,943.00	1	\$7,943.00	\$540.00
Upgrade to Quad Opteron 8384 2.7Gz	311-9170	1	\$4,999.00	1	\$4,999.00	
64GB,800MHZ, 16X4GB	311-9834	1	\$4,200.00	1	\$4,200.00	
PERC6i SAS RAID, Internal, Bat	341-5699	1	\$299.00	1	\$299.00	
PERC6E SAS RAID, 2X4 EXT 256	341-5842	1	\$799.00	7	\$5,593.00	
73GB,SAS,2.5-inch,15K RPM HD	341-4727	1	\$339.00	8	\$2,712.00	
DELL E157FP,15 IN,15.0 VIS	320-5090	1	\$189.00	1	\$189.00	
				Subtotal	\$25,935.00	\$540.00
Server Storage						
PV MD1120,RACK,2U,24 BAY,LBZL	223-6716	1	\$3,043.00	12	\$36,516.00	\$19,896.00
Enclosure Management Modules, PowerVault MD1120	341-6492	1	\$0.00	12	\$0.00	
73GB,SAS,2.5-inch,15K RPM HD	341-4727	1	\$339.00	288	\$97,632.00	
RACK-42U, CUST	340-4896	1	\$239.99	1	\$239.99	
				Subtotal	\$134,387.99	\$19,896.00
Server Software						
SQL Server 2008 Enterprise x64 Edition **	810-07507	2	\$23,432.00	4	\$93,728.00	
Windows Server 2008 Enterprise Edition (x64) **	P72-03168	2	\$2,310.00	1	\$2,310.00	
Professional Support (1 Incident)	N/A		\$245.00	1		\$245.00
				Subtotal	\$96,038.00	\$245.00
Client Hardware						
Dell PowerEdge 2900, E5405,2x6MB/2.0GHz,1333FSB	223-4719	1S	\$553.00	2	\$1,106.00	\$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	\$448.00	2	\$896.00	
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	\$2,938.00	\$984.00
Client Software						
Windows Server 2008 Standard Edition (x64) **	P73-04165	2	\$711.00	2	\$1,422.00	
				Subtotal	\$1,422.00	\$0.00
Infrastructure						
PowerConnect 2216, 16port Switch	222-2259	1	\$69.00	1	\$69.00	
1M SAS Cable, MD1000	310-7082	1	\$30.00	12	\$360.00	
				Subtotal	\$429.00	\$0.00
				Other Discounts*	(\$26,190.40)	
				Total	\$234,959.59	\$21,665.00

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 16% 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 # 475057394 as a complex quote.
Audited by Lorna Livingtree, Performance Metrics Inc.

Three-Year Cost of Ownership:	\$256,625	USD
TPC-E Throughput:	635.43	tpsE
Price/Performance:	\$403.87	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: 635.43 tpsE		Configured Customers: 320,000		
Response Times (in seconds)	Minimum	Average	90th%tile	Maximum
Broker-Volume	0.00	0.05	0.09	0.65
Customer-Position	0.00	0.06	0.12	4.20
Market-Feed	0.00	0.09	0.21	4.18
Market-Watch	0.00	0.04	0.08	3.05
Security-Detail	0.00	0.03	0.06	0.89
Trade-Lookup	0.01	0.87	1.12	2.06
Trade-Order	0.00	0.17	0.27	2.12
Trade-Result	0.00	0.19	0.30	3.46
Trade-Status	0.00	0.06	0.11	1.13
Trade-Update	0.02	1.03	1.21	1.98
Data-Maintenance	0.02	0.20		1.90
Transaction Mix		Transaction Count		Mix %
Broker-Volume		2,241,285		4.900%
Customer-Position		5,946,533		13.000%
Market-Feed		457,526		1.000%
Market-Watch		8,233,819		18.000%
Security-Detail		6,403,629		13.999%
Trade-Lookup		3,659,003		7.999%
Trade-Order		4,619,924		10.100%
Trade-Result		4,575,164		10.002%
Trade-Status		8,690,861		19.000%
Trade-Update		914,756		2.000%
Data-Maintenance		120		
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)			00:11:00	
Measurement Interval (hh:mm:ss)			02:00:00	
Business Recovery Time (hh:mm:ss)			00:52:26	
Total number of Transactions Completed in Measurement Interval			45,742,500	

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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 R905 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

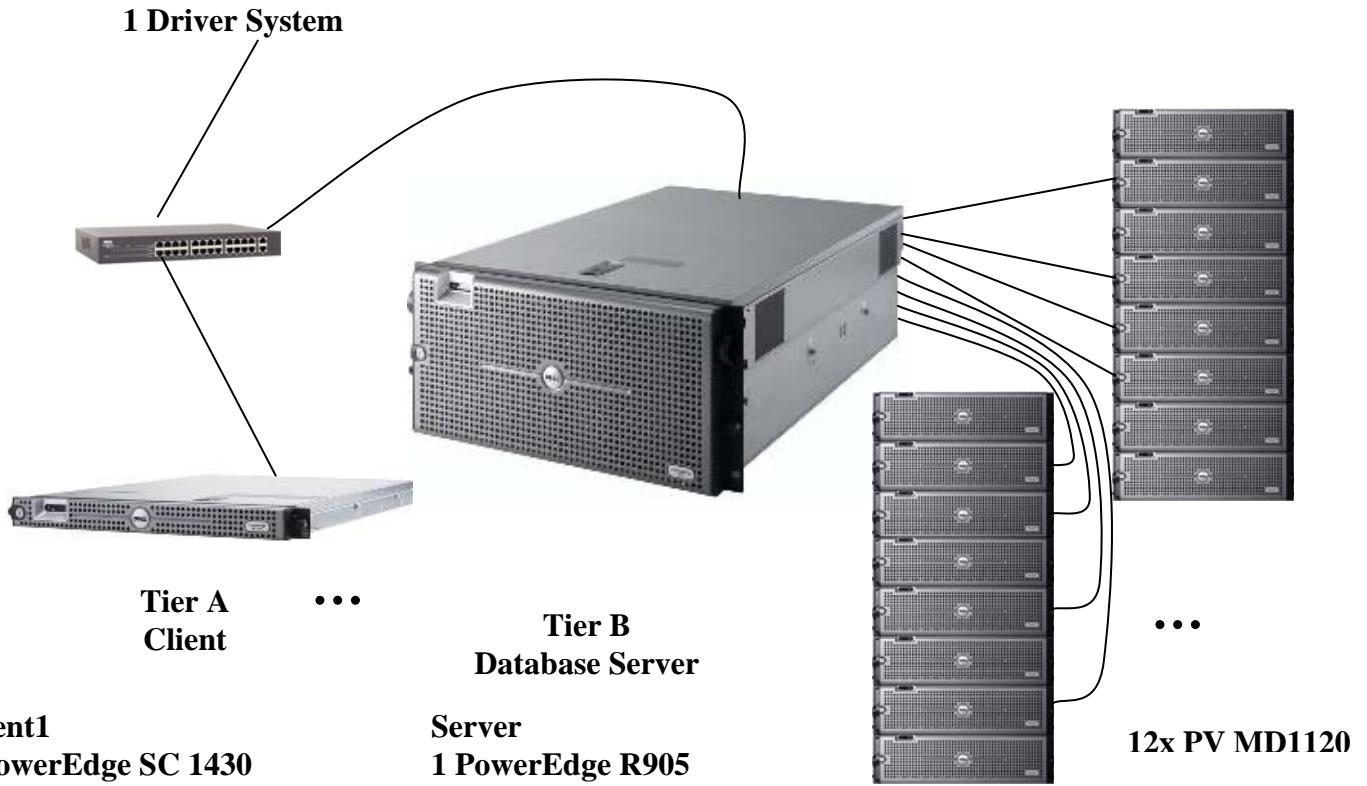
Table 1: Difference between priced and measured configuration

	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

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

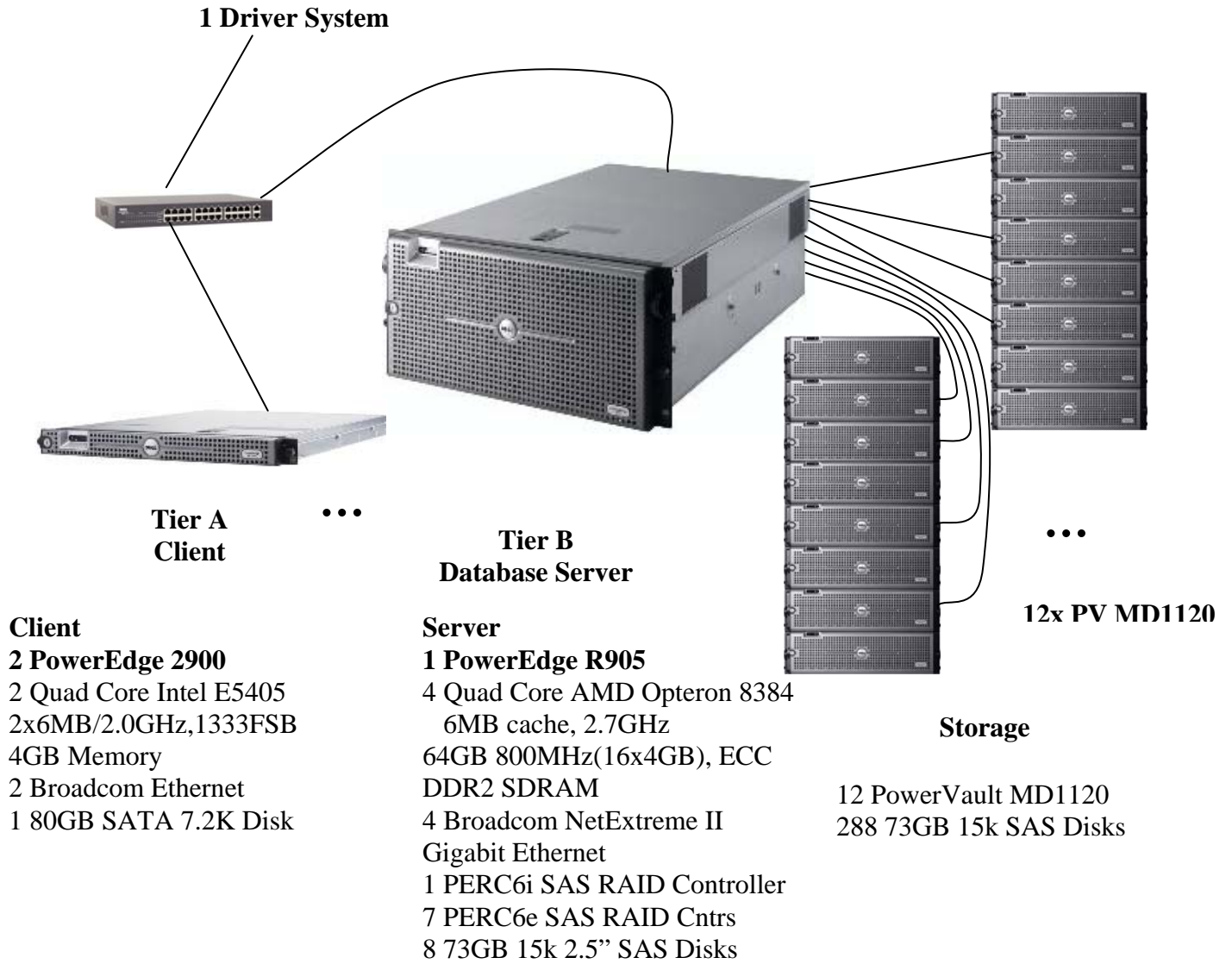
- 1 PowerEdge R905
- 4 Quad Core AMD Opteron 8384
- 6MB cache, 2.7GHz
- 64GB 800MHz(16x4GB), ECC
- DDR2 SDRAM
- 4 Broadcom NetExtreme II
- Gigabit Ethernet
- 1 PERC6i SAS RAID Controller
- 7 PERC6e SAS RAID Cntrs
- 8 73GB 15k 2.5" SAS Disks

Storage

- 12 PowerVault MD1120
- 288 73GB 15k SAS Disks

Priced Configuration

Figure 2: Priced Configuration



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 ***PEr905_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 R905 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 R905 motherboard uses the Broadcom HT-2100 and HT-1100 server chipset and can hold up to four quad-core AMD Opteron MP processors (2.7 GHz with 6MB L3 cache each). The system has 7 PCI-e I/O slots. The measured configuration used 64Gbytes of DDR II RAM, which was achieved by using 16 4096Mbyte DIMMs.

The PowerEdge R905 has an integrated PERC SAS controller to which was attached eight 73GB disk drives containing the operating system and database logs. In addition, 7 PERC6e SAS RAID controllers were installed in 7 PCI-e slots and connected to 12 MD 1120 disk pods, which can hold 24 disks each. Each of the 7 controllers managed either 8 or 4 RAID 5 LUNs. Each LUN had 6 physical drives. The total number of physical drives used for the database was 288 SAS disks. There were no empty PCI-e slots. Hyperthreading was not 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 integrated 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 150,000 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	2271956
Address	480004
Broker	3200
Cash_Transaction	5087231570
Charge	15
Commission_Rate	240
Company	160000
Company_Competitor	480000
Customer	320000
Customer_Account	1600000
Customer_Taxrate	640000
Daily_Market	286056000
Exchange	4
Financial	3200000
Holding	283275410
Holding_History	7410508338
Holding_Summary	15923696
Industry	102
Last_Trade	219200
News_Item	320000
News_Xref	320000
Sector	12
Security	219200
Settlement	5529600000
Status_Type	5
Taxrate	320
Trade	5529600000
Trade_History	13271094561
Trade_Request	0
Trade_Type	5
Watch_Item	32084987
Watch_List	320000
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 NTFS 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:\	200GB	Logs
1	1	1	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A1	67GB	Broker1
				C:\B\B1	2.75GB	Customer1
				C:\C\C1	13.4GB	Market1
				C:\D\D1	255.59GB	Backup1
		2	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A2	67GB	Broker2
				C:\B\B2	7GB	Customer2
				C:\C\C2	13.4GB	Market2
				C:\D\D2	255.59GB	Backup2
		3	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A3	67GB	Broker3
				C:\B\B3	2.75GB	Customer3
				C:\C\C3	13.4GB	Market3
				C:\D\D3	255.59GB	Backup3
		4	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A4	67GB	Broker4
				C:\B\B4	2.75GB	Customer4
				C:\C\C4	13.4GB	Market4
				C:\D\D4	255.59GB	Backup4
		5	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A5	67GB	Broker5
				C:\B\B5	2.75GB	Customer5
				C:\C\C5	13.4GB	Market5
				C:\D\D5	255.59GB	Backup5
		6	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A6	67GB	Broker6
				C:\B\B6	2.75GB	Customer6
				C:\C\C6	13.4GB	Market6
				C:\D\D6	255.59GB	Backup6

		7	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A7	67GB	Broker7
				C:\B\B7	2.75GB	Customer7
				C:\C\C7	13.4GB	Market7
				C:\D\D7	255.59GB	Backup7
		8	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A8	67GB	Broker8
				C:\B\B8	2.75GB	Customer8
				C:\C\C8	13.4GB	Market8
				C:\D\D8	255.59GB	Backup8
2	2	9	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A9	67GB	Broker9
				C:\B\B9	2.75GB	Customer9
				C:\C\C9	13.4GB	Market9
				C:\D\D9	255.59GB	Backup9
		10	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A10	67GB	Broker10
				C:\B\B10	2.75GB	Customer10
				C:\C\C10	13.4GB	Market10
				C:\D\D10	255.59GB	Backup10
		11	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A11	67GB	Broker11
				C:\B\B11	2.75GB	Customer11
				C:\C\C11	13.4GB	Market11
				C:\D\D11	255.59GB	Backup11
		12	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A12	67GB	Broker12
				C:\B\B12	2.75GB	Customer12
				C:\C\C12	13.4GB	Market12
				C:\D\D12	255.59GB	Backup12
		13	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A13	67GB	Broker13
				C:\B\B13	2.75GB	Customer13
				C:\C\C13	13.4GB	Market13
				C:\D\D13	255.59GB	Backup13
		14	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A14	67GB	Broker14
				C:\B\B14	2.75GB	Customer14
				C:\C\C14	13.4GB	Market14
				C:\D\D14	255.59GB	Backup14
15	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A15	67GB	Broker15		
		C:\B\B15	2.75GB	Customer15		
		C:\C\C15	13.4GB	Market15		
		C:\D\D15	255.59GB	Backup15		
16	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A16	67GB	Broker16		
		C:\B\B16	2.75GB	Customer16		
		C:\C\C16	13.4GB	Market16		
		C:\D\D16	255.59GB	Backup16		

3	3	17	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A17	67GB	Broker17
				C:\B\B17	2.75GB	Customer17
				C:\C\C17	13.4GB	Market17
				C:\D\D17	255.59GB	Backup17
		18	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A18	67GB	Broker18
				C:\B\B18	2.75GB	Customer18
				C:\C\C18	13.4GB	Market18
				C:\D\D18	255.59GB	Backup18
		19	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A19	67GB	Broker19
				C:\B\B19	2.75GB	Customer19
				C:\C\C19	13.4GB	Market19
				C:\D\D19	255.59GB	Backup19
		20	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A20	67GB	Broker20
				C:\B\B20	2.75GB	Customer20
				C:\C\C20	13.4GB	Market20
				C:\D\D20	255.59GB	Backup20
		21	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A21	67GB	Broker21
				C:\B\B21	2.75GB	Customer21
				C:\C\C21	13.4GB	Market21
				C:\D\D21	255.59GB	Backup21
		22	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A22	67GB	Broker22
				C:\B\B22	2.75GB	Customer22
				C:\C\C22	13.4GB	Market22
				C:\D\D22	255.59GB	Backup22
		23	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A23	67GB	Broker23
				C:\B\B23	2.75GB	Customer23
				C:\C\C23	13.4GB	Market23
				C:\D\D23	255.59GB	Backup23
24	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A24	67GB	Broker24		
		C:\B\B24	2.75GB	Customer24		
		C:\C\C24	13.4GB	Market24		
		C:\D\D24	255.59GB	Backup24		
4	4	25	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A25	67GB	Broker25
				C:\B\B25	2.75GB	Customer25
				C:\C\C25	13.4GB	Market25
				C:\D\D25	255.59GB	Backup25
		26	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A26	67GB	Broker26
				C:\B\B26	2.75GB	Customer26
				C:\C\C26	13.4GB	Market26
				C:\D\D26	255.59GB	Backup26

		27	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A27	67GB	Broker27
				C:\B\B27	2.75GB	Customer27
				C:\C\C27	13.4GB	Market27
				C:\D\D27	255.59GB	Backup27
		28	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A28	67GB	Broker28
				C:\B\B28	2.75GB	Customer28
				C:\C\C28	13.4GB	Market28
				C:\D\D28	255.59GB	Backup28
		29	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A29	67GB	Broker29
				C:\B\B29	2.75GB	Customer29
				C:\C\C29	13.4GB	Market29
				C:\D\D29	255.59GB	Backup29
		30	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A30	67GB	Broker30
				C:\B\B30	2.75GB	Customer30
				C:\C\C30	13.4GB	Market30
				C:\D\D30	255.59GB	Backup30
		31	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A31	67GB	Broker31
				C:\B\B31	2.75GB	Customer31
				C:\C\C31	13.4GB	Market31
				C:\D\D31	255.59GB	Backup31
32	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A32	67GB	Broker32		
		C:\B\B32	2.75GB	Customer32		
		C:\C\C32	13.4GB	Market32		
		C:\D\D32	255.59GB	Backup32		
5	5	33	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A33	67GB	Broker33
				C:\B\B33	2.75GB	Customer33
				C:\C\C33	13.4GB	Market33
				C:\D\D33	255.59GB	Backup33
34	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A34	67GB	Broker34		
		C:\B\B34	2.75GB	Customer34		
		C:\C\C34	13.4GB	Market34		
		C:\D\D34	255.59GB	Backup34		
35	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A35	67GB	Broker35		
		C:\B\B35	2.75GB	Customer35		
		C:\C\C35	13.4GB	Market35		
		C:\D\D35	255.59GB	Backup35		
36	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A36	67GB	Broker36		
		C:\B\B36	2.75GB	Customer36		
		C:\C\C36	13.4GB	Market36		
		C:\D\D36	255.59GB	Backup36		

		37	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A37	67GB	Broker37
				C:\B\B37	2.75GB	Customer37
				C:\C\C37	13.4GB	Market37
				C:\D\D37	255.59GB	Backup37
		38	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A38	67GB	Broker38
				C:\B\B38	2.75GB	Customer38
				C:\C\C38	13.4GB	Market38
				C:\D\D38	255.59GB	Backup38
		39	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A39	67GB	Broker39
				C:\B\B39	2.75GB	Customer39
				C:\C\C39	13.4GB	Market39
				C:\D\D39	255.59GB	Backup39
		40	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A40	67GB	Broker40
				C:\B\B40	2.75GB	Customer40
				C:\C\C40	13.4GB	Market40
				C:\D\D40	255.59GB	Backup40
6	6	41	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A41	67GB	Broker41
				C:\B\B41	2.75GB	Customer41
				C:\C\C41	13.4GB	Market41
				C:\D\D41	255.59GB	Backup41
		42	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A42	67GB	Broker42
				C:\B\B42	2.75GB	Customer42
				C:\C\C42	13.4GB	Market42
				C:\D\D42	255.59GB	Backup42
		43	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A43	67GB	Broker43
				C:\B\B43	2.75GB	Customer43
				C:\C\C43	13.4GB	Market43
				C:\D\D43	255.59GB	Backup43
		44	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A44	67GB	Broker44
				C:\B\B44	2.75GB	Customer44
				C:\C\C44	13.4GB	Market44
				C:\D\D44	255.59GB	Backup44
7	7	45	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A45	67GB	Broker45
				C:\B\B45	2.75GB	Customer45
				C:\C\C45	13.4GB	Market45
				C:\D\D45	255.59GB	Backup45
		46	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A46	67GB	Broker46
				C:\B\B46	2.75GB	Customer46
				C:\C\C46	13.4GB	Market46
				C:\D\D46	255.59GB	Backup46

	47	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A47	67GB	Broker47
			C:\B\B47	2.75GB	Customer47
			C:\C\C47	13.4GB	Market47
			C:\D\D47	255.59GB	Backup47
	48	6x73GB,15K,2.5",SAS MD1120 RAID5	C:\A\A48	67GB	Broker48
			C:\B\B48	2.75GB	Customer48
			C:\C\C48	13.4GB	Market48
			C:\D\D48	255.59GB	Backup48

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'
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 BackupDev13 'C:\D\D13\TPCHbackup13'
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 BackupDev15 'C:\D\D15\TPCHbackup15'
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 BackupDev31 'C:\D\D31\TPCHbackup31'
 BackupDev32 'C:\D\D32\TPCHbackup32'
 BackupDev33 'C:\D\D33\TPCHbackup33'
 BackupDev34 'C:\D\D34\TPCHbackup34'
 BackupDev35 'C:\D\D35\TPCHbackup35'
 BackupDev36 'C:\D\D36\TPCHbackup36'

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 Microsoft 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 R905 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)

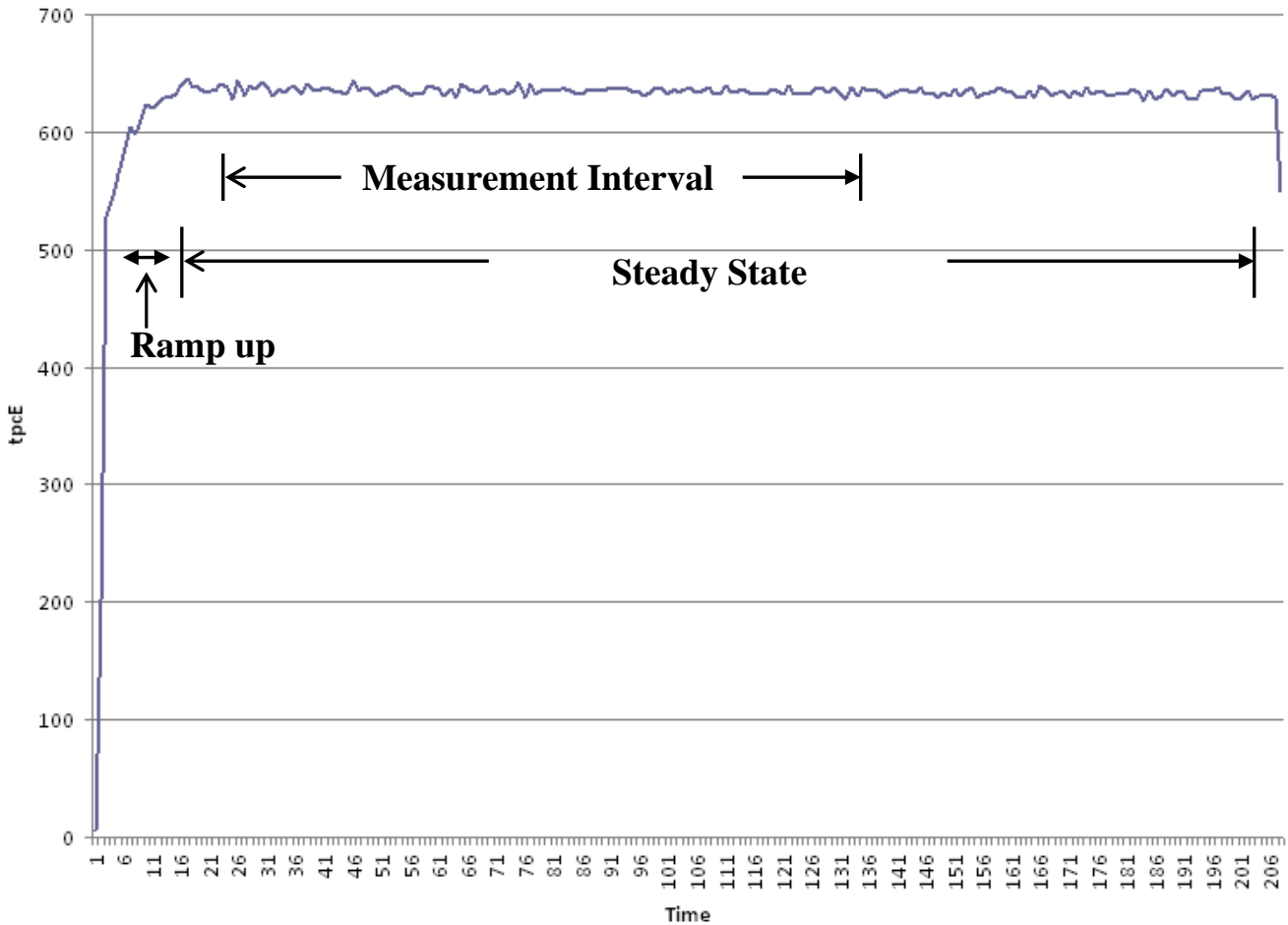
The measured tpsE was 635.43

6.2: Test Run times

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

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

Figure 3: Steady State graph



6.3: Steady State Measurement

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

It can be seen that after ramp-up a steady state was maintained through outt the measurement interval and until the run was stopped.

A 1 hour window sliding by 10 mins in steady state was evaluated and was found to vary by 0.45%. A 10 min window sliding by 1 min was found to vary by 1.04%.

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	50.01%	Ok	48.00%	52.00%
		Get history	50.02%	Ok	48.00%	52.00%
Trade Lookup	Ok	Frame 1	29.98%	Ok	28.50%	31.50%
		Frame 2	30.03%	Ok	28.50%	31.50%
		Frame 3	30.01%	Ok	28.50%	31.50%
		Frame 4	9.98%	Ok	9.50%	10.50%
Market Watch	Ok	By Watch List	60.04%	Ok	57.00%	63.00%

		By Customer Account	34.96%	Ok	33.00%	37.00%
		By Industry	5.00%	Ok	4.50%	5.50%
Trade Update	Ok	Frame 1	33.02%	Ok	31.00%	35.00%
		Frame 2	32.92%	Ok	31.00%	35.00%
		Frame 3	34.06%	Ok	32.00%	36.00%
Security Detail	Ok	Access LOB	1.00%	Ok	0.90%	1.10%
Trade Order	Ok	By Non-Owner	10.02%	Ok	9.50%	10.50%
		By Company Name	39.98%	Ok	38.00%	42.00%
		Buy on Margin	7.99%	Ok	7.50%	8.50%
		Rollback	0.99%	Ok	0.94%	1.04%
		LIFO	34.98%	Ok	33.00%	37.00%
		Trade Quantity 100	25.01%	Ok	24.00%	26.00%
		Trade Quantity 200	24.97%	Ok	24.00%	26.00%
		Trade Quantity 400	24.97%	Ok	24.00%	26.00%
		Trade Quantity 800	25.04%	Ok	24.00%	26.00%
		Market Buy	29.94%	Ok	29.70%	30.30%
		Market Sell	30.02%	Ok	29.70%	30.30%
		Limit buy	20.02%	Ok	19.80%	20.20%
		Limit sell	10.02%	Ok	9.90%	10.10%
		Stop Loss	10.00%	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 log and OS storage systems.

Redundancy level 5 was used for 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)

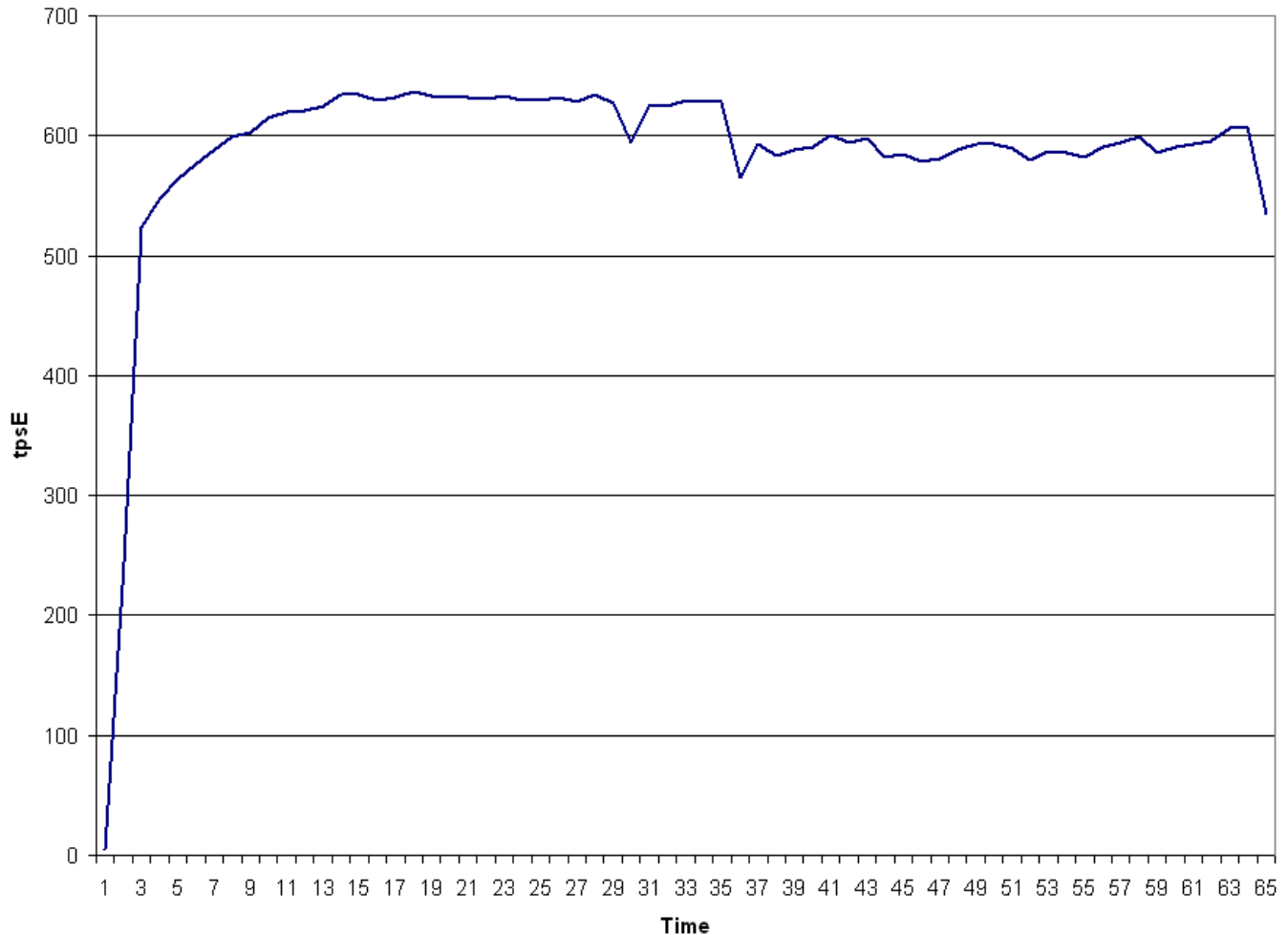
1. A restore was executed to yield a fresh database.
2. The rows in the Settlement table were counted to determine the initial count of completed trades present in the database (count-before).
3. A performance run was started with the same number of configured customers and driver load used for the measurement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

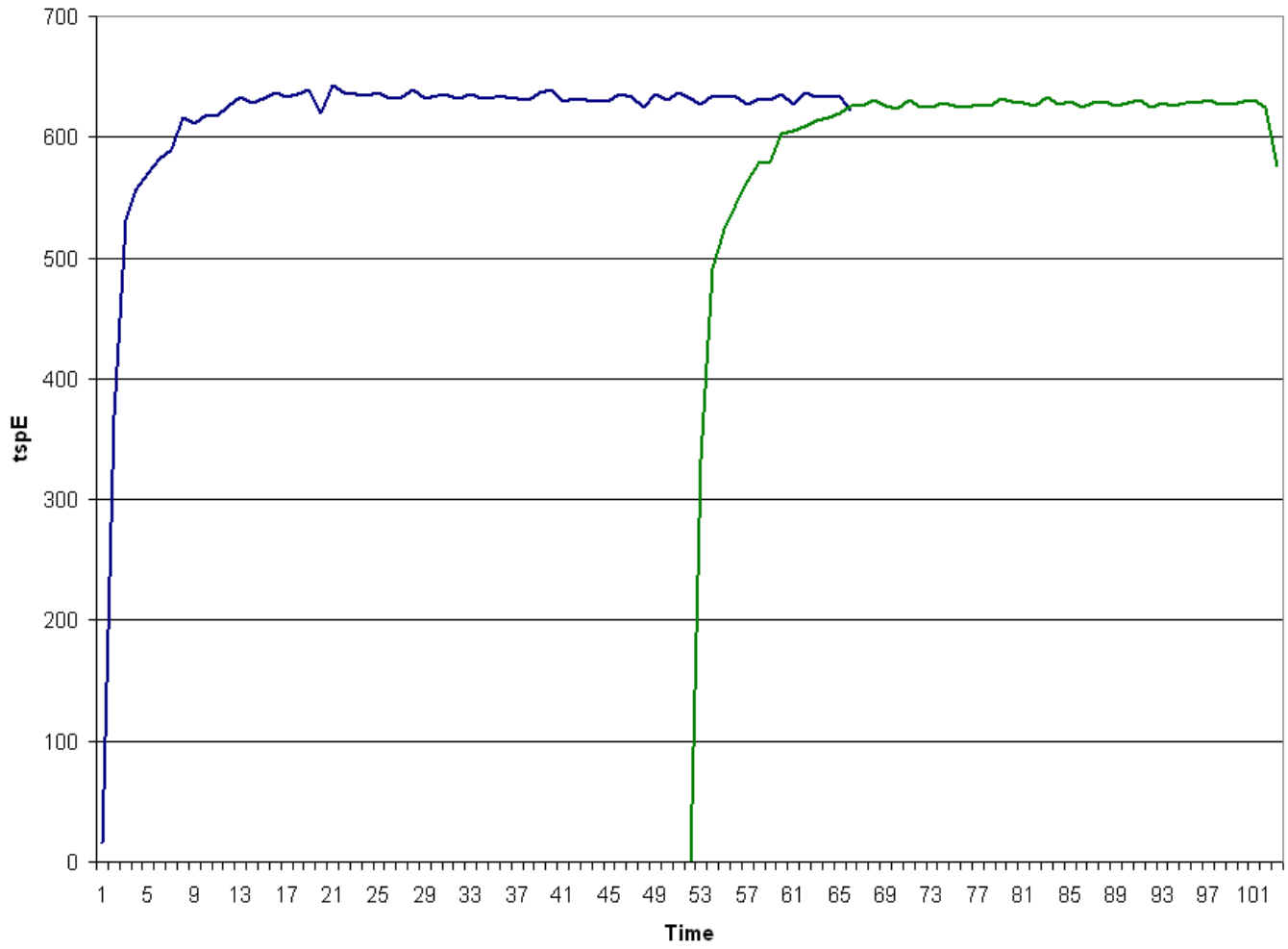
7.6: Business Recovery Time

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 52mins 26s. This is also recorded in the Executive Summary.

Figure 5: Business Recovery Tests Graph



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:



February 18, 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 R905
Database Manager: Microsoft SQL Server 2008 Enterprise x64 Edition
Operating System: Microsoft Windows Sever 2008 Enterprise x64 Edition

Server (Tier B): R905			
CPU's	Memory	Disks (total)	TpsE
4 AMD quad core @ 2.7 Ghz	64 GB	296 @ 73 GB	635.43
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 320,000 customers.
- The transaction components were properly implemented.
- The required network between the driver and the transaction harness was configured.
- The ACID properties were successfully demonstrated.
- The database was verified to have no Trade-Request rows prior to the start of the test run.
- The test run met all the requirements for timing, mix, and response times.
- Input data was generated according to the specified percentages.
- One and only one Data-Maintenance process was running during the test run.
- There were no inactive load units during the test run.
- Eight hours of mirrored log space was present on the measured system.
- Eight hours of growth space was present on the measured system.
- The data for the 60 day space calculation was verified.
- There were 1008 user contexts present on the system.
- The steady state portion of the test was 120 minutes.
- One checkpoint was taken after steady state and before the measured interval.
- Checkpoint interval was verified to be equal to or less than 7.5 minutes.
- The system pricing was checked for major components and maintenance.
- Third party quotes were verified for compliance.
- The FDR was reviewed and verified as required.

Auditor Notes:

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,

A handwritten signature in cursive script that reads "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)

February 10, 2009

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
810-07507	SQL Server 2008 Enterprise x64 Edition <i>Per Processor License</i> <i>Discount Schedule: Open Program - Level C</i> <i>Unit Price reflects a 6% discount from the retail unit price of \$24,999.</i>	\$23,432	4	\$93,728
P73-04165	Windows Server 2008 Standard Edition (x64) <i>Server License with 5 CALs</i> <i>Discount Schedule: Open Program - Level C</i> <i>Unit Price reflects a 29% discount from the retail unit price of \$999.</i>	\$711	2	\$1,422
P72-03168	Windows Server 2008 Enterprise Edition (x64) <i>Server License with 25 CALs</i> <i>Discount Schedule: Open Program - Level C</i> <i>Unit Price reflects a 42% discount from the retail unit price of \$3,999.</i>	\$2,310	1	\$2,310
N/A	Microsoft Problem Resolution Services <i>Professional Support</i> <i>(1 Incident)</i>	\$245	1	\$245

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

All products listed above are currently orderable and available.

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

This quote is valid for the next 90 days.

Reference ID: PEgepu0902100000000927.