

**TPC Benchmark™ E  
Full Disclosure Report  
DELL PowerEdge R910  
Using  
Microsoft SQL Server 2008 R2 Enterprise Edition x64  
On  
Microsoft Windows Server 2008 R2 Enterprise x64**



**Third Edition**

**Submitted for Review**

**October 25, 2010**

# **Dell, Inc. PowerEdge R910 Server with Microsoft SQL Server 2008 R2 Enterprise Edition x64 on Microsoft Windows Server 2008 R2 Enterprise x64**

## **Third Printing October 2010**

All rights reserved. Permission is hereby granted to reproduce this document in whole or in part provided the copyright notice is included on the title page of each item reproduced.

Printed in U.S.A.

Dell believes that the technical, pricing and discounting information in this document is accurate as of its publication date. The performance information in this document is for guidance only. System performance is highly dependent on many factors including system hardware, system and user software, and user-application characteristics. Customer applications must be carefully evaluated before estimating performance. DELL does not warrant or represent that a user can or will achieve similar performance as expressed in this document.

THE TERMS AND CONDITIONS GOVERNING THE SALE OF DELL HARDWARE PRODUCTS AND THE LICENSING OF DELL SOFTWARE CONSIST SOLELY OF THOSE SET FORTH IN THE WRITTEN CONTRACTS BETWEEN DELL AND ITS CUSTOMERS. NO REPRESENTATION OR OTHER AFFIRMATION OF FACT CONTAINED IN THIS DOCUMENT INCLUDING BUT NOT LIMITED TO STATEMENTS REGARDING PRICE, CAPACITY, RESPONSE-TIME PERFORMANCE, SUITABILITY FOR USE, OR PERFORMANCE OF PRODUCTS DESCRIBED HEREIN SHALL BE DEEMED TO BE A WARRANTY BY DELL FOR ANY PURPOSE, OR GIVE RISES TO ANY LIABILITY OF DELL WHATSOEVER.

Dell assumes no responsibility for any errors that may appear in this document. Dell reserves the right to make changes in specifications and other information contained in this document without prior notice, and the reader should in all cases consult Dell to determine whether any such changes have been made.

PowerEdge is a U.S. registered trademark of Dell, Inc.

Microsoft, Windows 2008 and SQL Server are registered trademarks of Microsoft Corporation

Intel and Xeon are registered trademarks of Intel Corporation.

TPC Benchmark E is a trademark of the Transaction Processing Performance Council.

# Abstract

This report documents the methodology and results of the TPC Benchmark E test conducted on a PowerEdge R910 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 1.9.0 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 R910	Microsoft Windows 2008 R2 Enterprise Ed. x64 SQL Server 2008 R2 Enterprise Ed. x64	\$575,235	1933.96	\$297.44	May 6, 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 Administrator, TPC  
Presidio of San Francisco  
Bldg 572B Rucker St.  
San Francisco, CA 94129-0920  
Phone: (415) 561-6272, fax 415-561 6120  
[www.tpc.org](http://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™ R910 Server

**TPC-E 1.9.0  
TPC Pricing 1.5**

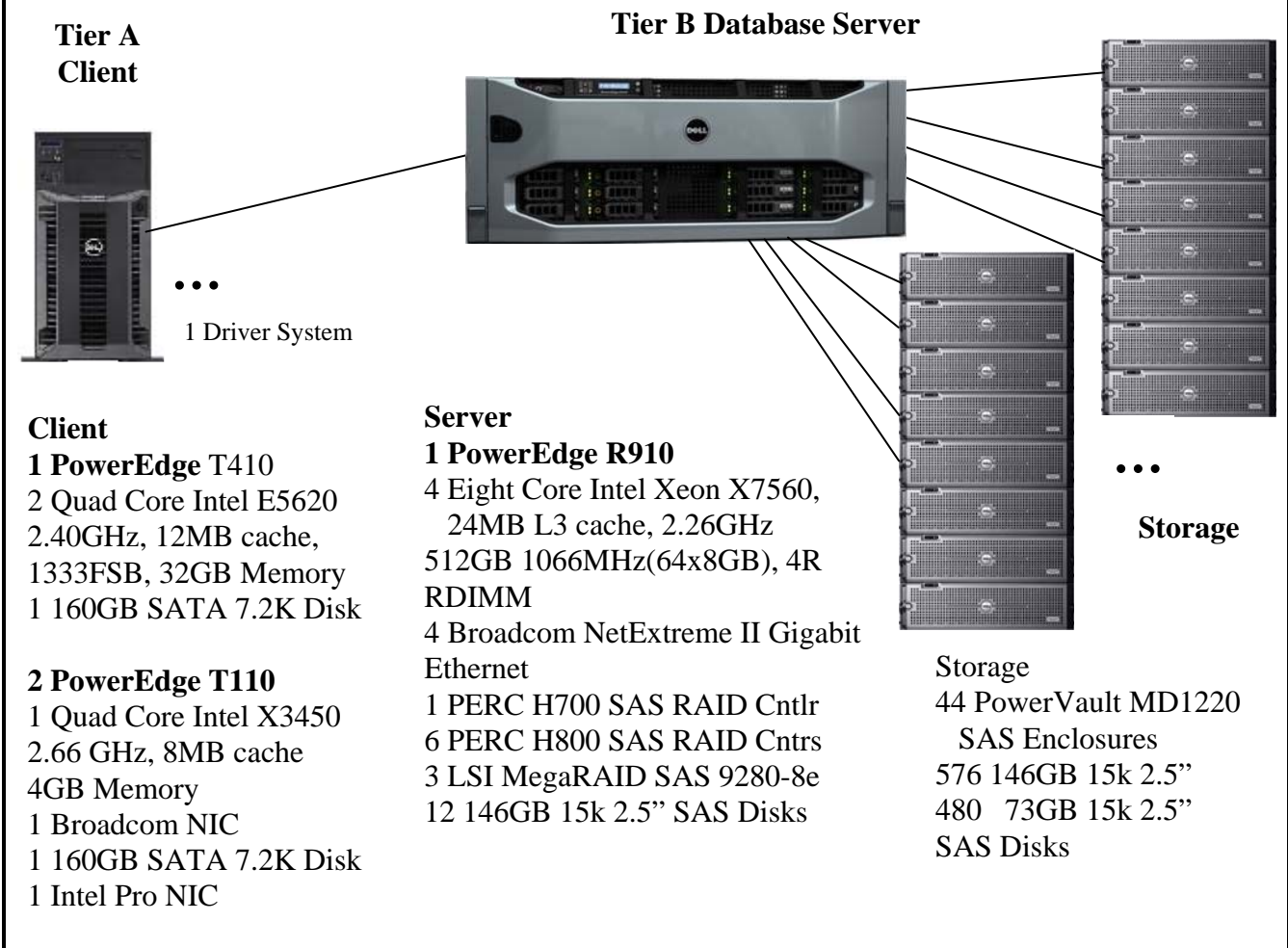
Report Date:  
April 11, 2010

Revision Date:  
October 25, 2010

TPC-E Throughput	Price/Performance	Availability Date	Total System Cost
<b>1933.96 tpsE</b>	<b>297.44USD per tpsE</b>	<b>May 6, 2010</b>	<b>\$575,235 USD</b>

## Database Server Configuration

Operating System	Database Manager	Processors/Cores/ Threads	Memory
<b>Microsoft Windows Server 2008 R2 Enterprise x64 Edition™</b>	<b>SQL Server 2008 R2 Enterprise x64 Edition™</b>	<b>4/32/64</b>	<b>512GB</b>



Initial Database Size <b>8,309.15GB</b>	Redundancy Level: 1 <b>RAID10 Log Data</b>	Storage <b>12 x 146GB, 576 x 146GB, 480 x 73GB</b>
--	---	---



## PowerEdge R910

### TPC-E 1.9.0 TPC Pricing 1.5

Report Date  
April 11, 2010  
Revision Date  
October 25, 2010  
Availability Date  
May 6, 2010

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3 yr. Maint. Price
<b>Server Hardware</b>						
R910 Chassis for up to Sixteen 2.5" HDs	244-8696	1	\$2,954.00	1	\$2,954.00	\$1,119.00
Dual 2-port Embedded Broadcom 5709 Gigabit NIC	330-7444	1	299.00	1	\$299.00	
2xIntel Xeon X7560 2.26GHz, 24M cache, 6.40 GT/s QPI	317-3280	1	\$8,999.00	1	\$8,999.00	
Upgrade to Four Intel Xeon X7560 2.26GHz, 8C	317-3286	1	\$8,999.00	1	\$8,999.00	
HO Pwr Sply,Non-Redundant,1100W UPG	330-7496	1	\$598.00	1	\$598.00	
Memory Riser for PE R910, Qty 8	330-6786	1	\$1,596.00	1	\$1,596.00	
512GB Memory (64x8GB), 1066MHz, Quad Ranked	317-3321	1	\$24,130.00	1	\$24,130.00	
R910 Add-in Card with 4x Low Profile PCIe	330-6790	1	\$49.00	1	\$49.00	
PERC H700 Integrated RAID Controller, 512MB Cache	342-0371	1	\$499.00	1	\$499.00	
PERC H800 RAID Adapter for External JBOD, 512MB	341-5842	1	\$649.00	6	\$3,894.00	
MegaRAID SAS 9280-8e External RAID Adapter	A3578859	1	\$720.99	3	\$2,162.97	
146GB,SAS,2.5-inch,15K RPM HD	342-0427	1	\$439.00	12	\$5,268.00	
DELL E170S,Standard, 17in VIS	320-5090	1	\$177.00	1	\$177.00	
				<b>Subtotal</b>	<b>\$59,624.97</b>	<b>\$1,119.00</b>
<b>Server Storage</b>						
PV MD1220,RACK,2U,24 BAY,LBZL	224-7093	1	\$2,794.00	24	\$67,056.00	
PV MD1220,RACK,2U,24 BAY,LBZL	224-7093	1s	\$2,794.00	20	\$55,880.00	
PV MD1220,RACK,2U,24 BAY,LBZL (10% Spares)	224-7093	1s	\$2,794.00	5		\$13,970.00
Enclosure Management Modules, PowerVault MD1220	330-6058	1	\$0.00	24	\$0.00	
Enclosure Management Modules, PowerVault MD1220	330-6058	1s	\$0.00	20	\$0.00	
73GB,SAS,2.5-inch,15K RPM HD	341-9888	1s	\$329.00	480	\$157,920.00	
73GB,SAS,2.5-inch,15K RPM HD (10% Spares)	341-9888	1s	\$329.00	48		\$15,792.00
146GB,SAS,2.5-inch,15K RPM HD	341-9889	1	\$439.00	576	\$252,864.00	
146GB,SAS,2.5-inch,15K RPM HD (10% spares)	341-9889	1s	\$439.00	58		\$25,462.00
RACK-42U, CUST	340-4896	1	\$239.99	2	\$479.98	
				<b>Subtotal</b>	<b>\$534,199.98</b>	<b>\$55,224.00</b>
<b>Server Software</b>						
SQL Server 2008 Enterprise x64 Edition **	N/A	2	\$19,188.00	4	\$76,752.00	
Windows Server 2008 Enterprise Edition (x64) **	P72-04217	2	\$2,280.00	1	\$2,280.00	
Professional Support (1 Incident)	N/A		\$259.00	1		\$259.00
				<b>Subtotal</b>	<b>\$79,032.00</b>	<b>\$259.00</b>
<b>Client Hardware</b>						
Dell PowerEdge T410 w/ Intel E5620 Quad core, 1066 FSB	224-8663	1s	\$321.00	1	\$321.00	\$708.00
Intel Xeon E5620 2.4GHz, 12M Cache, Turbo, HT	317-4112	1s	\$579.00	1	\$579.00	
Intel Xeon E5620 2.4GHz, 12M Cache, Turbo, HT	317-4124	1s	\$579.00	1	\$579.00	
32GB,1333MHz,(8X4GB),2R,RDIMMS	317-2564	1s	\$1,690.00	1	\$1,690.00	
160G 7K SATA2,3G,3.5,HP	341-6084	1s	\$99.00	1	\$99.00	
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	\$419.00	2	\$838.00	
4GB,1033MHz,(2X2GB),2R,UDIMM	317-2034	1	\$158.00	2	\$316.00	
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	
				<b>Subtotal</b>	<b>\$5,234.00</b>	<b>\$1,692.00</b>
<b>Client Software</b>						
Windows Server 2008 Standard Edition (x64) **	P73-04980	2	\$711.00	3	\$2,133.00	
				<b>Subtotal</b>	<b>\$2,133.00</b>	<b>\$0.00</b>
<b>Infrastructure</b>						
1M SAS Cable, MDXX00	310-6061	1	\$30.00	44	\$1,320.00	
				<b>Subtotal</b>	<b>\$1,320.00</b>	<b>\$0.00</b>
				<b>Other Discounts*</b>	<b>(\$150,094.74)</b>	<b>(\$14,508.75)</b>
				<b>Total</b>	<b>\$531,449.21</b>	<b>\$43,785.25</b>
<b>Notes:</b>						
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.				<b>Three-Year Cost of Ownership:</b>	<b>\$575,235</b>	<b>USD</b>
** All Microsoft maintenance is covered by the maint. costs of Microsoft SQL Server				<b>TPC-E Throughput:</b>	<b>1,933.96</b>	<b>tpsE</b>
Price Source: 1=Dell, 2=Microsoft, NIO = Not Immediately Orderable				<b>Price/Performance:</b>	<b>\$297.44</b>	<b>tpsE/USD</b>
Pricing may be verified by calling 1-800-BUY-DELL and referencing quote # 536775819 as a complex quote.						
<b>Audited by Lorna Livingtree, Performance Metrics Inc.</b>						
<i>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.</i>						

Numerical Quantities Summary				
<b>Reported Throughput: 1933.96 tpsE</b>		<b>Configured Customers: 1,025,000</b>		
<b>Response Times (in seconds)</b>	<b>Minimum</b>	<b>Average</b>	<b>90<sup>th</sup>%tile</b>	<b>Maximum</b>
Broker-Volume	0.01	0.06	0.10	4.36
Customer-Position	0.00	0.04	0.07	3.62
Market-Feed	0.00	0.04	0.07	44.18
Market-Watch	0.00	0.04	0.08	3.93
Security-Detail	0.00	0.02	0.04	2.87
Trade-Lookup	0.00	0.52	0.71	3.07
Trade-Order	0.00	0.09	0.15	10.02
Trade-Result	0.00	0.11	0.18	6.40
Trade-Status	0.00	0.03	0.05	2.16
Trade-Update	0.01	0.58	0.73	12.41
Data-Maintenance	0.01	0.09		0.58
<b>Transaction Mix</b>		<b>Transaction Count</b>		<b>Mix %</b>
Broker-Volume		6,823,240		4.900%
Customer-Position		18,103,398		13.000%
Market-Feed		1,392,471		1.000%
Market-Watch		25,065,856		18.000%
Security-Detail		19,495,843		14.000%
Trade-Lookup		11,139,302		7.999%
Trade-Order		14,065,000		10.100%
Trade-Result		13,924,541		9.999%
Trade-Status		26,458,366		19.000%
Trade-Update		2,784,755		2.000%
Data-Maintenance		120		
<b>Test Duration and Timings</b>				
Ramp-up Time (hh:mm:ss)			00:18:19	
Measurement Interval (hh:mm:ss)			02:00:00	
Business Recovery Time (hh:mm:ss)			09:43:09	
Total number of Transactions Completed in Measurement Interval			139,252,772	

# Table of Contents

- Abstract** ..... iii
- Auditor** ..... iii
- Table of Contents** ..... vii
- Figures**..... 1
- Tables** ..... 2
- Introduction**..... 3
  - Document Structure ..... 3
  - Benchmark Overview ..... 3
- Clause 1: General Items** ..... 4
  - 1.1: Order and Titles..... 4
  - 1.2: Executive Summary Statement ..... 4
  - 1.3: Test Sponsor ..... 4
  - 1.4: Configuration Diagram ..... 4
  - 1.5: Hardware configuration ..... 7
  - 1.6: Software Configuration ..... 7
- Clause 2: Database Design Scaling and Population** ..... 9
  - 2.1: Physical Database Organization ..... 9
  - 2.2: Table and Row Partitioning ..... 9
  - 2.3: Replications, Duplications and Additions..... 9
  - 2.4: Initial Cardinality of Tables ..... 10
  - 2.5: Disk Configuration Data ..... 11
  - 2.6: Database Interface ..... 21
- Clause 3: Transaction Items** ..... 22
  - 3.1: Code Functionality..... 22
  - 3.2: Database Requirements..... 22
- Clause 4: SUT, Driver and Network**..... 23
  - 4.1: EGenDriver Items..... 23
  - 4.2: Network Configuration..... 23
- Clause 5: EGen Items** ..... 24
  - 5.1: EGen Version ..... 24
  - 5.2: EGen Code ..... 24

5.3: EGen Modifications .....	24
5.4: EGen Loader Extension Code.....	24
<b>Clause 6: Performance Metrics and Response time .....</b>	<b>25</b>
6.1: Measured Throughput (tpsE) .....	25
6.2: Test Run times .....	25
6.3: Steady State Measurement.....	26
6.4: Work Measurements during Test Run.....	26
6.5: Transaction Averages .....	26
<b>Clause 7: Transaction and System Properties.....</b>	<b>28</b>
7.1 : Transaction Properties (ACID) .....	28
7.2: Redundancy Level.....	28
7.3: Data Accessibility Tests .....	28
7.4: Data Accessibility Test Graph .....	29
7.5: Business Recovery Tests.....	29
7.6: Business Recovery Time.....	30
<b>Clause 8: Pricing .....</b>	<b>31</b>
8.1: 60-day space.....	32
8.2: Attestation Letter .....	32
<b>Clause 9: Supporting Files .....</b>	<b>36</b>
9.1: Supporting Files .....	36
<b>APPENDIX A: Third Party Price Quotations .....</b>	<b>36</b>



# Figures

---

- Figure 1: Measured Configuration..... 5
- Figure 2: Priced Configuration ..... 6
- Figure 3: Steady State graph..... 25
- Figure 4: Data Accessibility Graph ..... 29
- Figure 5: Business Recovery Tests Graph..... 31

# Tables

---

Table 1: Difference between priced and measured configuration .....	4
Table 2: Physical database organization .....	9
Table 3: Table Cardinality .....	10
Table 4: Disk Configuration .....	11
Table 5: Transaction Averages .....	26
Table 6: Space Requirements .....	32

# 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 R910 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

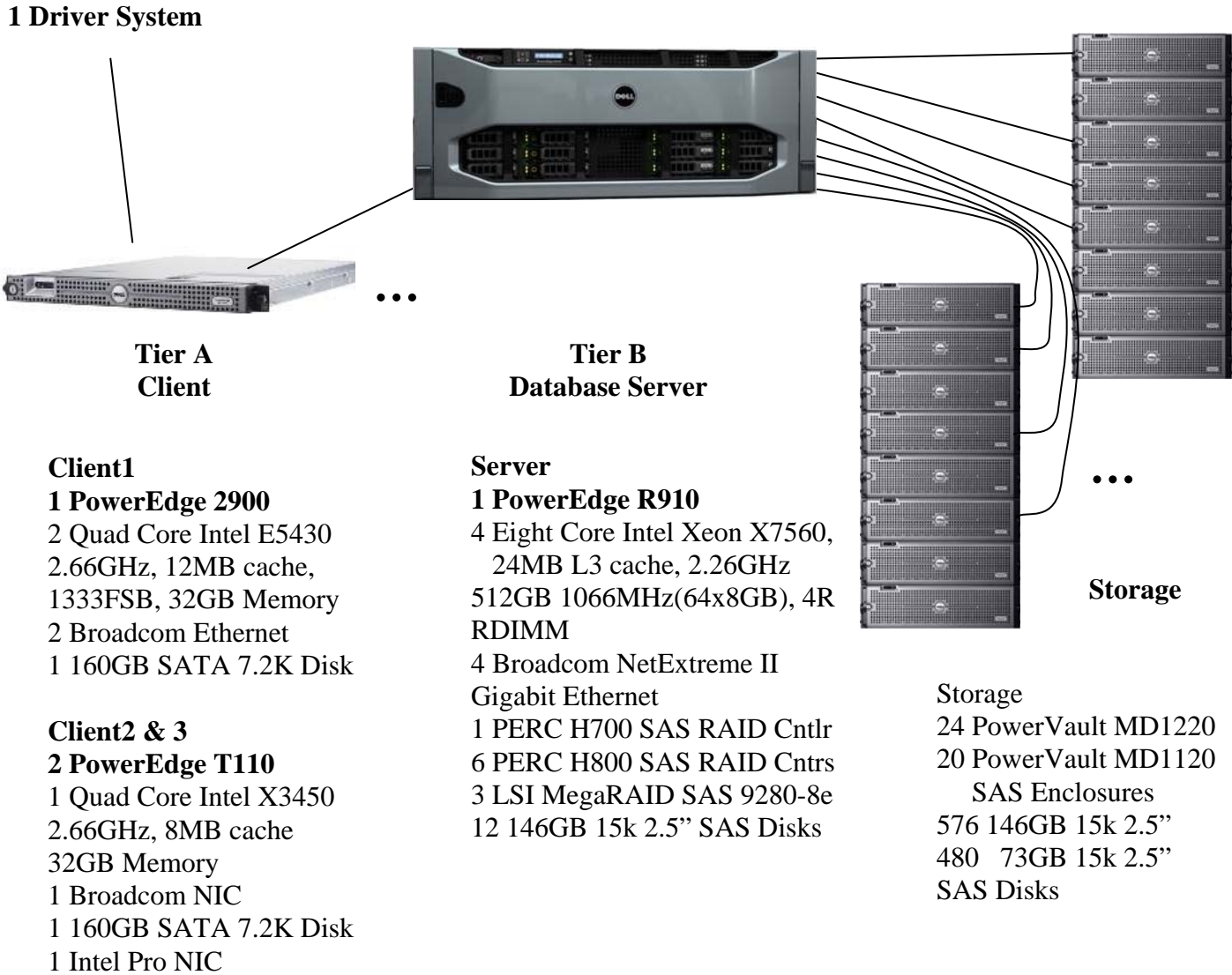
**Table 1: Difference between priced and measured configuration**

	<b>Priced</b>	<b>Measured</b>	
N/A	N/A	N/A	N/A

# Measured Configuration

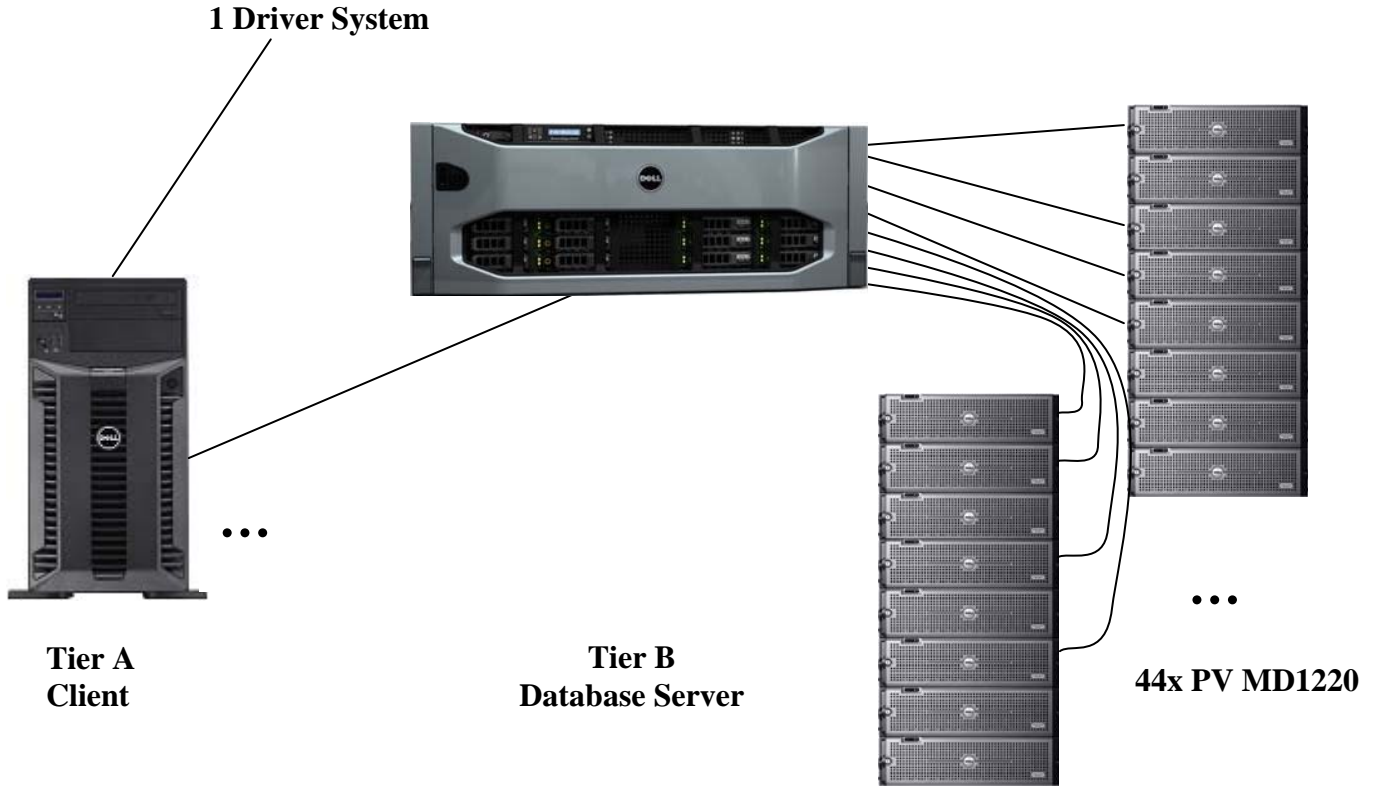
The measured and priced configurations are identical.

**Figure 1: Measured Configuration**



# Priced Configuration

Figure 2: Priced Configuration



**Client1**  
**1 PowerEdge T410**  
 2 Quad Core Intel E5620  
 2.40GHz, 12MB cache,  
 1333FSB, 32GB Memory  
 1 Broadcom Ethernet  
 1 160GB SATA 7.2K Disk

**Client2 & 3**  
**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 R910**  
 4 Eight Core Intel Xeon X7560  
 24MB L3 cache, 2.26GHz  
 512GB 1066MHz(64x8GB), 4R  
 RDIMM  
 4 Broadcom NetExtreme II  
 Gigabit Ethernet  
 1 PERC H700 SAS RAID Cntrlr  
 6 PERC H800 SAS RAID Cntrs  
 3 LSI MegaRAID SAS 9280-8e  
 12 146GB 15k 2.5" SAS Disks

**Storage**  
 Storage  
 44 PowerVault MD1220  
 SAS Enclosures  
 576 146GB 15k 2.5"  
 480 73GB 15k 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 R910\_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 R910 server (tier B) driven by 3 Dell PowerEdge (tierA) clients. The clients and server are networked together via cat5e networking cables. One Dell PowerEdge T710 server was the driver system that emulated 1632 users executing the standard TPC-E workload. The driver system is connected to the client via cat5e networking cables. 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 R910 uses the Intel 7500 chipset and can hold up to 4 - eight core Intel Xeon X7560 processors (2.26 GHz with 24MB L3 cache each). The system was configured with 10 PCI-e I/O slots. The measured configuration used 512GB of 1066MH, 4R RDIMM, which was achieved by using 64 8192Mbyte DIMMs.

The PowerEdge R910 has an internal PERC H700 SAS controller to which was attached 12 - 146GB disk drives containing the operating system and database logs. In addition, 6 PERC H800 SAS RAID controllers and 3 LSI MegaRAID SAS 9280-8e controllers were installed in 9 PCI-e slots and connected to 24 MD 1220 disk pods and 20 MD 1120 disk pods, which can hold 24 disks each. Each of the 9 controllers managed 8 to 12 RAID 10 LUNs. Each LUN had 12 physical drives. The total number of physical drives used for the database was 1068 SAS disks. There was one empty PCI-e slots. Hyperthreading was enabled on this server.

The T410 client server has two Intel Quad-core Xeon processor with 12MB of L2 cache and a FSB rated at 1333MHz. The system had 32 Gbytes of RAM, one 160 GB hard disk, and 1 intergrated ethernet ports.

The PE T110 client server has one Intel Quad-core Xeon processor with 8MB of Smart Cache and a FSB rated at 1333MHz. The system had 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 cat5e network cables. 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	CASH_TRANSACTION	ACCOUNT_PERMISSION
COMMISSION_RATE	HOLDING	ADDRESS
EXCHANGE	HOLDING_HISTORY	BROKER
INDUSTRY	HOLDING_SUMMARY	COMPANY
SECTOR	SETTLEMENT	COMPANY_COMPETITOR
STATUS_TYPE	TRADE	CUSTOMER
TAXRATE	TRADE_HISTORY	CUSTOMER_ACCOUNT
TRADE_TYPE	TRADE_REQUEST	CUSTOMER_TAXRATE
ZIP_CODE		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 1,025,000 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	7277539
Address	1537504
Broker	10250
Cash_Transaction	16294994199
Charge	15
Commission_Rate	240
Company	512500
Company_Competitor	1537500
Customer	1025000
Customer_Account	5125000
Customer_Taxrate	2050000
Daily_Market	916273125
Exchange	4
Financial	10250000
Holding	906842419
Holding_History	23737047918
Holding_Summary	50974251
Industry	102
Last_Trade	702125
News_Item	1025000
News_Xref	1025000
Sector	12
Security	702125
Settlement	17712000000
Status_Type	5
Taxrate	320
Trade	17712000000
Trade_History	42508800690
Trade_Request	0
Trade_Type	5
Watch_Item	102484524
Watch_List	1025000
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	24	12x146GB,15K,SAS Onboard RAID10	C:\	40GB	OS
			12x146GB,15K,SAS Onboard RAID10	E:\	776.75GB	Logs
1	1	0	12x73GB,15K,SAS MD1220	C:\A\A49	1MB	Fixed_49
				C:\B\B49	3.5GB	Scaling_49
			RAID10	C:\C\C49	119GB	Growing_49
				C:\D\D49	284.56GB	Backup_49
		1	12x73GB,15K,SAS MD1220	C:\A\A50	1MB	Fixed_50
				C:\B\B50	3.5GB	Scaling_50
			RAID10	C:\C\C50	119GB	Growing_50
				C:\D\D50	284.56GB	Backup_50
		2	12x73GB,15K,SAS MD1220	C:\A\A51	1MB	Fixed_51
				C:\B\B51	3.5GB	Scaling_51
			RAID10	C:\C\C51	119GB	Growing_51
				C:\D\D51	284.56GB	Backup_51
		3	12x73GB,15K,SAS MD1220	C:\A\A52	1MB	Fixed_52
				C:\B\B52	3.5GB	Scaling_52
			RAID10	C:\C\C52	119GB	Growing_52
				C:\D\D52	284.56GB	Backup_52
		4	12x73GB,15K,SAS MD1220	C:\A\A53	1MB	Fixed_53
				C:\B\B53	3.5GB	Scaling_53
			RAID10	C:\C\C53	119GB	Growing_53
				C:\D\D53	284.56GB	Backup_53
5	12x73GB,15K,SAS MD1220	C:\A\A54	1MB	Fixed_54		
		C:\B\B54	3.5GB	Scaling_54		
	RAID10	C:\C\C54	119GB	Growing_54		

2

2

		4		4
		C:\D\D5 4	284.56G B	Backup_54
6	12x73GB,15K,SAS	C:\A\A55	1MB	Fixed_55
	MD1220	C:\B\B55	3.5GB	Scaling_55
	RAID10	C:\C\C5 5	119GB	Growing_5 5
		C:\D\D5 5	284.56G B	Backup_55
7	12x73GB,15K,SAS	C:\A\A56	1MB	Fixed_56
	MD1220	C:\B\B56	3.5GB	Scaling_56
	RAID10	C:\C\C5 6	119GB	Growing_5 6
		C:\D\D5 6	284.56G B	Backup_56
8	12x73GB,15K,SAS	C:\A\A57	1MB	Fixed_57
	MD1220	C:\B\B57	3.5GB	Scaling_57
	RAID10	C:\C\C5 7	119GB	Growing_5 7
		C:\D\D5 7	284.56G B	Backup_57
9	12x73GB,15K,SAS	C:\A\A58	1MB	Fixed_58
	MD1220	C:\B\B58	3.5GB	Scaling_58
	RAID10	C:\C\C5 8	119GB	Growing_5 8
		C:\D\D5 8	284.56G B	Backup_58
10	12x73GB,15K,SAS	C:\A\A59	1MB	Fixed_59
	MD1220	C:\B\B59	3.5GB	Scaling_59
	RAID10	C:\C\C5 9	119GB	Growing_5 9
		C:\D\D5 9	284.56G B	Backup_59
11	12x73GB,15K,SAS	C:\A\A60	1MB	Fixed_60
	MD1220	C:\B\B60	3.5GB	Scaling_60
	RAID10	C:\C\C6 0	119GB	Growing_6 0
		C:\D\D6 0	284.56G B	Backup_60
12	12x73GB,15K,SAS	C:\A\A61	1MB	Fixed_61
	MD1220	C:\B\B61	3.5GB	Scaling_61
	RAID10	C:\C\C6 1	119GB	Growing_6 1
		C:\D\D6 1	284.56G B	Backup_61
13	12x73GB,15K,SAS	C:\A\A62	1MB	Fixed_62
	MD1220	C:\B\B62	3.5GB	Scaling_62
	RAID10	C:\C\C6 2	119GB	Growing_6 2
		C:\D\D6 2	284.56G B	Backup_62
14	12x73GB,15K,SAS	C:\A\A63	1MB	Fixed_63
	MD1220	C:\B\B63	3.5GB	Scaling_63
	RAID10	C:\C\C6 3	119GB	Growing_6 3
		C:\D\D6	284.56G	Backup_63

3

3

		3	B	
15	12x73GB,15K,SAS	C:\A\A64	1MB	Fixed_64
	MD1220	C:\B\B64	3.5GB	Scaling_64
	RAID10	C:\C\C6 4	119GB	Growing_6 4
		C:\D\D6 4	284.56G B	Backup_64
16	12x73GB,15K,SAS	C:\A\A65	1MB	Fixed_65
	MD1220	C:\B\B65	3.5GB	Scaling_65
	RAID10	C:\C\C6 5	119GB	Growing_6 5
		C:\D\D6 5	284.56G B	Backup_65
17	12x73GB,15K,SAS	C:\A\A66	1MB	Fixed_66
	MD1220	C:\B\B66	3.5GB	Scaling_66
	RAID10	C:\C\C6 6	119GB	Growing_6 6
		C:\D\D6 6	284.56G B	Backup_66
18	12x73GB,15K,SAS	C:\A\A67	1MB	Fixed_67
	MD1220	C:\B\B67	3.5GB	Scaling_67
	RAID10	C:\C\C6 7	119GB	Growing_6 7
		C:\D\D6 7	284.56G B	Backup_67
19	12x73GB,15K,SAS	C:\A\A68	1MB	Fixed_68
	MD1220	C:\B\B68	3.5GB	Scaling_68
	RAID10	C:\C\C6 8	119GB	Growing_6 8
		C:\D\D6 8	284.56G B	Backup_68
20	12x73GB,15K,SAS	C:\A\A69	1MB	Fixed_69
	MD1220	C:\B\B69	3.5GB	Scaling_69
	RAID10	C:\C\C6 9	119GB	Growing_6 9
		C:\D\D6 9	284.56G B	Backup_69
21	12x73GB,15K,SAS	C:\A\A70	1MB	Fixed_70
	MD1220	C:\B\B70	3.5GB	Scaling_70
	RAID10	C:\C\C7 0	119GB	Growing_7 0
		C:\D\D7 0	284.56G B	Backup_70
22	12x73GB,15K,SAS	C:\A\A71	1MB	Fixed_71
	MD1220	C:\B\B71	3.5GB	Scaling_71
	RAID10	C:\C\C7 1	119GB	Growing_7 1
		C:\D\D7 1	284.56G B	Backup_71
23	12x73GB,15K,SAS	C:\A\A72	1MB	Fixed_72
	MD1220	C:\B\B72	3.5GB	Scaling_72
	RAID10	C:\C\C7 2	119GB	Growing_7 2
25	12x146GB,15K,SAS	C:\A\A1	1MB	Fixed_1
	MD1220	C:\B\B1	3.5GB	Scaling_1
	RAID10	C:\C\C1	132.5GB	Growing_1

4

4

		C:\D\D1	680.74G B	Backup_1
26	12x146GB,15K,SAS	C:\A\A2	1MB	Fixed_2
	MD1220	C:\B\B2	3.5GB	Scaling_2
	RAID10	C:\C\C2	132.5GB	Growing_2
		C:\D\D2	680.74G B	Backup_2
27	12x146GB,15K,SAS	C:\A\A3	1MB	Fixed_3
	MD1220	C:\B\B3	3.5GB	Scaling_3
	RAID10	C:\C\C3	132.5GB	Growing_3
		C:\D\D3	680.74G B	Backup_3
28	12x146GB,15K,SAS	C:\A\A4	1MB	Fixed_4
	MD1220	C:\B\B4	3.5GB	Scaling_4
	RAID10	C:\C\C4	132.5GB	Growing_4
		C:\D\D4	680.74G B	Backup_4
29	12x146GB,15K,SAS	C:\A\A5	1MB	Fixed_5
	MD1220	C:\B\B5	3.5GB	Scaling_5
	RAID10	C:\C\C5	132.5GB	Growing_5
		C:\D\D5	680.74G B	Backup_5
30	12x146GB,15K,SAS	C:\A\A6	1MB	Fixed_6
	MD1220	C:\B\B6	3.5GB	Scaling_6
	RAID10	C:\C\C6	132.5GB	Growing_6
		C:\D\D6	680.74G B	Backup_6
31	12x146GB,15K,SAS	C:\A\A7	1MB	Fixed_7
	MD1220	C:\B\B7	3.5GB	Scaling_7
	RAID10	C:\C\C7	132.5GB	Growing_7
		C:\D\D7	680.74G B	Backup_7
32	12x146GB,15K,SAS	C:\A\A8	1MB	Fixed_8
	MD1220	C:\B\B8	3.5GB	Scaling_8
	RAID10	C:\C\C8	132.5GB	Growing_8
		C:\D\D8	680.74G B	Backup_8
33	12x146GB,15K,SAS	C:\A\A9	1MB	Fixed_9
	MD1220	C:\B\B9	3.5GB	Scaling_9
	RAID10	C:\C\C9	132.5GB	Growing_9
		C:\D\D9	680.74G B	Backup_9
34	12x146GB,15K,SAS	C:\A\A10	1MB	Fixed_10
	MD1220	C:\B\B10	3.5GB	Scaling_10
	RAID10	C:\C\C10	132.5GB	Growing_10
		C:\D\D10	680.74G B	Backup_10
35	12x146GB,15K,SAS	C:\A\A11	1MB	Fixed_11
	MD1220	C:\B\B11	3.5GB	Scaling_11
	RAID10	C:\C\C11	132.5GB	Growing_11
		C:\D\D11	680.74G B	Backup_11
36	12x146GB,15K,SAS	C:\A\A12	1MB	Fixed_12

5

5

	MD1220	C:\B\B12	3.5GB	Scaling_12
	RAID10	C:\C\C1 2	132.5GB	Growing_1 2
		C:\D\D1 2	680.74G B	Backup_12
		C:\D\D7 2	284.56G B	Backup_72
37	12x73GB,15K,SAS	C:\A\A73	1MB	Fixed_73
	MD1220	C:\B\B73	3.5GB	Scaling_73
	RAID10	C:\C\C7 3	119GB	Growing_7 3
		C:\D\D7 3	284.56G B	Backup_73
38	12x73GB,15K,SAS	C:\A\A74	1MB	Fixed_74
	MD1220	C:\B\B74	3.5GB	Scaling_74
	RAID10	C:\C\C7 4	119GB	Growing_7 4
		C:\D\D7 4	284.56G B	Backup_74
39	12x73GB,15K,SAS	C:\A\A75	1MB	Fixed_75
	MD1220	C:\B\B75	3.5GB	Scaling_75
	RAID10	C:\C\C7 5	119GB	Growing_7 5
		C:\D\D7 5	284.56G B	Backup_75
40	12x73GB,15K,SAS	C:\A\A76	1MB	Fixed_76
	MD1220	C:\B\B76	3.5GB	Scaling_76
	RAID10	C:\C\C7 6	119GB	Growing_7 6
		C:\D\D7 6	284.56G B	Backup_76
41	12x73GB,15K,SAS	C:\A\A77	1MB	Fixed_77
	MD1220	C:\B\B77	3.5GB	Scaling_77
	RAID10	C:\C\C7 7	119GB	Growing_7 7
		C:\D\D7 7	284.56G B	Backup_77
42	12x73GB,15K,SAS	C:\A\A78	1MB	Fixed_78
	MD1220	C:\B\B78	3.5GB	Scaling_78
	RAID10	C:\C\C7 8	119GB	Growing_7 8
		C:\D\D7 8	284.56G B	Backup_78
43	12x73GB,15K,SAS	C:\A\A79	1MB	Fixed_79
	MD1220	C:\B\B79	3.5GB	Scaling_79
	RAID10	C:\C\C7 9	119GB	Growing_7 9
		C:\D\D7 9	284.56G B	Backup_79
44	12x73GB,15K,SAS	C:\A\A80	1MB	Fixed_80
	MD1220	C:\B\B80	3.5GB	Scaling_80
	RAID10	C:\C\C8 0	119GB	Growing_8 0
		C:\D\D8 0	284.56G B	Backup_80
45	12x146GB,15K,SAS	C:\A\A13	1MB	Fixed_13

6

6

	MD1220	C:\B\B13	3.5GB	Scaling_13
	RAID10	C:\C\C1 3	132.5GB	Growing_1 3
		C:\D\D1 3	680.74G B	Backup_13
46	12x146GB,15K,SAS	C:\A\A14	1MB	Fixed_14
	MD1220	C:\B\B14	3.5GB	Scaling_14
	RAID10	C:\C\C1 4	132.5GB	Growing_1 4
		C:\D\D1 4	680.74G B	Backup_14
47	12x146GB,15K,SAS	C:\A\A15	1MB	Fixed_15
	MD1220	C:\B\B15	3.5GB	Scaling_15
	RAID10	C:\C\C1 5	132.5GB	Growing_1 5
		C:\D\D1 5	680.74G B	Backup_15
48	12x146GB,15K,SAS	C:\A\A16	1MB	Fixed_16
	MD1220	C:\B\B16	3.5GB	Scaling_16
	RAID10	C:\C\C1 6	132.5GB	Growing_1 6
		C:\D\D1 6	680.74G B	Backup_16
49	12x146GB,15K,SAS	C:\A\A17	1MB	Fixed_17
	MD1220	C:\B\B17	3.5GB	Scaling_17
	RAID10	C:\C\C1 7	132.5GB	Growing_1 7
		C:\D\D1 7	680.74G B	Backup_17
50	12x146GB,15K,SAS	C:\A\A18	1MB	Fixed_18
	MD1220	C:\B\B18	3.5GB	Scaling_18
	RAID10	C:\C\C1 8	132.5GB	Growing_1 8
		C:\D\D1 8	680.74G B	Backup_18
51	12x146GB,15K,SAS	C:\A\A19	1MB	Fixed_19
	MD1220	C:\B\B19	3.5GB	Scaling_19
	RAID10	C:\C\C1 9	132.5GB	Growing_1 9
		C:\D\D1 9	680.74G B	Backup_19
52	12x146GB,15K,SAS	C:\A\A20	1MB	Fixed_20
	MD1220	C:\B\B20	3.5GB	Scaling_20
	RAID10	C:\C\C2 0	132.5GB	Growing_2 0
		C:\D\D2 0	680.74G B	Backup_20
53	12x146GB,15K,SAS	C:\A\A21	1MB	Fixed_21
	MD1220	C:\B\B21	3.5GB	Scaling_21
	RAID10	C:\C\C2 1	132.5GB	Growing_2 1
		C:\D\D2 1	680.74G B	Backup_21
54	12x146GB,15K,SAS	C:\A\A22	1MB	Fixed_22
	MD1220	C:\B\B22	3.5GB	Scaling_22
	RAID10	C:\C\C2	132.5GB	Growing_2



7

7

		2		2
		C:\D\D2 2	680.74G B	Backup_22
55	12x146GB,15K,SAS	C:\A\A23	1MB	Fixed_23
	MD1220	C:\B\B23	3.5GB	Scaling_23
	RAID10	C:\C\C2 3	132.5GB	Growing_2 3
		C:\D\D2 3	680.74G B	Backup_23
56	12x146GB,15K,SAS	C:\A\A24	1MB	Fixed_24
	MD1220	C:\B\B24	3.5GB	Scaling_24
	RAID10	C:\C\C2 4	132.5GB	Growing_2 4
		C:\D\D2 4	680.74G B	Backup_24
57	12x73GB,15K,SAS	C:\A\A81	1MB	Fixed_81
	MD1220	C:\B\B81	3.5GB	Scaling_81
	RAID10	C:\C\C8 1	119GB	Growing_8 1
		C:\D\D8 1	284.56G B	Backup_81
58	12x73GB,15K,SAS	C:\A\A82	1MB	Fixed_82
	MD1220	C:\B\B82	3.5GB	Scaling_82
	RAID10	C:\C\C8 2	119GB	Growing_8 2
		C:\D\D8 2	284.56G B	Backup_82
59	12x73GB,15K,SAS	C:\A\A83	1MB	Fixed_83
	MD1220	C:\B\B83	3.5GB	Scaling_83
	RAID10	C:\C\C8 3	119GB	Growing_8 3
		C:\D\D8 3	284.56G B	Backup_83
60	12x73GB,15K,SAS	C:\A\A84	1MB	Fixed_84
	MD1220	C:\B\B84	3.5GB	Scaling_84
	RAID10	C:\C\C8 4	119GB	Growing_8 4
		C:\D\D8 4	284.56G B	Backup_84
61	12x73GB,15K,SAS	C:\A\A85	1MB	Fixed_85
	MD1220	C:\B\B85	3.5GB	Scaling_85
	RAID10	C:\C\C8 5	119GB	Growing_8 5
		C:\D\D8 5	284.56G B	Backup_85
62	12x73GB,15K,SAS	C:\A\A86	1MB	Fixed_86
	MD1220	C:\B\B86	3.5GB	Scaling_86
	RAID10	C:\C\C8 6	119GB	Growing_8 6
		C:\D\D8 6	284.56G B	Backup_86
63	12x73GB,15K,SAS	C:\A\A87	1MB	Fixed_87
	MD1220	C:\B\B87	3.5GB	Scaling_87
	RAID10	C:\C\C8 7	119GB	Growing_8 7
		C:\D\D8	284.56G	Backup_87

8

8

		7	B	
64	12x73GB,15K,SAS	C:\A\A88	1MB	Fixed_88
	MD1220	C:\B\B88	3.5GB	Scaling_88
	RAID10	C:\C\C8	119GB	Growing_88
		C:\D\D8	284.56GB	Backup_88
65	12x146GB,15K,SAS	C:\A\A25	1MB	Fixed_25
	MD1220	C:\B\B25	3.5GB	Scaling_25
	RAID10	C:\C\C25	132.5GB	Growing_25
		C:\D\D25	680.74GB	Backup_25
66	12x146GB,15K,SAS	C:\A\A26	1MB	Fixed_26
	MD1220	C:\B\B26	3.5GB	Scaling_26
	RAID10	C:\C\C26	132.5GB	Growing_26
		C:\D\D26	680.74GB	Backup_26
67	12x146GB,15K,SAS	C:\A\A27	1MB	Fixed_27
	MD1220	C:\B\B27	3.5GB	Scaling_27
	RAID10	C:\C\C27	132.5GB	Growing_27
		C:\D\D27	680.74GB	Backup_27
68	12x146GB,15K,SAS	C:\A\A28	1MB	Fixed_28
	MD1220	C:\B\B28	3.5GB	Scaling_28
	RAID10	C:\C\C28	132.5GB	Growing_28
		C:\D\D28	680.74GB	Backup_28
69	12x146GB,15K,SAS	C:\A\A29	1MB	Fixed_29
	MD1220	C:\B\B29	3.5GB	Scaling_29
	RAID10	C:\C\C29	132.5GB	Growing_29
		C:\D\D29	680.74GB	Backup_29
70	12x146GB,15K,SAS	C:\A\A30	1MB	Fixed_30
	MD1220	C:\B\B30	3.5GB	Scaling_30
	RAID10	C:\C\C30	132.5GB	Growing_30
		C:\D\D30	680.74GB	Backup_30
71	12x146GB,15K,SAS	C:\A\A31	1MB	Fixed_31
	MD1220	C:\B\B31	3.5GB	Scaling_31
	RAID10	C:\C\C31	132.5GB	Growing_31
		C:\D\D31	680.74GB	Backup_31
72	12x146GB,15K,SAS	C:\A\A32	1MB	Fixed_32
	MD1220	C:\B\B32	3.5GB	Scaling_32
	RAID10	C:\C\C32	132.5GB	Growing_32
		C:\D\D32	680.74GB	Backup_32
73	12x146GB,15K,SAS	C:\A\A33	1MB	Fixed_33

9

9

	MD1220	C:\B\B33	3.5GB	Scaling_33
	RAID10	C:\C\C3 3	132.5GB	Growing_3 3
		C:\D\D3 3	680.74G B	Backup_33
74	12x146GB,15K,SAS	C:\A\A34	1MB	Fixed_34
	MD1220	C:\B\B34	3.5GB	Scaling_34
	RAID10	C:\C\C3 4	132.5GB	Growing_3 4
		C:\D\D3 4	680.74G B	Backup_34
75	12x146GB,15K,SAS	C:\A\A35	1MB	Fixed_35
	MD1220	C:\B\B35	3.5GB	Scaling_35
	RAID10	C:\C\C3 5	132.5GB	Growing_3 5
		C:\D\D3 5	680.74G B	Backup_35
76	12x146GB,15K,SAS	C:\A\A36	1MB	Fixed_36
	MD1220	C:\B\B36	3.5GB	Scaling_36
	RAID10	C:\C\C3 6	132.5GB	Growing_3 6
		C:\D\D3 6	680.74G B	Backup_36
77	12x146GB,15K,SAS	C:\A\A37	1MB	Fixed_37
	MD1220	C:\B\B37	3.5GB	Scaling_37
	RAID10	C:\C\C3 7	132.5GB	Growing_3 7
		C:\D\D3 7	680.74G B	Backup_37
78	12x146GB,15K,SAS	C:\A\A38	1MB	Fixed_38
	MD1220	C:\B\B38	3.5GB	Scaling_38
	RAID10	C:\C\C3 8	132.5GB	Growing_3 8
		C:\D\D3 8	680.74G B	Backup_38
79	12x146GB,15K,SAS	C:\A\A39	1MB	Fixed_39
	MD1220	C:\B\B39	3.5GB	Scaling_39
	RAID10	C:\C\C3 9	132.5GB	Growing_3 9
		C:\D\D3 9	680.74G B	Backup_39
80	12x146GB,15K,SAS	C:\A\A40	1MB	Fixed_40
	MD1220	C:\B\B40	3.5GB	Scaling_40
	RAID10	C:\C\C4 0	132.5GB	Growing_4 0
		C:\D\D4 0	680.74G B	Backup_40
81	12x146GB,15K,SAS	C:\A\A41	1MB	Fixed_41
	MD1220	C:\B\B41	3.5GB	Scaling_41
	RAID10	C:\C\C4 1	132.5GB	Growing_4 1
		C:\D\D4 1	680.74G B	Backup_41
82	12x146GB,15K,SAS	C:\A\A42	1MB	Fixed_42
	MD1220	C:\B\B42	3.5GB	Scaling_42
	RAID10	C:\C\C4	132.5GB	Growing_4

			2		2
			C:\D\D4 2	680.74G B	Backup_42
83	12x146GB,15K,SAS		C:\A\A43	1MB	Fixed_43
	MD1220		C:\B\B43	3.5GB	Scaling_43
	RAID10		C:\C\C4 3	132.5GB	Growing_4 3
			C:\D\D4 3	680.74G B	Backup_43
84	12x146GB,15K,SAS		C:\A\A44	1MB	Fixed_44
	MD1220		C:\B\B44	3.5GB	Scaling_44
	RAID10		C:\C\C4 4	132.5GB	Growing_4 4
			C:\D\D4 4	680.74G B	Backup_44
85	12x146GB,15K,SAS		C:\A\A45	1MB	Fixed_45
	MD1220		C:\B\B45	3.5GB	Scaling_45
	RAID10		C:\C\C4 5	132.5GB	Growing_4 5
			C:\D\D4 5	680.74G B	Backup_45
86	12x146GB,15K,SAS		C:\A\A46	1MB	Fixed_46
	MD1220		C:\B\B46	3.5GB	Scaling_46
	RAID10		C:\C\C4 6	132.5GB	Growing_4 6
			C:\D\D4 6	680.74G B	Backup_46
87	12x146GB,15K,SAS		C:\A\A47	1MB	Fixed_47
	MD1220		C:\B\B47	3.5GB	Scaling_47
	RAID10		C:\C\C4 7	132.5GB	Growing_4 7
			C:\D\D4 7	680.74G B	Backup_47
88	12x146GB,15K,SAS		C:\A\A48	1MB	Fixed_48
	MD1220		C:\B\B48	3.5GB	Scaling_48
	RAID10		C:\C\C4 8	132.5GB	Growing_4 8
			C:\D\D4 8	680.74G B	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'  
...  
BackupDev64 'C:\D\D64\TPCHbackup64'

## 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 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 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 R910 server has an inbuilt network Ethernet controller with 4 1000MB/s ports. One of the ports is used to connect directly to the Driver system. The other 3 ports are connected directly to the clients (tier A) systems. The Client systems also have inbuilt network controllers with 2 1000MB/s ports. One of these ports is connected to the driver system and the other is connected to the R910 DB Server. 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 1.9.0

## 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)

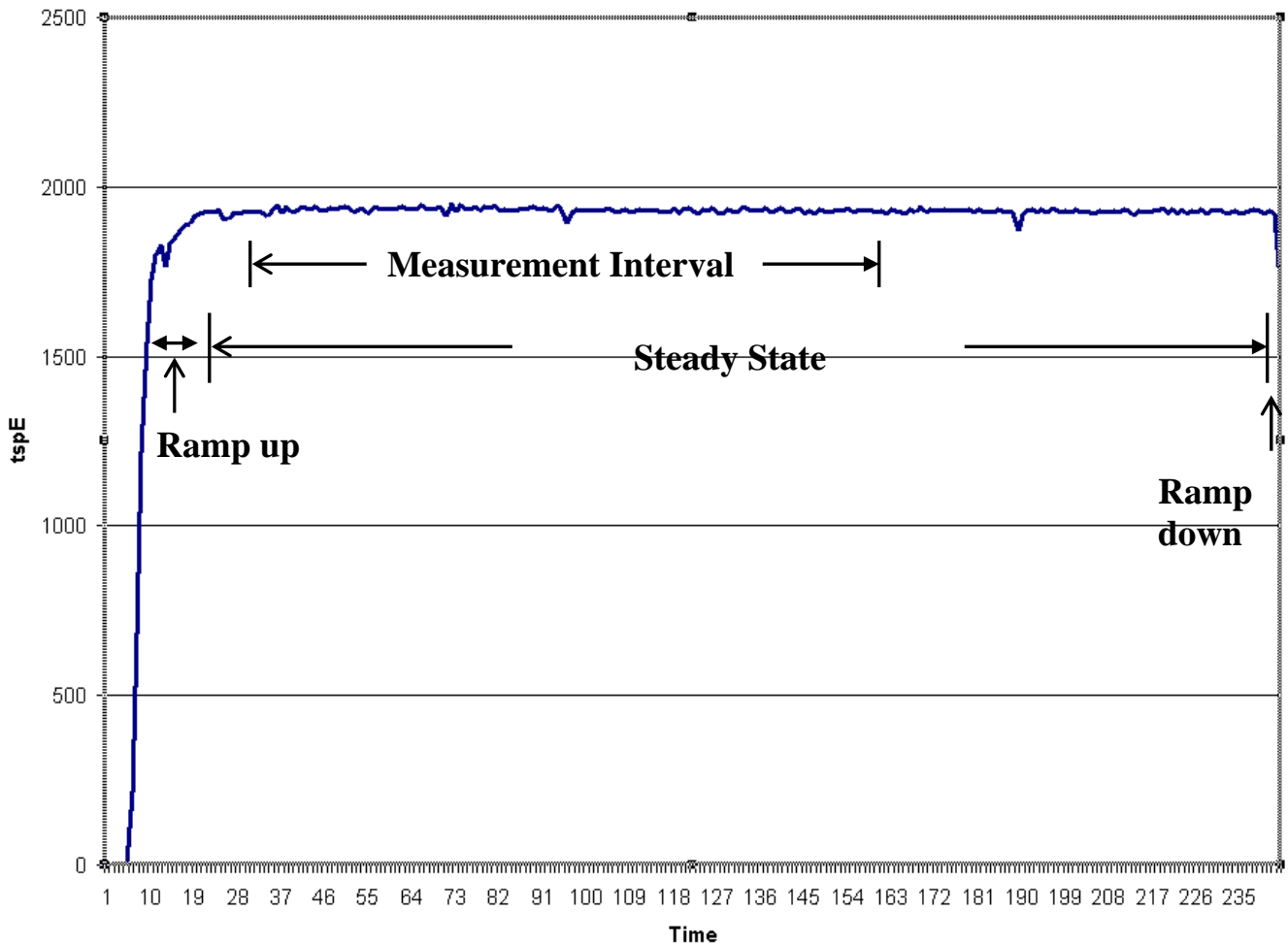
The measured tpsE was 1933.96

## 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	49.98%	Ok	48.00%	52.00%
		Get history	50.01%	Ok	48.00%	52.00%
Trade Lookup	Ok	Frame 1	30.00%	Ok	28.50%	31.50%
		Frame 2	29.99%	Ok	28.50%	31.50%
		Frame 3	29.99%	Ok	28.50%	31.50%
		Frame 4	10.02%	Ok	9.50%	10.50%
Market Watch	Ok	By Watch List	60.02%	Ok	57.00%	63.00%

		By Customer Account	34.98%	Ok	33.00%	37.00%
		By Industry	5.00%	Ok	4.50%	5.50%
Trade Update	Ok	Frame 1	32.95%	Ok	31.00%	35.00%
		Frame 2	33.02%	Ok	31.00%	35.00%
		Frame 3	34.04%	Ok	32.00%	36.00%
Security Detail	Ok	Access LOB	1.00%	Ok	0.90%	1.10%
Trade Order	Ok	By Non-Owner	10.00%	Ok	9.50%	10.50%
		By Company Name	40.01%	Ok	38.00%	42.00%
		Buy on Margin	7.99%	Ok	7.50%	8.50%
		Rollback	0.99%	Ok	0.94%	1.04%
		LIFO	34.99%	Ok	33.00%	37.00%
		Trade Quantity 100	24.98%	Ok	24.00%	26.00%
		Trade Quantity 200	25.01%	Ok	24.00%	26.00%
		Trade Quantity 400	25.01%	Ok	24.00%	26.00%
		Trade Quantity 800	25.01%	Ok	24.00%	26.00%
		Market Buy	30.00%	Ok	29.70%	30.30%
		Market Sell	30.00%	Ok	29.70%	30.30%
		Limit buy	20.01%	Ok	19.80%	20.20%
		Limit sell	10.00%	Ok	9.90%	10.10%
		Stop Loss	9.99%	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)*

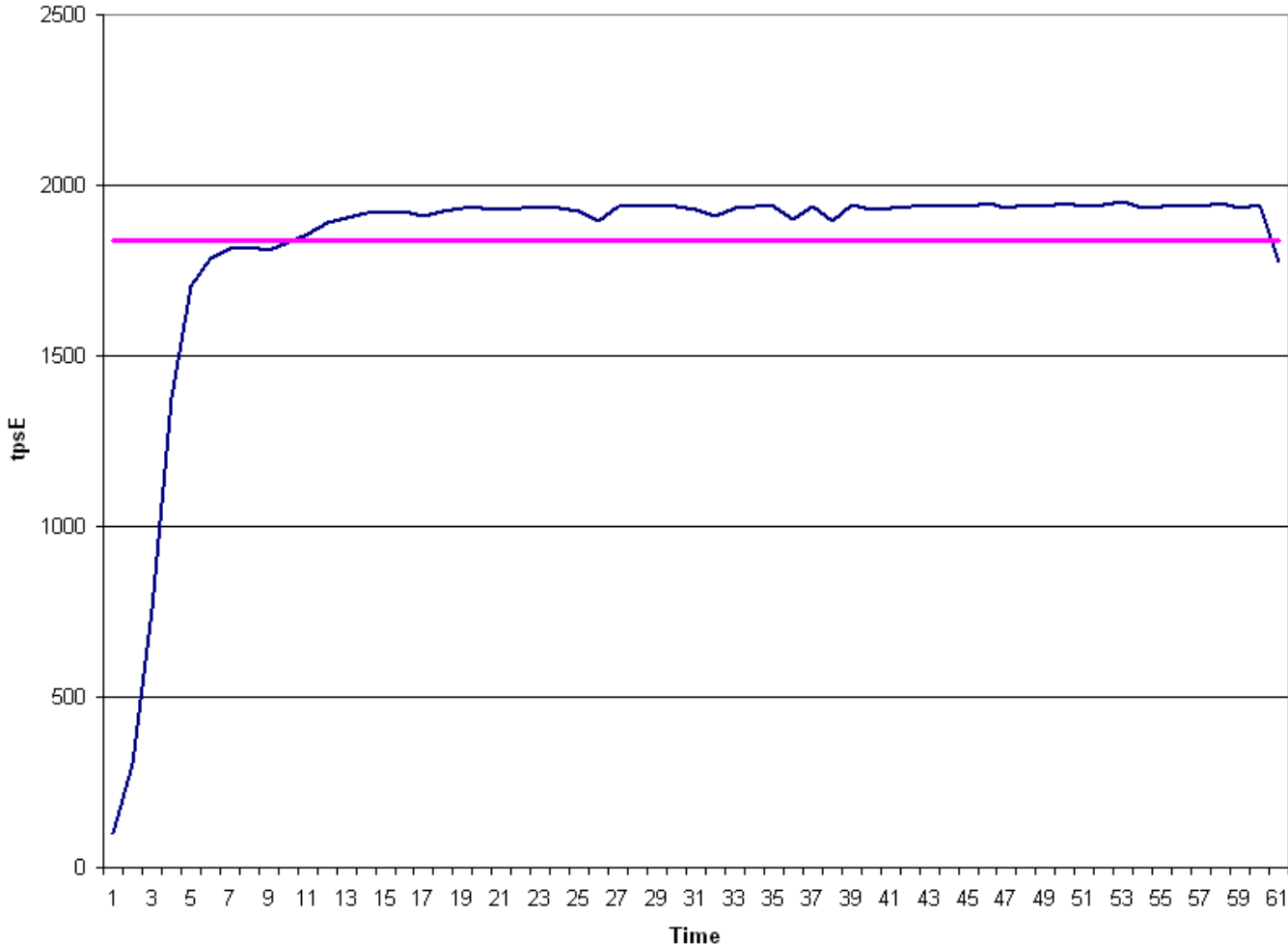
1. A restore was executed to yield a fresh database.
2. The rows in the Settlement table were counted to determine the initial count of completed trades present in the database (count-before).
3. A performance run was started with the same number of configured customers and driver load used for the measurement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

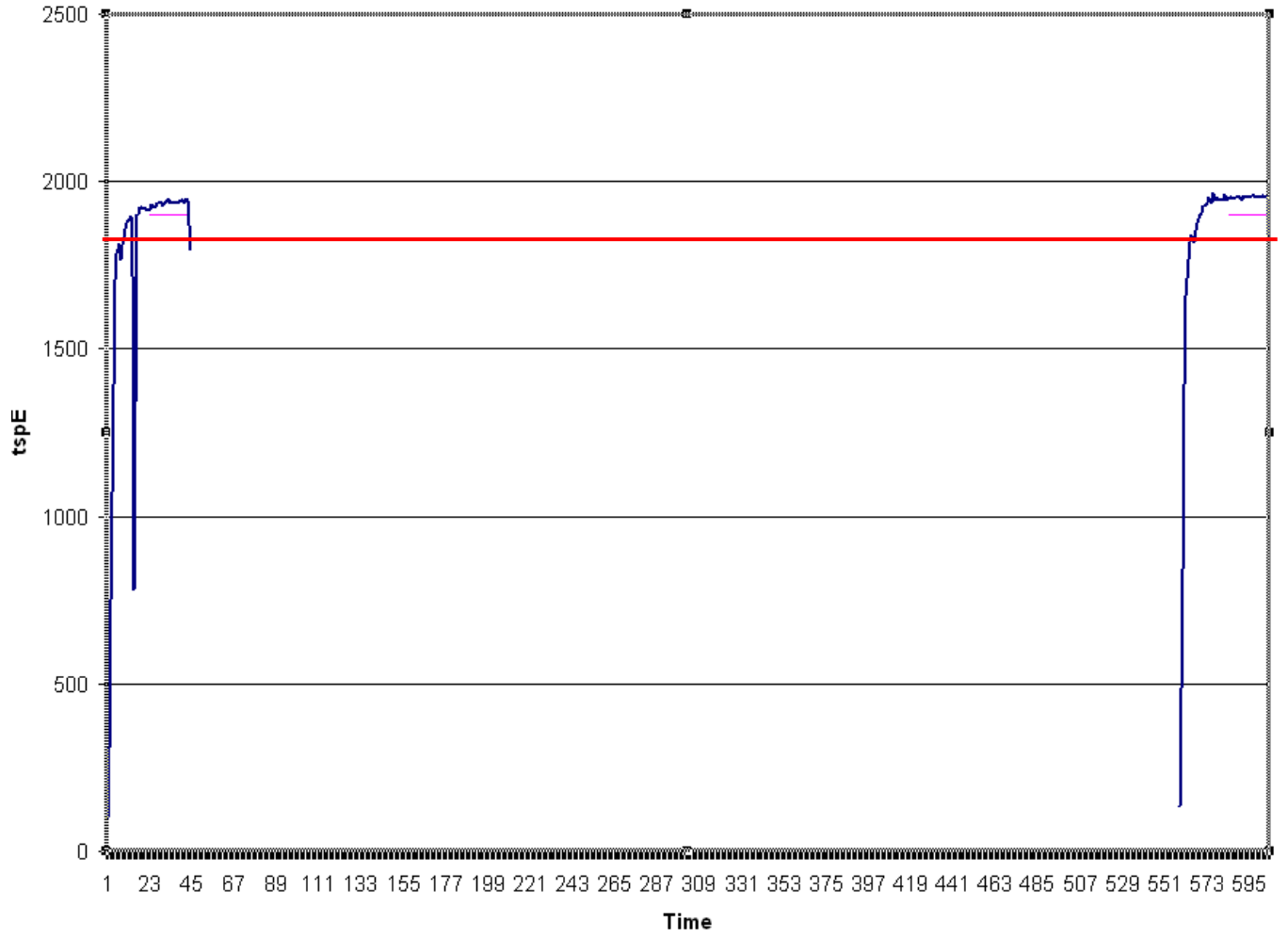
## **7.6: Business Recovery Time**

*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 9 hours 43mins 9s. 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

Microsoft SQL Server 2008 R2 Ent Edition will be orderable and available by May 6, 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:



### PERFORMANCE METRICS INC. TPC Certified Auditors

---

October 21, 2010

Mr. Joe Noyola  
Dell, Inc.  
One Dell Way  
Round Rock, TX 78682

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

Platform: Dell PowerEdge R910  
Database Manager: Microsoft SQL Server 2008 Enterprise x64 Edition  
Operating System: Microsoft Windows Sever 2008 Enterprise x64 Edition

Server (Tier B): R910			
CPU's	Memory	Disks (total)	TpsE
4 Intel 8 core Xeon @ 2.27 Ghz	512 GB	480 @ 73 GB 588 @ 146 GB	<b>1933.96</b>
Clients (Tier A): 1 PE 2900			
2 Intel Xeon quad core @ 2.66 Ghz	32 GB	1 @ 160 GB	Na
Clients (Tier A): 2 T110			
1 Intel Xeon quad core @ 2.67 Ghz	4 GB	1 @ 160 GB	NA

- The priced configuration is substituting PV MD1220 disk enclosures for the measured PV MD1120 disk enclosures.
- The priced configuration is substituting newer 73GB disk drives for older model disk drives.
- The priced configuration is substituting PowerEdge T410 clients for the tested clients.

I have reviewed the technical specifications for these substitutions and it is my opinion that these substitutions are compliant with the substitution rules.

Sincerely,

*Lorna Livingtree*

Lorna Livingtree



# 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)*

October 16, 2010

Dell Computers  
 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
*	<b>SQL Server 2008 R2 Enterprise Edition</b> <i>Per Processor License            Open Program - Level C            Unit Price reflects a 33% discount from the retail unit price of \$28,749.</i>	\$19,188	4	\$76,752
P72-04217	<b>Windows Server 2008 R2 Enterprise Edition</b> <i>Server License with 25 CALs            Open Program - Level C            Unit Price reflects a 43% discount from the retail unit price of \$3,999.</i>	\$2,280	1	\$2,280
P73-04980	<b>Windows Server 2008 R2 Standard Edition</b> <i>Server License with 5 CALs            Open Program - Level C            Unit Price reflects a 31% discount from the retail unit price of \$1,029.</i>	\$711	3	\$2,133
N/A	<b>Microsoft Problem Resolution Services</b> <i>Professional Support            (1 Incident).</i>	\$259	1	\$259

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>

SQL Server 2008 R2 Enterprise Edition will be orderable and available by May 6, 2010.

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

This quote is valid for the next 90 days.

Reference ID: TPCE\_g3wOpiq6ZAv85z6nZgEuEWcaGiGBvsjw\_V1.0.0.