TPC Benchmark® E
Full Disclosure Report

HP ProLiant DL580 G7

using Microsoft SQL Server 2008 R2 Enterprise Edition
on Microsoft Windows Server 2008 R2 Enterprise Edition

First Edition
June 21 , 2010

First Edition June 21 , 2010

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Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC Benchmark® E should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

All performance data contained in this report was obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. Hewlett-Packard Company does not warrant or represent that a user can or will achieve similar performance expressed in transactions per second (tpsE ®) or normalized price/performance ($/tpsE ®). No warranty of system performance or price/performance is expressed or implied in this report.

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Abstract

Overview

This report documents the methodology and results of the TPC Benchmark® E (TPC-E) and TPC Benchmark® Energy (TPC-Energy) test conducted on the using HP ProLiant DL580 G7. The operating system used for the benchmark was Microsoft Windows Server 2008 R2 Enterprise Edition. The report also includes the results of the TPC Benchmark® Energy (TPC-Energy) test conducted on the same system.

TPC Benchmark® E Metrics

The standard TPC Benchmark ® E metrics, tpsE® (transactions per second), price per tpsE ® (three year capital cost per measured tpsE ®) and the availability date are reported as required by the benchmark specification.

TPC Benchmark® Energy Metrics

The standard TPC Benchmark ® Energy metrics, watts per tpsE is optionally reported by the benchmark specification.

Standard and Executive Summary Statements

The following pages contain the Executive Summary of the benchmark results for the system.

Auditor

The benchmark configuration, environment and methodology used to produce and validate the test results, and the pricing model used to calculate the cost per tpsE®, were audited by Lorna Livingtree of Performance Metrics, Inc. to verify compliance with the relevant TPC specifications.

HP Proliant DL580 G7

Intel Xeon X7560 2.27 GHz 24MB L3

C/S with 4 ProLiant DL 360 G5

TPCE Rev 1.10.0
TPC Pricing 1.5.0
TPC Energy 1.1.1
Report Date
June 21, 2010

TPC-E Throughput	Price/Performance	Availability Date	Total System Cost	TPC-Energy Metric
2001.12 tpsE	$347 USD/tpsE	June 21, 2010	$692,874 USD	5.84 watts/tpsE

Database Server Configuration

Operating System	Database Manager	Processor/Cores/Thread	Memory
Microsoft Windows Server 2008 R2 Enterprise Edition	Microsoft SQL Server 2008 R2 Enterprise Edition	4/32/64 Intel Xeon X7560 2.27 GHz 24MB L3	1024 GB

Tier B: Server
HP Proliant DL580G7

4 x Intel Xeon Processor X7560 EX 2.27 GHZ
1024GB Memory
1 x HP NC364T PCI Express Quad Port Gigabit Server Adapter
2 x HP 72GB 3G SAS 15K SFF DP

Database Log

4 x HP 300GB 6G SAS 10K SFF DP (internal)

Storage

10 x HP Smart Array P411/512 MB
40 x HP StorageWorks D2700 Disk Enclosure
750 x 72GB 6G SAS 15K SFF DP
240 x 146GB SAS 15K SFF DP

Tier A: Clients

4 x ProLiant DL360g5
1 x Quad-Core Intel Xeon processor E5420 2.50Ghz
16 x 72GB SAS 10K SFF DP
2 x Onboard 1Gbps Ethernet
2 x HP NC360T PCI-E Dual Port

Initial Database Size	Redundancy Level: 1	Storage
8,938.1 GB	RAID10:Log/RAID10:Data	752x72GB 15K, 240x146GB 15K , 4x300GB 10K

	HP ProLiant DL580G7 Intel Xeon X7560 2.27 GHz 24MB L3				TPC-E	1.10.0
					TPC-Pricing	1.5.0
					Report date	21-Jun-10
					Availability Date	21-Jun-10
Description	**Part Number**	**Brand**	**Unit Price**	**Qty.**	**Extended Price**	**3 Yr Maint Price**
Server Hardware (Tier B)						
HP DL580R07 CTO Chassis	588857-B21	1	4,597	1	4,597	
HP X7560 DL580 G7 2P FIO Kit	588143-L21	1	10,000	2	20,000	
HP 16GB 4Rx4 PC3-8500R-7 US Kit/S-Buy	500666-S21	1	1,449	64	92,736	
HP 72GB SAS 15K SFF DP ENT HDD	512545-B21	1	349	2	698	
HP Smart Array P411/512 MB with BBWC Controller	462832-B21	1	649	10	6,490	
HP NC364T PCI Express Quad Port Gigabit Server Adapter	412648-B21	1	229	1	229	
HP LE1851w 18.5-Inch wide Monitor	NK033AA#ABA	1	159	1	159	
HP PS/2 Keyboard And Mouse Bundle	RC464AA#ABA	1	39	1	39	
HP 300GB SAS 10K SFF DP ENT HDD	512547-B21	1	499	4	1,996	
HP 3y 4h 24x7 ProLiant DL58x HW Support ,Proliant Server DL58x	U4545E	1	1,397	1		$1,397
			Subtotal		**$126,944**	**$1,397**
Server Software						
SQL Server 2008 R2 Enterprise Edition, Per Processor License	810-07580	2	19,188	4	76,752	
Windows Server 2008 R2 Enterprise Edition	P72-04217	2	2,280	1	2,280	
Microsoft Problem Resolution Services	N/A	2	259	1		259
			Subtotal		**$79,032**	**259**
Storage						
HP StorageWorks D2700 Disk Enclosure	AJ941A	1	3,399	40	135,960	
HP StorageWorks D2700 Disk Enclosure (10% Spares)	AJ941A	1	3,399	4	13,596	
HP 72GB 6G SAS 15K SFF DP ENT HDD	512545-B21	1	349	760	265,240	
HP 146GB 6G SAS 15K SFF DP ENT HDD	512547-B21	1	499	240	119,760	
HP 146GB 6G SAS 15K SFF DP ENT HDD (10% Spares)	512547-B21	1	499	24	11,976	
HP 72GB 6G SAS 15K SFF DP ENT HDD (10% Spares)	512545-B21	1	349	77	26,873	
HP 5642 Pallet Unassembled Rack	358254-B21	1	865	2	1,730	
			Subtotal		**575,135**	**0**
Client Hardware (Tier A)						
HP ProLiant DL360 G5 E5420 2.50GHz Quad Core 2GB Rack Server	457925-001	1	2,499	4	9,996	
HP 72GB 3G SAS 10K SFF DP ENT HDD	384842-B21	1	259	16	4,144	
HP NC360T PCI-E Dual Port Gigabit Server Adapter	412648-B21	1	229	4	916	
HP 3y 4h 24x7 ProLiant DL36x HW Support ,ProLiant DL36x	U4497E	1	698	4		2,792
			Subtotal		**15,056**	**2,792**
Client Software						
Microsoft Windows Server 2008 Standard (x64)	P73-04165	2	711	4	2,844	
			Subtotal		**2,844**	**0**
Infrastructure						
HP ProCurve 2910al-24G Switch 24-port 10/100/1000 basic Layer 3	J9145A#ABA	1	2,609	2	5,218	
3-year, 4-hour onsite, 24x7 coverage for hardware	U4835E	1	227	2		454
HP 1.2m/4ft CAT5 RJ45 M/M Ethernet Cable	C7533A	1	4	20	74	
			Subtotal		**5,292**	**454**
		Total Extended Price			**$804,303**	**$4,902**
HP's Large Configuration Discount *	16.0%	**Total Discounts**			**$115,588**	**$743**
		Grand Total			**$688,715**	**$4,159**

Pricing: 1=HP Direct 800-203-6748 2= Microsoft. Note 1: Discount based on HP Direct guidence applies to all lines where pricing = 1. Note 2: All the hardware are available to order. Note 3: The benchmark results were audited by Lorna Livingtree of Performance Metrics.

Three-year Cost of Ownership: USD	**$692,874**
tpsE	**2,001.12**
$ USD/tpsE	**$347**

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 terms, please inform at pricing@tpc.org. Thank you.

Hewlett-Packard Company	HP ProLiant DL580G7 2.27 GHz 24MB L3 C/S with 4 HP ProLiant DL360 G5			TPC-E Rev. 1.10.0 TPC-Pricing 1.5.0 TPC-Energy 1.1.1 Report Date: June 21, 2010
Total System Cost	TPC-E Throughput	Price/Performance	Availability Date	TPC-Energy Metric
$692,874.00	2001.12 tpsE	$347 USD/tpsE	June 21, 2010	5.84 watts/tpsE

Numerical Quanties For Reported Energy Configuration:
REC Idle Power: 10,600 watts
Average Power of REC: 11,683 watts

	Secondary Metrics	Additional Numerical Quanties			
	watts / tpsE	Full Load Avg watts	Full Load % of REC	Idle Avg. watts	Idle % of REC
Database Server	0.85	1,701.27	14.6%	1,315.87	12.4%
Storage	4.54	9,081.84	77.7%	8,431.85	79.5%
Application Server	0.38	769.64	6.6%	722.20	6.8%
Miscellaneous	0.06	129.94	1.1%	130.03	1.2%
Total REC	5.84	11,683	100%	10,600	100%

Lowest ambient temperature at air inlet: 20.47 °C
Items in Priced Configuration not in the Reported Energy Configuration:
None

Items in Reported Energy Configuration not in the Measured Energy Configuration:
1 HP LE1851w 18.5-Inch wide Monitor Part Number NK033AA#ABA

HP DL580 G7

Intel Xeon X7560 2.27 GHz 24MB L3

TPCE Rev 1.10.0
TPC Pricing 1.5.0

Report Date
June 21, 2010

Availability Date
June 21, 2010

Numerical Quantities Summary

Reported Throughput	2001.12 tpsE	Configured Customers:	1,050,000

Response Times (in seconds)	Minimum	Average	90th %tile	Maximum
Broker Volume	0.00	0.06	0.10	2.72
Customer Position	0.00	0.04	0.06	4.56
Market Feed	0.00	0.03	0.05	6.94
Market Watch	0.00	0.04	0.08	4.56
Security Detail	0.00	0.02	0.04	2.64
Trade Lookup	0.00	0.41	0.61	5.08
Trade Order	0.00	0.08	0.13	19.56
Trade Result	0.00	0.10	0.16	20.41
Trade Status	0.00	0.02	0.04	4.52
Trade Update	0.01	0.46	0.63	5.03
Data Maintenance	0.00	0.07		0.54

Transaction Mix	Transaction Count	Mix %
Broker Volume	7,059,217	4.900%
Customer Position	18,729,046	13.000%
Market Feed	1,440,830	1.000%
Market Watch	25,932,421	18.000%
Security Detail	20,170,447	14.000%
Trade Lookup	11,525,319	8.000%
Trade Order	14,551,286	10.100%
Trade Result	14,408,134	10.001%
Trade Status	27,373,279	19.000%
Trade Update	2,881,222	2.000%
Data Maintenance	120	

Ramp-up Time	1:17:00
Measurement Interval	2:00:00
Business Recovery Time	1:10:49
Total Number of Transactions Completed in Measurement Interval	144,071,201

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Preface

Document Structure

This is the full disclosure report for a benchmark test of the using Microsoft SQL Server 2008 R2 Enterprise Edition. It meets the requirements of the TPC Benchmark ® E Standard Specification, Revision 1.10.0 dated Sept 2009 TPC Benchmark® E was developed by the **T**ransaction Processing **P**erformance **C**ouncil (TPC). It is the intent of this group to develop a suite of benchmarks to measure the performance of computer systems executing a wide range of applications. Hewlett-Packard Company and Microsoft, Inc. are active participants in the TPC.

The requirements for this Full Disclosure Report are in Clause 9 of TPC Benchmark ® E Specification.

TPC Benchmark® E Overview

TPC Benchmark™ E (TPC-E) is an On-Line 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 database schema, data population, transactions, and implementation rules have been designed to be broadly representative of modern OLTP systems. 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 operations are modeled as follows:

- The database is continuously available 24 hours a day, 7 days a week, for data processing from multiple **Sessions** and data modifications against all tables, except possibly during infrequent (e.g., once a month) maintenance **Sessions**.
- Due to the worldwide nature of the application modeled by the TPC-E benchmark, any of the transactions may be executed against the database at anytime, especially in relation to each other.

The TPC-E benchmark simulates the OLTP workload of a brokerage firm. The focus of the benchmark is the central database that executes 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 Orders 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 of the sections in this report correspond with those specified in the TPC-E specification.

1.2 Pricing

*The **FDR** must follow all reporting rules specified in the effective version of the TPC Pricing Specification, located at www.tpc.org. (9.1.1.2)*

The pricing rules for this FDR follow the current standard at the time of publication, TPC Pricing Specification 1.5.0.

1.3 Executive Summary Statement

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

The Executive Summary statement is included after the preamble of this Full Disclosure Report, as well as a separate document.

1.4 Supporting Files

A directory structure for the supporting files must be followed. (9.1.1.3)

The accompanying support files are in the proper structure as defined by the specification.

1.5 Auditor

*The name of the **Auditor** who certified the result must be included after the Price Spreadsheet. (9.2.2.2)*

This Benchmark, Executive Summary, and Full Disclosure Report were audited by Lorna Livingtree of Performance Metrics, Inc.. The attestation letter is included in this FDR.

1.6 Configuration Diagrams

*Diagrams of both **Measured** and **Priced Configurations** must be **reported** in the **Report**, accompanied by a description of the differences. (9.3.1.2, 9.3.1.3)*

The Benchmarked and Priced configurations of the driver, SUT Server, and DBMS server are the same and illustrated in Figure 1.1.

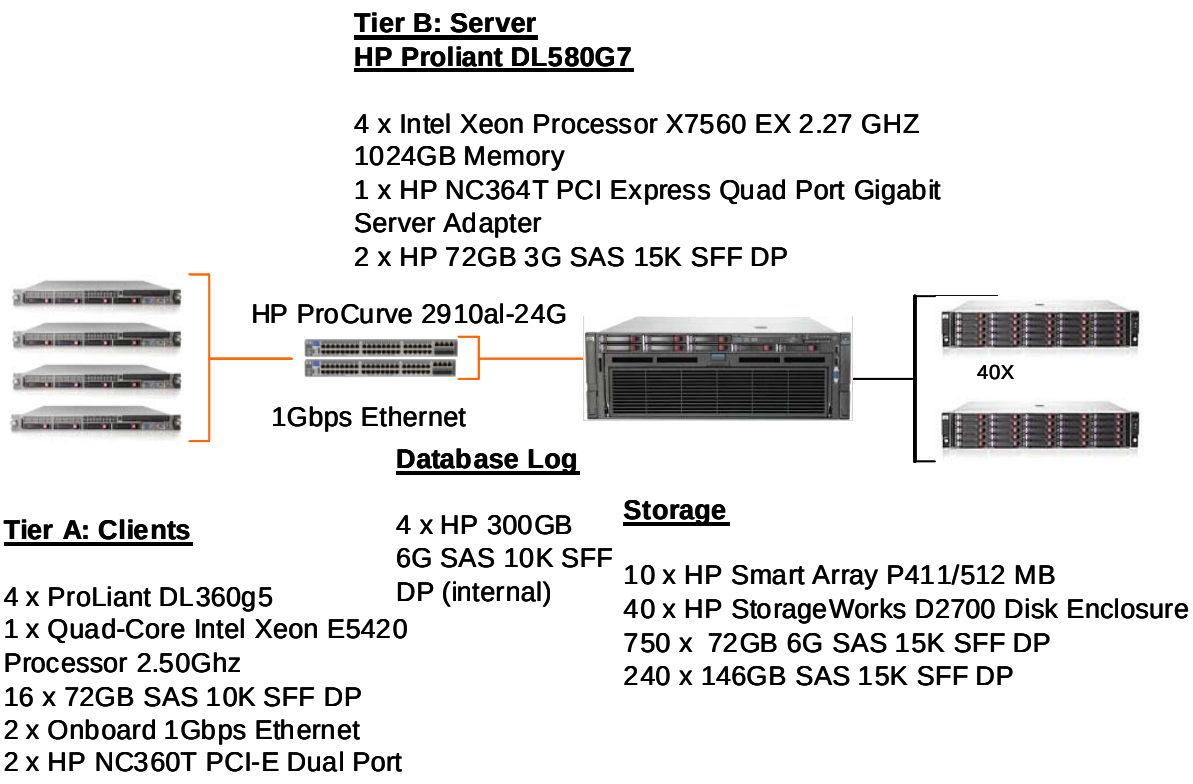

Figure 1.1 Benchmarked and Priced Configuration

1.7 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.*

A description of any firmware updates or patches to the hardware.

A description of any GUI configuration used to configure the system hardware.

*A description of exactly how the hardware is combined to create the complete system. For example, if the **SUT** description lists a base chassis with 1 processor, a processor update package of 3 processors, a NIC controller and 3 disk controllers, a description of where and how the processors, NIC and disk controllers are placed within the base chassis must be **reported** in the **Report**.*

A description of how the hardware components are connected. The description can assume the reader is knowledgeable of computer systems and the TPC-E specification. For example, only a description that Controller 1 in slot A is connected to Disk Tower 5 is required. The reader is assumed to be knowledgeable enough to determine what type of cable is required based upon the component descriptions and how to plug the cable into the components.

The HP ProLiant DL580 G7, in the benchmarked configuration, consists of a single cabinet with 4 sockets. Each socket has 1 processor installed, along with 64 x 16 GB DIMMs. The various HBA's, NICS, and other IO cards are installed in the various chassis as defined in the file **HWConfig.pdf** in the *\Supporting Files\Introduction\TierB* "Introduction" directory. Additionally, the **DiskConfig.pdf** file in the *Supporting Files* directory shows how the SmartArray and disk subsystem were configured.

1.8 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. This includes, but is not limited to:*

A description of any updates or patches to the software.

A description of any changes to the software.

A description of any GUI configurations used to configure the software.

The file **Win2008Setup.pdf** in the *\SupportingFiles\Introduction\TierB* directory outlines the steps taken to configure the OS and DBMS. The file **DiskDriverCfg.pdf** in *RaidDriver* outlines the steps to configure the disk driver used for the Smart Array Controllers. The file **PerfDriver.reg** is the registry entry for the initial performance driver settings. The file **SQL2008Setup.doc** in *\SupportingFiles\Introduction\TierB* likewise outlines the steps taken to setup the DBMS. Other supporting files (registry, configuration) are also included in the respective directories.

Clause 2: Database Design, Scaling & Population Items

2.1 Physical Database Organization

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

The database tables and indices were organized into two SQL Server filegroups as shown in Table 2.1 below. The tables that grew during the run, defined as *growing tables* in the TPC-E specification, were placed in a file group called Growing, while the tables that do not grow during the run, designated as *fixed and scaling*, and were placed in a filegroup called Fixed.

Directory **Clause2** in *Supporting Files* contains the scripts used to create the data base filegroups, tables, constraints, and indices. In addition, files to create TEMPDB files before the build and remove them after the build are included, as well as a script to remove the LOAD_FG files and filegroup after the build and before the initial backup.

Fixed		Growing
Account_Permission	Security	Cash_Transaction
Address	Watch_Item	Holding
Company	Watch_List	Holding_History
Company_Competitor	Charge	Holding_Summary
Customer	Commission_Rate	Settlement
Customer_Account	Exchange	Trade
Customer_TaxRate	Industry	Trade_History
Daily_Market	Sector	Trade_Request
Financial	Status_Type	
Last_Trade	TaxRate	
News_Item	Trade_Type	
News_Xref	Zip_Code	
Broker		

Table 2.1 – FileGroup Table Assignments

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 was done for this benchmark.

2.3 Replication, Duplication

*Replication of tables, if used, must be **reported** in the **Report. (9.3.2.3).***
*Additional and/or duplicated columns in any table must **be** reported in the Report along with a statement on the impact on performance. (9.3.2.4)*

No replication or duplication was done for this benchmark.

2.4 Cardinality of Tables

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

The TPC-E database was configured using 1,050,000 customers. Table 2.2 below shows the cardinality of each table.

Table	Rows
ACCOUNT_PERMISSION	7454828
ADDRESS	1575004
BROKER	10500
COMPANY	525000
COMPANY_COMPETITOR	1575000
CUSTOMER	1050000
CUSTOMER_ACCOUNT	5250000
CUSTOMER_TAXRATE	2100000
DAILY_MARKET	938621250
FINANCIAL	10500000
LAST_TRADE	719250
NEWS_ITEM	1050000
NEWS_XREF	1050000
SECURITY	719250
WATCH_ITEM	104941231
WATCH_LIST	1050000
CASH_TRANSACTION	16692481567
HOLDING	928855578
HOLDING_HISTORY	24316103321
HOLDING_SUMMARY	52216631
SETTLEMENT	18144000000
TRADE	18144000000
TRADE_HISTORY	43545559454
TRADE_REQUEST	0
CHARGE	15
COMMISSION_RATE	240
EXCHANGE	4
INDUSTRY	102
SECTOR	12
STATUS_TYPE	5
TAXRATE	320
TRADE_TYPE	5
ZIP_CODE	14741

Table 2.2 Initial Cardinality of Tables

2.5 Disk Configuration

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

Table 2.3 shows the configuration of the HP SmartArray P411 750 Drives configured for data connected to 10 HP SmartArray P411 controllers in 40 x D2700 enclosures, and 4 Drives configured for the log connected to 1 x HP Smart Array P410i controller in internal bay. All 40 x D2700 were configured as RAID1+0 arrays across all 25 disks in each enclosure, including the log.

Each data array was partitioned with 3 types of partitions: Growing, Fixed, and Backup. The first two types were used during the performance run, and the Backup partition was used for database backups. The first 2 partitions were RAW; the 3rd was configured as NTFS. Access to all the partitions was by using mount points, no drive letters were used except for the log and the boot/utility drives.

SA #, Type	Cab, Bay, Chassis, Slot	Disk #	Drives Enclosure RAID Lvl	Path Filesystem Partition	Size	Use
1, P410i	Internal,1-6,0,0	1	2x72 SCSI, Internal RAID1	C:, NTFS	72GB	Win2008 Boot, PageFile, Utility, Scripts Mount Point Root, DB Root File
		2	4x300 SCSI, Internal RAID1	F:, RAW	558.7GB	Database log
2, P411	1-4,1-100,1,1	3	48x146 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG
		4	48x146 SAS D2700 RAID1+0	C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS)	450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Backup Backup Backup Backup Backup

Table 2.3 Disk/Partition Configuration (continued)

SA #, Type	Cab, Bay, Chassis, Slot	Disk #	Drives Enclosure RAID Lvl	Path Filesystem Partition	Size	Use
3, P411	5-8,1-1001,2	5	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup Backup Backup
		6	50x72 SAS D2700 RAID1+0			
4, P411	9-12,1-100,1,3	7	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup
		8	50x72 SAS D2700 RAID1+0			

				C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS)	450.0 GB 450.0 GB	Backup Backup
5, P411	13-16,1-100,1,4	9	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup Backup Backup
		10	50x72 SAS D2700 RAID1+0			

Table 2.3 Disk/Partition Configuration (continued)

SA #, Type	Cab, Bay, Chassis, Slot	Disk #	Drives Enclosure RAID Lvl	Path Filesystem Partition	Size	Use
6, P411	17-20,1-100,1,5	11	48x146 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG
		12	48x146 SAS D2700 RAID1+0			

				C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS)	125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Grow FG Backup Backup Backup Backup Backup
7, P411	21-24,1-100,1,6	13	48x146 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS) C:\e-back\back06\ (NTFS)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup Backup Backup Backup
		14	50x72 SAS D2700 RAID1+0			
8, P411	25-28,1-100,1,7	15	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG
		16	50x72 SAS D2700 RAID1+0			

				C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS) C:\e-back\back06\ (NTFS)	450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Backup Backup Backup Backup Backup Backup

SA #, Type	Cab, Bay, Chassis, Slot	Disk #	Drives Enclosure RAID Lvl	Path Filesystem Partition	Size	Use
9, P411	29-32,1-100,1,8	17	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS) C:\e-back\back06\ (NTFS)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup Backup Backup Backup
		18	50x72 SAS D2700 RAID1+0			
10, P411	33-36,1-100,1,9	19	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG
		20	50x72 SAS D2700 RAID1+0			

				C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS) C:\e-back\back06\ (NTFS)	125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup Backup Backup Backup
11, P411	37-40,1-100,1,10	21	50x72 SAS D2700 RAID1+0	C:\e-fix\fx1\ (RAW) C:\e-grow\gw1\ (RAW) C:\e-fix\fx2\ (RAW) C:\e-grow\gw2\ (RAW) C:\e-fix\fx3\ (RAW) C:\e-grow\gw3\ (RAW) C:\e-fix\fx4\ (RAW) C:\e-grow\gw4\ (RAW) C:\e-fix\fx5\ (RAW) C:\e-grow\gw5\ (RAW) C:\e-fix\fx6\ (RAW) C:\e-grow\gw6\ (RAW) C:\e-fix\fx7\ (RAW) C:\e-grow\gw7\ (RAW) C:\e-fix\fx8\ (RAW) C:\e-grow\gw8\ (RAW) C:\e-fix\fx9\ (RAW) C:\e-grow\gw9\ (RAW) C:\e-fix\fx10\ (RAW) C:\e-grow\gw10\ (RAW) C:\e-back\back01\ (NTFS) C:\e-back\back02\ (NTFS) C:\e-back\back03\ (NTFS) C:\e-back\back04\ (NTFS) C:\e-back\back05\ (NTFS) C:\e-back\back06\ (NTFS)	3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 3.01 GB 125.01 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB 450.0 GB	Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Fixed FG Grow FG Backup Backup Backup Backup Backup Backup
		22	50x72 SAS D2700 RAID1+0			

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**.(9.3.2.7)*

*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)*

Client software interfaced to SQL Server through stored procedures invoked by the clients with ODBC calls. The application code was C++.

The data model implemented by Microsoft SQL Server 2008 R2 Enterprise Edition is relational.

The methodology used to load the database is contained in the file **MSTPCE Database Setup Reference.pdf** in the CLAUSE2 directory in *SupportingFiles* directory.

Clause 3: Transaction Related Items

3.1 Code Functionality

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

Secondary sponsor-supplied code is functionally equivalent to pseudo-code in the specification.

3.2 Database Footprint

*A statement that the database footprint requirements were met must be **reported** in the **Report**. (9.3.3.2)*

Database footprint requirements were met.

Clause 4: SUT, Driver and Network Related Items

4.1 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**) and any optional **Database Server** interface networks (9.3.4.1)*

The network configurations for both the priced and reported configurations are the same. All network connections were through two HP ProCurve 2910al-24G networking switches. The 1 driver machine and the 4 client machines were networked via their built in 1Gbps ports and one external HP 360T dual port NIC while the other was used for access by the driver during the runs. The DBMS server used one internal quad port 1Gbps NIC and one external HP 364T quad port NIC for data base traffic during the measured run. Figures 1.1 shows configuration of the network.

Clause 5: Egen Related Items

5.1 Egen Version

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

Egen Version used for this test was 1.10.0

5.2 Egen Code

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

All required TPC provided Egen code was used in this 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** if any of the changes to **EGen** do not have a formal waiver that must also be **reported** in the **Report**.*

No modifications to Egen were done for this report.

5.4 Egen Loader Extensions

*If the **Test Sponsor** extended **EGenLoader** the use of the extended **EGenLoader** and the audit of the extension code by an **Auditor** must be **reported** in the **Report (9.3.5.4)***

Egen Loader was not extended for this report.

5.5 Egen Loader Make Files

*The make/project files used to compile/link **EGenLoader** and **EGenValidate** must be **reported** in the **Supporting Files**. The compiler/linker options and flags used to compile/link **EGen** Objects for the **SUT** must be **reported** in the **Supporting Files**.(9.3.5.5)*

The Visual C++ project files are included in the **EgenMakeFiles** directory in the **Clause5** directory in the *Supporting Files* directory.

Clause 6: Performance Metrics and Response Time Related Items

6.1 EgenDriver and MEE instances

*The number of **EGenDriverMEE** and **EGenDriverCE** instances used in the benchmark must be **reported** in the **Report (9.3.6.1)***

24 instances of both the EgenDriverMEE and EgenDriverCE were used in this report.

6.2 Measured Throughput

*The **Measured Throughput** must be **reported** in the **Report. (9.3.6.2)***

Measured tpsE for this run was 2,001.12 tpsE.

Test Run Graph and Steady State Measurement

*A **Test Run Graph** of throughput versus elapsed wall clock time must be **reported** in the **Report** for the Trade-Result Transaction.(9.3.6.3)*

*The method used to determine that the **SUT** had reached a **Steady State** prior to commencing the **Measurement Interval** must be **reported** in the **Report**.(9.3.6.4)*

After initial ramp-up, throughput and response time were observed until both were constant, generally to within less than a percent of the reported throughput. Throughput and response time were determined by examining the data after the run was terminated. The data was reported over every 60 second window during the test run. Ramp up and steady state can be seen from the graph below.

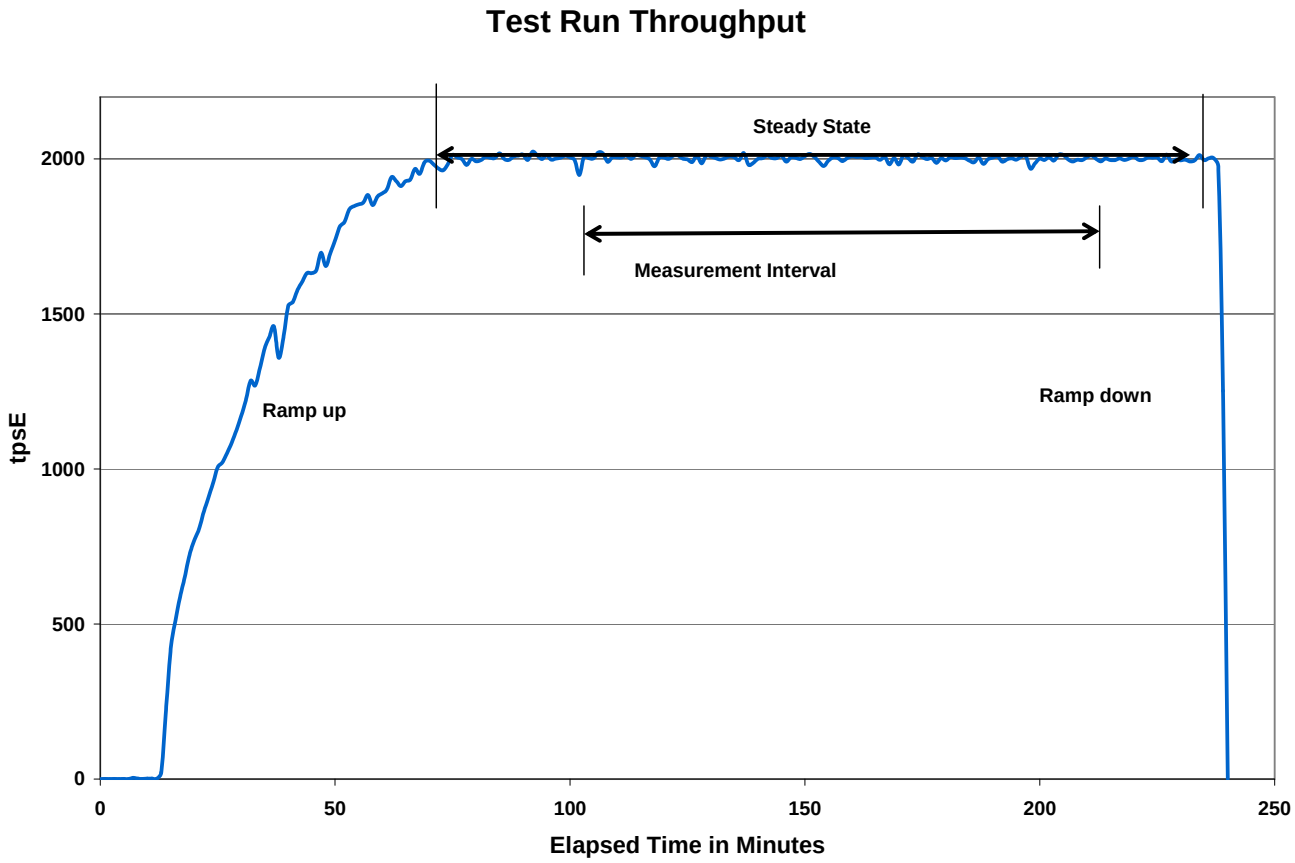

Figure 6.1 Test Run Time/Steady State Measurement Run Data

6.4 Work Measurement

*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 check-pointing, writing **Undo/Redo Log** records, etc). (9.3.6.5)*

During the run, the Customer Emulator engines (Driver Engines) generated transactions via the audited stored procedures as per the TPC-E specification. Each transaction was time-stamped, response time verified, and the transactions logged into individual log files. Communication was done between the Driver Engine Customer Emulators and Market Emulators to the SUT Server emulators, which in turn generated commands via ODBC connections to Microsoft SQL Server 2008 R2 Enterprise Edition. Satisfying these ODBC requests constitute the primary load on the server during the run.

Checkpoints were performed to flush all dirty pages from memory, and write a record of this fact to the transaction log. This was accomplished by setting the SQL Recovery Interval to 32767, which effectively tells SQL to not checkpoint automatically. Near the beginning of the test run, a script was started that did manual checkpoints, specifying an interval of 435 seconds. SQL Server was run with run flag 3502, which caused it to display messages when checkpoints were started and ended. This was used to verify the checkpoints were done in the time intervals as required by the TPC-E specification.

6.5 Transaction Reporting

*The recorded averages over the **Measurement Interval** for each of the **Transaction** input parameters specified by clause 6.4.1 must be **reported** in the **Report**. (9.3.6.6)*

Table 6.2 shows the Averages for the Test Run.

Transaction	Over-all	Parameter	Value	Range Check	Acceptable Range	
					Min	Max
Customer Position	OK	By Tax ID	49.98%	Ok	48.00%	52.00%
		Get History	50.00%	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	30.00%	Ok	28.50%	31.50%
		Frame 4	9.99%	Ok	9.50%	10.50%
Market Watch	OK	By Watch List	60.01%	Ok	57.00%	63.00%
		By Customer Acct	34.99%	Ok	33.00%	37.00%
		By Industry	5.00%	Ok	4.50%	5.50%
Trade Update	OK	Frame 1	33.01%	Ok	31.00%	35.00%
		Frame 2	33.01%	Ok	31.00%	35.00%
		Frame 3	33.98%	Ok	32.00%	36.00%
Security Detail	OK	Access LOB	1.01%	Ok	0.90%	1.10%
Trade Order	OK	By Non-Owner	10.00%	Ok	9.50%	10.50%
		By Company Name	39.99%	Ok	38.00%	42.00%
		Buy on Margin	8.00%	Ok	7.50%	8.50%
		Rollback	0.99%	Ok	0.94%	1.04%
		LIFO	35.01%	Ok	33.00%	37.00%
		Trade by Qty 100	25.00%	Ok	24.00%	26.00%
		Trade by Qty 200	24.98%	Ok	24.00%	26.00%
		Trade by Qty 400	25.01%	Ok	24.00%	26.00%
		Trade by Qty 800	25.01%	Ok	24.00%	26.00%
		Market Buy	30.01%	Ok	29.70%	30.30%
		Market Sell	30.00%	Ok	29.70%	30.30%
		Limit Buy	20.00%	Ok	19.80%	20.20%
		Limit Sell	10.01%	Ok	9.90%	10.10%
		Stop Loss	9.98%	Ok	9.90%	10.10%

Table 6.2 Average Transaction Parameters

Clause 7: Transaction and System Properties

7.1 ACID Tests

*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 Atomicity, Consistency, Isolation, and Durability tests are specified by the TPC-E specification. These requirements are translated into audited procedures which are executed either on a fresh database (Isolation, Atomicity), or after a test run (Consistency). Instructions for running these tests are included in the file ***MSTPCE ACID Procedures.pdf.*** This file, along with results of these tests is contained in the *Supporting Files* directory under ***Clause7***.

Durability test consisted of Data Accessibility and Business Recovery tests. The procedures for each are outlined below.

7.2 Redundancy Level and Data Accessibility Tests

*The **Test Sponsor** must **report** in the **Report** the Redundancy Level and describe the Data **Accessibility** test(s) used to demonstrate compliance.(9.3.7.2)*

Redundancy level 1 was used for all tests and the measured run.

The Data Accessibility Test was performed according to the following steps

1. The rows in the Settlement table were counted to establish the initial count of trades present.
2. A run was started using the same profile and configuration as the test run (reported result) and ramped up to 95% of the Reported Throughput.
3. After more 5 minutes of running at >= 95% of the Reported Throughput, a data disk in the RAID10 data arrays was pulled, and a few seconds later, a log disk in the RAID10 log array was pulled.
4. The benchmark was allowed to run for 5 more minutes at steady state, all at >= 95% of Reported Throughput.
5. After the 5 minutes, the disks were replaced by different disks of the same size and a rebuild of the volumes started automatically by the Smart Array controllers.
6. The run continued for more than 20 minutes at >=95% of the Reported Throughput.
7. The run was also crashed as a part of the Business Recovery test. Various reports were run. No errors were reported at any time in this process.
8. The rows in the Settlement table were counted again to establish the final number of trades present in the data base.
9. The initial count was subtracted from the final count and was verified against the reported number of Trade-Result transactions
10. After the two disks were rebuilt, the recovery was considered complete.

7.3 Data Accessibility Graph

*A Data **Accessibility** Graph for each run demonstrating a Redundancy Level must be **reported** in the **Report. (9.3.7.3)***

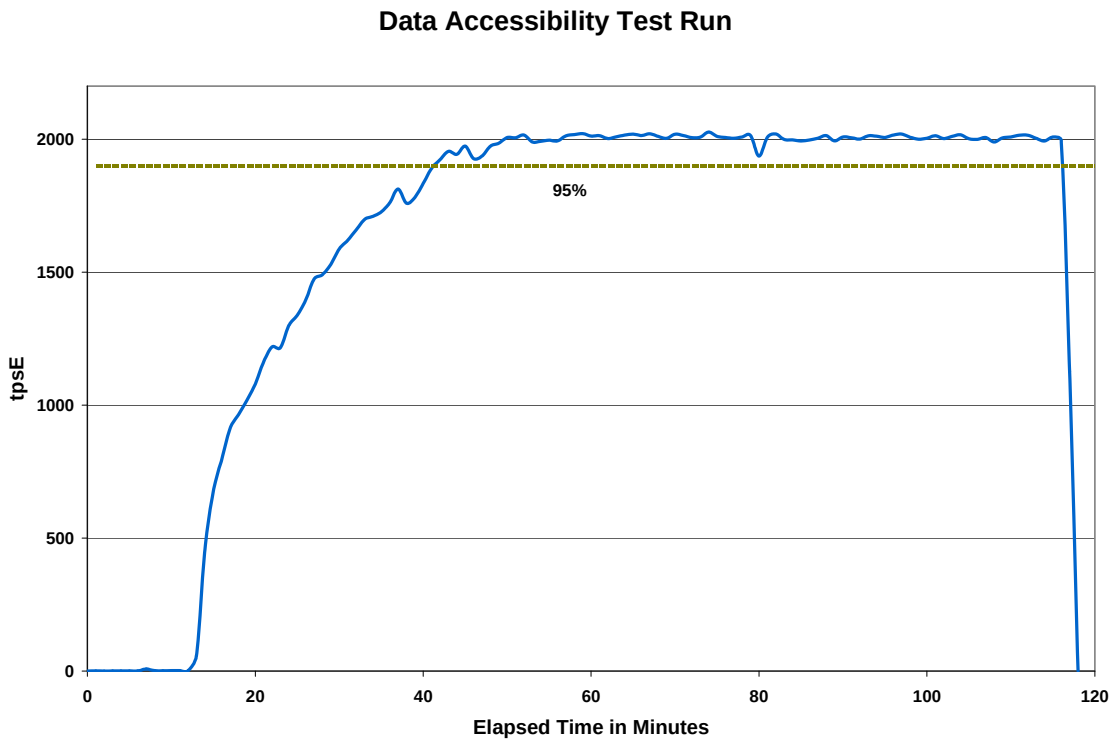

Figure 7.1 Data Accessibility Test Run Graph

7.4 Business Recovery Tests

*The **Test Sponsor** must describe in the **Report** the test(s) used to demonstrate **Business Recovery**.(9.3.7.4)*

This test measures the time it takes to recover to 95% of the reported throughput after a system power loss.

1. The rows in the Settlement table were counted to establish the initial count of trades present.
2. A run was started using the same profile and configuration as the test run (reported result) and ramped up to 95% of the Reported Throughput.
3. Primary power to Tier B server was removed (i.e., the plug was pulled).
4. Drivers noted transaction failures almost immediately, and the driver environment was terminated while the servers were booting back up.
5. Power was restored to Tier B server, and the machines rebooted.
6. After the OS was running, SQL Server was started, which automatically started transaction recovery of the primary TPCE data base. This process reads the transaction log and reapplies all committed transactions and rollback any incomplete transactions. At the end of this process, the database on disk will be logically consistent.
7. Business Recovery starts with the first line of output produced by Microsoft SQL Server 2008 R2 Enterprise Edition.
8. After SQL finished recovery of TPCE and reported that the data base was available, the Trade-Cleanup Transaction was executed.
9. The benchmark was started and ramped up as before to 95% of the Reported Throughput.

10. The benchmark was allowed to run at >=95% for 20 minutes.
11. The driver environment was terminated gracefully. No errors were reported.
12. The rows in the Settlement table were counted again to determine the final number of trades present.
13. The initial count was subtracted from the final count was calculated, and this number was verified to be greater than or equal to the number of Trade-Result transacts as logged during the run.
14. The Consistency scripts were run to verify the data base was logically consistent.
15. The beginning of the first window of time where >=95% for 20 minutes was noted, which marked the end of the Business Recovery interval.

Business Recovery Time was 1 hour 10 minutes and 49 seconds. This is also reported in the Executive Summary.

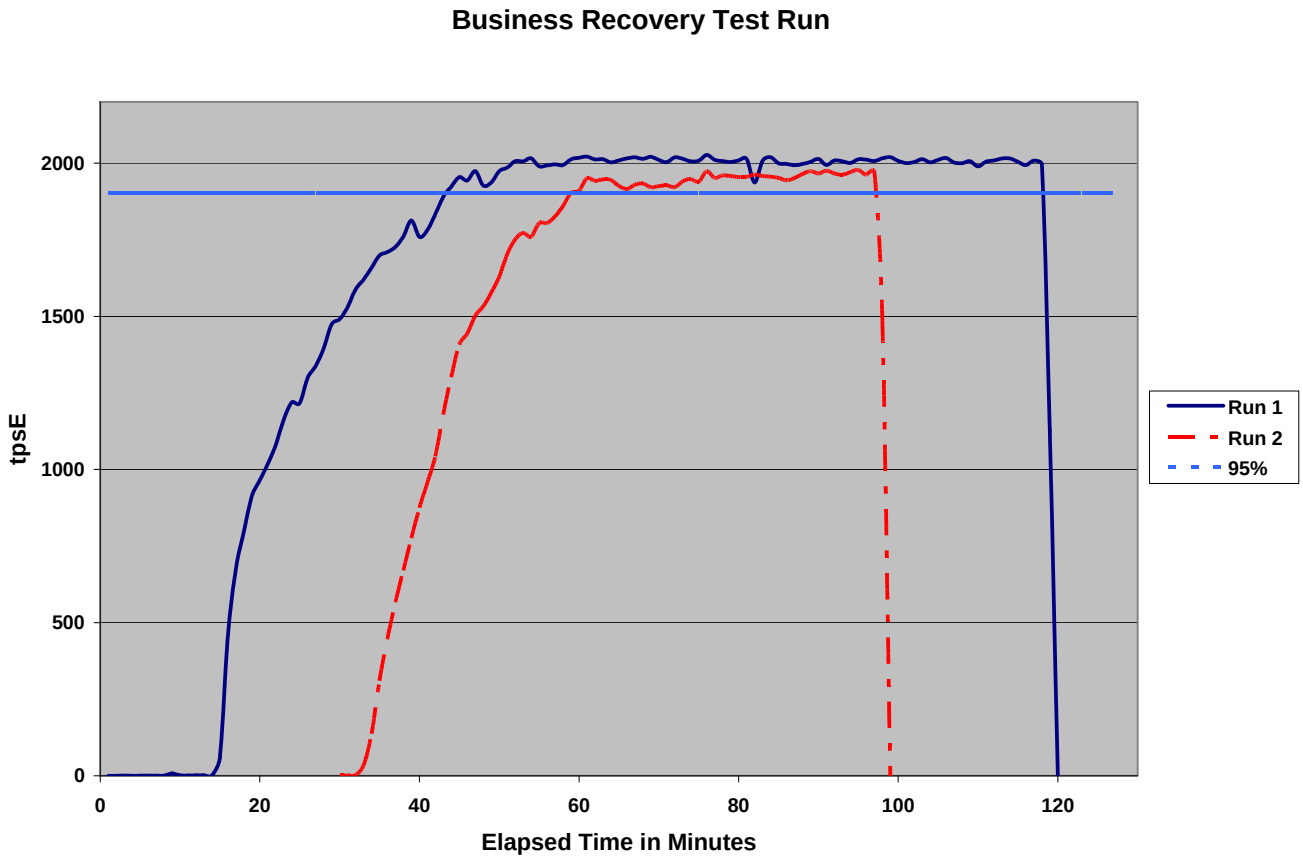

Figure 7.2 The Business Recovery Tests Graph

Clause 8: Pricing Related Items

8.1 60-Day Space

*Details of the **60-Day Space** computations along with proof that the database is configured to sustain a **Business Day** of growth must be **reported** in the **Report**. (9.3.8.1)*

Below is the 60 Day Space spreadsheet as prepared by the auditor and verified from the IO configuration.

Space calulcations for TPC-E

Customers: 1,050,000
TpsE: 2,001.12
TradeResult count: 25,092,724

Table	Rows	Data(KB)	Index(KB)	Total	Total + 5%	Rows After	Data After(KB)	Index After(KB)
ACCOUNT_PERMISSION	7454828	634672	4824	639,496	671,471	7454828	634840	4976
ADDRESS	1575004	90928	1688	92,616	97,247	1575004	90984	1688
BROKER	10500	768	1008	1,776	1,865	10500	768	1008
CASH_TRANSACTION	16692481567	1723585048	3638648	1,727,223,696	1,813,584,881	16715568160	1728212240	3653800
CHARGE	15	8	8	16	17	15	8	8
COMMISSION_RATE	240	16	16	32	34	240	16	16
COMPANY	525000	114392	34032	148,424	155,845	525000	114400	34032
COMPANY_COMPETITOR	1575000	42368	36288	78,656	82,589	1575000	42368	36288
CUSTOMER	1050000	177920	48248	226,168	237,476	1050000	177952	48248
CUSTOMER_ACCOUNT	5250000	475816	103424	579,240	608,202	5250000	475816	103424
CUSTOMER_TAXRATE	2100000	43856	1688	45,544	47,821	2100000	44016	1688
DAILY_MARKET	938621250	48618192	172632	48,790,824	51,230,365	938621250	48619536	172856
EXCHANGE	4	8	8	16	17	4	8	8
FINANCIAL	10500000	1235496	4960	1,240,456	1,302,479	10500000	1235736	5128
HOLDING	928855578	61933360	39226928	101,160,288	106,218,302	929475296	63454648	39233064
HOLDING_HISTORY	24316103321	884222152	511080024	1,395,302,176	1,465,067,285	24349951871	887213104	513095952
HOLDING_SUMMARY	52216631	2277952	9872	2,287,824	2,402,215	52216316	2277952	9872
INDUSTRY	102	8	24	32	34	102	8	24
LAST_TRADE	719250	44784	1688	46,472	48,796	719250	44784	1688
NEWS_ITEM	1050000	113839752	2800	113,842,552	119,534,680	1050000	113839776	2808
NEWS_XREF	1050000	26216	1688	27,904	29,299	1050000	26216	1688
SECTOR	12	8	24	32	34	12	8	24
SECURITY	719250	113640	27976	141,616	148,697	719250	113664	27976
SETTLEMENT	18144000000	961819160	2028632	963,847,792	1,012,040,182	18169092724	964542592	2038224
STATUS_TYPE	5	8	8	16	17	5	8	8
TAXRATE	320	24	16	40	42	320	40	16
TRADE	18144000000	2164943072	1089210440	3,254,153,512	3,416,861,188	18169212174	2168131200	1097614440
TRADE_HISTORY	43545559454	1309641120	3415856	1,313,056,976	1,378,709,825	43605827113	1314255024	3435216
TRADE_REQUEST	0	8	40	48	50	119450	52192	23040
TRADE_TYPE	5	8	1032	1,040	1,092	5	8	1032
WATCH_ITEM	104941231	2928488	12192	2,940,680	3,087,714	104941231	2928648	12352
WATCH_LIST	1050000	26216	23312	49,528	52,004	1050000	26216	23312
ZIP_CODE	14741	488	176	664	697	14741	488	176
Totals in KB	1.22901E+11	7276835952	1649090200	8925926152	9372222460		7296555264	1659584080

Database File Groups	Allocated size MB	Required size MB	Diff	
Fixed	300,000	173,182	126,818	OK
Growing	12,500,000	8,979,452	3,520,548	OK
Total	12,800,000	9,152,634		
Total in GB	12,500.0	8,938.1		

Growing Space	30,210,248	KB
per Trade Results	1.20	KB
Data Growth	69,386,040	KB
60 Day Space	13,089,088,541	KB
60 Day Space	12,483	GB

		%	size
Log space before in MB	15,886	3.1772187	500000
Log space after in MB	179,460	35.89209	500000
per Trade Results	0.007		
Log Growth	375,693	MB	
Total 8 hours log space	391,579	MB	
Total 8 hours log space	382.40	GB	

	Count	Formatted size GB	Total GB Configured	Total Needed
Data Disks configured	0	33.37	-	
	750	66.85	50,138	
	240	135.49	32,518	
RAID 10 overhead 50%			(41,328)	
Data Disks space total			**41,328**	12,483
Log Disks configured	4	279.35	1,117	
RAID 10 overhead 50%			(559)	
Log Disk space total			559	382

8.1 Attestation Letter

June 20, 2010

Mr. Paul Cao
Senior System Engineer
Hewlett-Packard Company
20555 SH 249
Houston, TX 77070

I have verified by remote the TPC Benchmark™ E for the following configuration:
Platform: HP ProLiant DL580 G7
Database Manager: Microsoft SQL Server 2008 R2 Enterprise Edition
Operating System: Microsoft Windows Server 2008 R2 Enterprise Edition
Transaction Monitor: Microsoft COM+

System Under Test:			
CPU's	Memory	Disks (total)	TpsE
4 Intel 8 core @ 2.3 Ghz	Main: 1.00 TB	752 @ 72 GB 4 @ 300 GB 240 @ 146 GB	**2,001.12**
4 Clients (Tier A): ProLiant DL360 G5			

1 Intel quad core @ 2.50 Ghz	2 GB	4 @ 72 GB	NA	**NA**

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

- All EGen components were verified to be version 1.10.0.
- The database files were properly sized and populated for 1,050,000 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 on Data-Maintenance process was running during the test run.
- There were no inactive load units during the test run.
- Eight hours of mirrored log space was present on the measured system.
- Eight hours of growth space was present on the measured system.
- The data for the 60 day space calculation was verified.
- The steady state portion of the test was 120 minutes.
- Checkpoint interval was verified to be equal to or less than 7.5 minutes and no two checkpoints lasted longer than 15 minutes.
- The system pricing was checked for major components and maintenance.
- Third party quotes were verified for compliance.
- The FDR, Executive Summary and Supporting Files were reviewed and verified as required.

Auditor Notes: None.

Sincerely,

Lorna Livingtree, Certified Auditor

Clause 9: Supporting Files

9.1 Supporting Files

*The **Supporting Files** contain human readable and machine executable (i.e., able to be performed by the appropriate program without modification) scripts that are required to recreate the benchmark **Result**. If there is a choice of using a GUI or a script, then the machine executable script must be provided in the **Supporting Files**. If no corresponding script is available for a GUI, then the **Supporting Files** must contain a detailed step by step description of how to manipulate the GUI.(9.4)*

Appendix A: Third Party Pricing Quotes/Pricing

Microsoft

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

June 16, 2010

Hewlett-Packard Company
Paul Cao
20555 SH 249
Houston, TX 77070

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
810-07580	**SQL Server 2008 R2 Enterprise Edition** *Per Processor License* *Open Program - Level C* *Unit Price reflects a 33% discount from the retail unit price of $28,749.*	$19,188	4	$76,752
P72-04217	**Windows Server 2008 R2 Enterprise Edition** *Server License with 25 CALs* *Open Program - Level C* *Unit Price reflects a 43% discount from the retail unit price of $3,999.*	$2,280	1	$2,280
P73-04165	**Windows Server 2008 Standard Edition** *Server License with 5 CALs* *Open Program - Level C* *Unit Price reflects a 29% discount from the retail unit price of $999.*	$711	4	$2,844
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident).*	$259	1	$259

All Microsoft products listed above are currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found at the Microsoft Product Information Center at **http://www.microsoft.com/products/info/render.aspx?view=22&type=how**
Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at $259 per call.

This quote is valid for the next 90 days.

Reference ID: TPCE_g3wOpiq6ZAtgdnQQtWbatNjU7f+RiCyr_V1.0.0.

Appendix B: TPC-Energy Disclosure Report

B.1. TPC-Energy Clause 2-related items (Methodology)

B.1.1. Minimum ambient temperature

The minimum ambient temperature must be discolsed

Minimum Temperature reported by EMSC = 20.47 °C

B.1.2. External electric power source characteristics

The characteristics of the external electric power source must be disclosed. In particular, the voltage, frequency in Hertz, and phase information must be reported.

The external electric power source has the folowing characteristics: 208V, 60Hz, single phase.

B.1.3. Air-pressure alterations

A statement is required that assures that nothing was done to alter the air-pressure in the measurement environment.

Nothing was done to alter the air-pressure in the measurement environment.

B.1.4. Temperature measurement

A description of where the temperature was measured and how it was determined that this was representative of the lowest ambient temperature is required.

The temperature was measured at the SUT air inlet located at the lowest temerature of the SUT

B.1.5. Cooling method

If a method of cooling other than circulation of ambient air is employed in the REC, a statement describing this method must be included.

No other method of cooling was used.

B.1.6. PTD license

To be compliant with licenses associated with EMS, the following statement must be included in every FDR which contains a TPC-Energy Metric:

> *The power and temperature characteristics of the MEC were measured using TPC's Energy Measurement Software (EMS). This includes the EMS-PTD, a modified version of the SPEC PTDaemon, which is provided under license from the Standard Performance Evaluation Corporation (SPEC).*

B.2. TPC-Energy Clause 3-related items (Metrics)

B.2.1. Primary Metric

The normalized work derived from the Performance Metric (as described in Clause 3.2.1) must be disclosed

5.84 watts / tpsE

The computation for total energy used for each measurement segment that contributes to a Performance Metric must be disclosed. If the energy of the entire Priced Configuration is not derived from direct measurements, the methods for deriving the energy for components that were not measured must be disclosed (See Clause 7.3.3.4)

			Full Load Energy									
PMU	Full Load Average Watts Reading	% of Reading Uncertainty	Watts Reading Correction	Wattage Range Setting	% of Range Uncertainty	Wattage Range Correction	Total Wattage Correction	Accuarcy Correction Factor	Reported Watt - Seconds	Adjusted Watt - Seconds	Reported Seconds	Adjusted Average Watts
DB Server PMU-1	1696.34	0.10%	+1.70	3000	0.10%	+3.00	+4.70	0.28%	12,215,344	12,249,162	7,200	1,701.27
DB Server Total	**1696.34**								**12,215,344**	**12,249,162**		**1,701.27**
Storage PMU-1	2821.57	0.10%	+2.82	6000	0.10%	+6.00	+8.82	0.31%	20,318,134	20,381,658	7,200	2,830.79
Storage PMU-2	2498.64	0.10%	+2.50	6000	0.10%	+6.00	+8.50	0.34%	17,992,675	18,053,874	7,200	2,507.48
Storage PMU-3	2663.42	0.10%	+2.66	6000	0.10%	+6.00	+8.66	0.33%	19,179,277	19,241,662	7,200	2,672.45
Storage PMU-4	1066.9	0.10%	+1.07	3000	0.10%	+3.00	+4.07	0.38%	7,682,779	7,712,065	7,200	1,071.12
Storage Total	**9050.53**								**65,172,865**	**65,389,258**		**9,081.84**
App Server PMU-1	767.27	0.10%	+0.77	1500	0.10%	+1.50	+2.27	0.30%	5,525,101	5,541,428	7,200	769.64
App Server Total	**767.27**								**5,525,101**	**5,541,428**		**769.64**
Misc PMU-1	101.22	0.10%	+0.10	600	0.10%	+0.60	+0.70	0.69%	728,887	733,936	7,200	101.94
Monitor Name Plate	28	0.00%	+0.00	0	0.00%	+0.00	+0.00	0.00%	201,600	201,600	7,200	28.00
Misc Total	**129.22**								**930,487**	**935,536**		**129.94**
REC Total	**11,643.36**								**83,843,796**	**84,115,385**		**11,683**

All monitors power consumption in the Miscellanous Subsystem were calculated using nameplate values.

The duration of each measurement that produces a Performance Metric must be disclosed

The duration of the measured run was 120 minutes. The idle measurement was 10 minutes.

The average power requirement for each measurement that produces one of these metrics,

	Secondary Metrics	Additional Numerical Quanties				
	Watts / tpsE	Full Load Avg Watts	Full Load % of REC	Full Load Watt Secs	Idle Avg. Watts	Idle % of REC
Database Server	0.85	1,701.27	14.6%	12,249,162	1,315.87	12.4%
Storage	4.54	9,081.84	77.7%	65,389,258	8,431.85	79.5%
Application Server	0.38	769.64	6.6%	5,541,428	722.20	6.8%
Miscellaneous	0.06	129.94	1.1%	935,536	130.03	1.2%
Total REC	5.84	11683	100%	84,115,385	10600	100%
			Total SUT Work	14,408,064		
Reported tpsE	2001.12		MI Seconds	7200		

Total REC Energy Consumption = 84,115,385 watt-seconds
SUT Total Work = 14,408,064 transactions

84,115,385 watt-seconds / 14,408,064 = 5.84 watts / tpsE

B.2.2. Secondary Metrics At Reported Performance

If the TPC-Energy Secondary Metrics are reported, the components of the REC that are included in each subsystem must be identified. This can be achieved with separate lists to be included in the FDR or with a specific designation in the price spreadsheet. Every component in the REC that consumes energy must be included in exactly one subsystem.

TPC-Energy secondary metrics are reported.

Description	Part Number	Qty
Server Subsystem		
HP DL580R07 CTO Chassis	588857-B21	1
HP X7560 DL580 G7 2P FIO Kit	588143-L21	2
HP 16GB 4Rx4 PC3-8500R-7 US Kit/S-Buy	500666-S21	64
HP 72GB 3G SAS 10K SFF DP ENT HDD	384842-B21	2
HP Smart Array P411/512 MB with BBWC Controller	462832-B21	7
HP NC364T PCI Express Quad Port Gigabit Server Adapter	412648-B21	1
HP LE1851w 18.5-Inch wide Monitor	NK033AA#ABA	1
HP PS/2 Keyboard And Mouse Bundle	RC464AA#ABA	1
HP 300GB SAS 10K SFF DP ENT HDD	512547-B21	4
Storage Subsystem		
HP StorageWorks D2700 Disk Enclosure	AJ941A	40
HP 72GB 6G SAS 15K SFF DP ENT HDD	512545-B21	760
HP 146GB 6G SAS 15K SFF DP ENT HDD	512547-B21	240
Application Server Subsystem		
HP ProLiant DL360 G5 E5420 2.50GHz Quad Core 2GB Rack Server	457925-001	4
HP 72GB 3G SAS 10K SFF DP ENT HDD	384842-B21	16
HP NC360T PCI-E Dual Port Gigabit Server Adapter	412648-B21	4
HP 3y 4h 24x7 ProLiant DL36x HW Support ,ProLiant DL36x	U4497E	4
Miscellaneous Subsystem		
HP ProCurve 2910al-24G Switch 24-port 10/100/1000 basic Layer 3	J9145A#ABA	2
HP LE1851w 18.5-Inch wide Monitor	NK033AA#ABA	1

For each defined subsystem, the calculations defined for the TPC-Energy Secondary Metrics in Clause 3.3 must be reported, using the Performance Metric of the entire SUT and the energy consumption for each REC subsystem.

	Secondary Metrics	Additional Numerical Quanties				
	Watts / tpsE	Full Load Avg Watts	Full Load % of REC	Full Load Watt Secs	Idle Avg. Watts	Idle % of REC
Database Server	0.85	1,701.27	14.6%	12,249,162	1,315.87	12.4%
Storage	4.54	9,081.84	77.7%	65,389,258	8,431.85	79.5%
Application Server	0.38	769.64	6.6%	5,541,428	722.20	6.8%
Miscellaneous	0.06	129.94	1.1%	935,536	130.03	1.2%
Total REC	5.84	11683	100%	84,115,385	10600	100%
			Total SUT Work	14,408,064		
Reported tpsE	2001.12		MI Seconds	7200		

2,001.12 tpsE * 7200 seconds MI = 14,408,064 transactions (SUT Total Work)

12,249,162 watt-seconds / 14,408,064 transactions = 0.85 DBServer watts/tpsE

65,389,258 watt-seconds / 14,408,064 transactions = 4.54 Storage watts/ tpsE

5,541,428 watt-seconds / 14,408,064 transactions = 0.38 AppServer watts/ tpsE

935,536 watt-seconds / 14,408,064 transactions = 0.06 Misc. watts/ tpsE

B.2.3. Idle Power reporting

The Idle Power measurement/calculation for the REC must be reported as numerical quantities.

The Idle power measurement for REC = 10,600 watts.

If TPC-Energy Secondary Metrics are reported, then the Idle Power measurement/calculation for each subsystem must also be reported as numerical quantities.

			Idle Load Energy									
PMU	Idle Average Watts Reading	% of Reading Uncertainty	Watts Reading Correction	Wattage Range Setting	% of Range Uncertainty	Wattage Range Correction	Total Wattage Correction	Accuarcy Correction Factor	Reported Watt - Seconds	Adjusted Watt - Seconds	Reported Seconds	Adjusted Average Watts
DB Server PMU-1	1310.87	0.10%	+1.31	1500	0.10%	+1.50	+2.81	0.21%	787,833	789,523	600	1,315.87
DB Server Total	1310.87								787,833	789,523		1,315.87
Storage PMU-1	2542.69	0.10%	+2.54	6000	0.10%	+6.00	+8.54	0.34%	1,528,159	1,533,293	600	2,555.49
Storage PMU-2	2432.73	0.10%	+2.43	6000	0.10%	+6.00	+8.43	0.35%	1,462,072	1,467,140	600	2,445.23
Storage PMU-3	2456.13	0.10%	+2.46	6000	0.10%	+6.00	+8.46	0.34%	1,476,137	1,481,219	600	2,468.70
Storage PMU-4	956.88	0.10%	+0.96	3000	0.10%	+3.00	+3.96	0.41%	575,082	577,460	600	962.43
Storage Total	8388.43								5,041,450	5,059,113		8,431.85
App Server PMU-1	718.78	0.10%	+0.72	1500	0.10%	+1.50	+2.22	0.31%	431,989	433,323	600	722.20
App Server Total	718.78								431,989	433,323		722.20
Misc PMU-1	101.16	0.10%	+0.10	600	0.10%	+0.60	+0.70	0.69%	60,799	61,221	600	102.03
Monitor Name Plate	28	0.00%	+0.00	0	0.00%	+0.00	+0.00	0.00%	16,800	16,800	600	28.00
Misc Total	129.16								77,599	78,021		130.03
REC Total	10,547.24								6,338,872	6,359,978		10,600

The length of time between the conclusion of the performance measurement and the start of the idle measurement must be reported.

Idle measurement was started 12 minutes after all data processing was completed.

The duration of the idle measurement must be reported

Idle measurement duration was 10 minutes.

A statement is required that assures that the system is in a state that is ready to run the Application(s) of the benchmark for the duration of the idle measurement.

The system is in a state that is ready to run the Application(s) of the benchmark for the duration of the idle measurement. This was verified by executing one transaction after the idle measurement interval was completed. The transaction time was compared to the allowed 90^{th} percentile and found to meet the required specifications.

B.2.4. Disclosure requirements when only part of the REC is measured for power

If all PMU's of the REC are not measured for energy use, the FDR must include a description of which PMUs of REC were measured with a power analyzer. The FDR must disclose which PMUs of the REC were computed based on the energy measurements of similar PMUs. A diagram must be included that identifies the portions of the configuration which were measured for energy use and which were calculated. This diagram may be combined with other diagrams required by the TPC Benchmark Standard.

- *The method used to determine which PMUs were measured must be disclosed.*
- *The power values for the each partial-REC measurement for duration of the performance and idle measurements must be disclosed.*
- *The calculation for the power requirements of the entire REC and, if applicable, each subsystem must be disclosed.*

The monitor power consumption in the Miscellaneous Subsystem was calculated using the nameplate value.

B.2.5. Disclosure requirements when component substitution is used

If the TPC Benchmark Standard allows the Priced Configuration to differ from the Measured Configuration, the methods used to assign energy or power characteristics to the substitute components must be disclosed

The Priced Configuration was identical to the Measured Configuration.

			Full Load Energy									
PMU	Full Load Average Watts Reading	% of Reading Uncertainty	Watts Reading Correction	Wattage Range Setting	% of Range Uncertainty	Wattage Range Correction	Total Wattage Correction	Accuarcy Correction Factor	Reported Watt - Seconds	Adjusted Watt - Seconds	Reported Seconds	Adjusted Average Watts
DB Server PMU-1	1696.34	0.10%	+1.70	3000	0.10%	+3.00	+4.70	0.28%	12,215,344	12,249,162	7,200	1,701.27
DB Server Total	**1696.34**								**12,215,344**	**12,249,162**		**1,701.27**
Storage PMU-1	2821.57	0.10%	+2.82	6000	0.10%	+6.00	+8.82	0.31%	20,318,134	20,381,658	7,200	2,830.79
Storage PMU-2	2498.64	0.10%	+2.50	6000	0.10%	+6.00	+8.50	0.34%	17,992,675	18,053,874	7,200	2,507.48
Storage PMU-3	2663.42	0.10%	+2.66	6000	0.10%	+6.00	+8.66	0.33%	19,179,277	19,241,662	7,200	2,672.45
Storage PMU-4	1066.9	0.10%	+1.07	3000	0.10%	+3.00	+4.07	0.38%	7,682,779	7,712,065	7,200	1,071.12
Storage Total	**9050.53**								**65,172,865**	**65,389,258**		**9,081.84**
App Server PMU-1	767.27	0.10%	+0.77	1500	0.10%	+1.50	+2.27	0.30%	5,525,101	5,541,428	7,200	769.64
App Server Total	**767.27**								**5,525,101**	**5,541,428**		**769.64**
Misc PMU-1	101.22	0.10%	+0.10	600	0.10%	+0.60	+0.70	0.69%	728,887	733,936	7,200	101.94
Monitor Name Plate	28	0.00%	+0.00	0	0.00%	+0.00	+0.00	0.00%	201,600	201,600	7,200	28.00
Misc Total	**129.22**								**930,487**	**935,536**		**129.94**
REC Total	**11,643.36**								**83,843,796**	**84,115,385**		**11,683**

The method used to determine which PMUs were measured must be disclosed.

All priced PMUs were measured except for the monitor which the nameplate value was reported.

The power values for the each partial-REC measurement for duration of the performance and idle measurements must be disclosed.

See Chart Above.

B.3. TPC-Energy Clause 4-related items (Drivers /Controller)

A statement indicating the version of EMS used must be included in the FDR, including a statement that no alterations of this code were made for the benchmark, except as specified by Clause 7.3.4.3. This includes levels for the EMS-PTD Manager, EMS-PTD and EMS-controller

EMS version was 1.1.1 and no alterations were made.

Input parameters for the EMS software must be disclosed

Any changes in the EMS components must be documented. Documentation must include a description of the issue, the reason the change was necessary for disclosure of the Result, and the changes made to resolve it. Any change to TPC-Provided Code must be included with the submission as a Supporting File.

No changes to EMS components were made.

B.4. TPC-Energy Clause 6-related items (Instrumentation)

B.4.1. Power Analyzer information

			Power Analyzer Specifications and Settings						
PMU	Make	Model	Serial Number	Calibration Date	Wattage (W) Range Setting	Voltage (V) Range Setting	Current (A) Range Setting	% of reading	% of Range
DB Server PMU-1	Yokogawa	WT210	91J713272	8/26/2009	1500	300	5	0.10%	0.10%
Storage PMU-1	Yokogawa	WT210	91GB53023	12/10/2009	6000	300	20	0.10%	0.10%
Storage PMU-2	Yokogawa	WT210	91GB45372	12/10/2009	6000	300	20	0.10%	0.10%
Storage PMU-3	Yokogawa	WT210	91J716746	12/10/2009	6000	300	20	0.10%	0.10%
Storage PMU-4	Yokogawa	WT210	91GC21887	12/10/2009	3000	300	10	0.10%	0.10%
App Server PMU-1	Yokogawa	WT210	91GC23225	12/10/2009	1500	300	5	0.10%	0.10%
Misc PMU-1	Yokogawa	WT210	91K112851	2/8/2010	600	300	2	0.10%	0.10%

B.4.2. Temperature Sensor information

Make and model.
Accuracy and the source of info

Digi Watchport/H Temperature Probe.

Temperature accuracy from Manufacturer's Datasheet:
+/- 3.6º F (+/- 2º C) at -40º F to 14º F (-40º C to -10º C)
+/- 0.9º F (+/- 0.5º C) at 14º F to 185º F (-10º C to 85º C)

B.5. TPC-Energy Clause 8-related items

B.5.1. Auditor's attestation letter.

June 20, 2010

Mr. Paul Cao
Senior System Engineer
Hewlett-Packard Company
20555 SH 249
Houston, TX 77070

I have verified by remote the TPC Benchmark™ E for the following configuration:
Platform: HP ProLiant DL580 G7
Database Manager: Microsoft SQL Server 2008 R2 Enterprise Edition
Operating System: Microsoft Windows Server 2008 R2 Enterprise Edition

Transaction Monitor: Microsoft COM+

System Under Test:				
CPU's	Memory	Disks (total)		TpsE
4 Intel 8 core @ 2.3 Ghz	Main: 1.00 TB	752 @ 72 GB 4 @ 300 GB 240 @ 146 GB		**2,001.12**
4 Clients (Tier A): ProLiant DL360 G5				
1 Intel quad core @ 2.50 Ghz	2 GB	4 @ 72 GB	NA	**NA**

In addition to the performance metric, the energy consumption was measured during the performance runs in compliance with the TPC-Energy specification.

- The power analyzers used were verified to be approved and calibrated within one year prior to this measurement.
- The energy measurements met all requirements of the specification unless an exception is noted below.
- The calculations for the TPC-Energy Primary Metric were verified as completed correctly.
- The EMS software was verified to be the correct version and without any changes.
- The executive summary page and the FDR were verified for accuracy.

Auditor's Notes: None.

Sincerely,

Lorna Livingtree, Certified Auditor

B.6. TPC-Energy Supporting Files Index

Clause	Description	Path
7.4.1	PTDM Log Files (XML)	Misc-001.xml
7.4.1	PTDM Log Files (XML)	REC-Temperature-001.xml
7.4.1	PTDM Log Files (XML)	StorageArrayFour-001.xml
7.4.1	PTDM Log Files (XML)	StorageArrayOne-001.xml
7.4.1	PTDM Log Files (XML)	StorageArrayThree-001.xml
7.4.1	PTDM Log Files (XML)	StorageArrayTwo-001.xml
7.4.1	PTDM Log Files (XML)	AppServer-001.xml
7.4.1	PTDM Log Files (XML)	DBServer-001.xml
7.4.1	PTDM Log Files (txt)	001.report.perf-AppServer.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-DBServer.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-Misc.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-REC-Temperature.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-StorageArrayFour.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-StorageArrayOne.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-StorageArrayThree.txt
7.4.1	PTDM Log Files (txt)	001.report.perf-StorageArrayTwo.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-AppServer.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-DBServer.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-Misc.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-REC-Temperature.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-StorageArrayFour.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-StorageArrayOne.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-StorageArrayThree.txt
7.4.1	PTDM Log Files (txt)	001.report.idle-StorageArrayTwo.txt
7.4.1	Microsoft Excel Calculation Spreadsheet	DL580G7-TPC-E-TPC-Energy.xlsx