TPC Benchmark™ E and

TPC Benchmark™ Energy

Full Disclosure Report for

PRIMERGY RX500 S7

Using

Microsoft SQL Server 2012
Enterprise Edition

Using

Microsoft Windows Server 2008 R2
Enterprise Edition SP1

TPC-E Version 1.12.0

TPC-Energy Version 1.4.2

Submitted for Review

November 5, 2012

First Edition November 2012

Fujitsu believes that the information in this document is accurate as of the publication date. The information in this document is subject to change without notice. We assume no responsibility for any errors that may appear in this document. The pricing information in this document is believed to accurately reflect the current prices as of the publication date. However, we provide no warranty of the pricing information in this document.

Benchmark results are highly dependent upon workload, specific application requirements, 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 were obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. We do 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.

PRIMERGY RX500 S7 and PRIMERGY RX200 S7 are trademarks of Fujitsu.

Microsoft Windows Server 2008 R2, Microsoft SQL Server 2012 and BenchCraft are registered trademarks of Microsoft Corporation.

Intel® Xeon® Processor is a registered trademark of Intel.

TPC Benchmark™ is a trademark of the Transaction Processing Performance Council (TPC).

Other product names mentioned in this document may be trademarks and/or registered trademarks of their respective companies.

Abstract

This report documents the TPC Benchmark™ E results achieved by Fujitsu using Microsoft SQL Server 2012 Enterprise Edition.

The TPC Benchmark™ E tests were run on a PRIMERGY RX500 S7 system using the Microsoft Windows Server 2008 R2 Enterprise Edition SP1 operating system.

The results, summarized below, show the number of TPC Benchmark™ E transactions per second (tpsE), the price per tpsE ($/tpsE) and the TPC-Energy (Watts/tpsE).

Hardware	Software	Total System Cost	tpsE	$ USD/tpsE	Availability Date
Fujitsu PRIMERGY RX500 S7	**Microsoft SQL Server 2012 Enterprise Edition Microsoft Windows Server 2008 R2 Enterprise Edition SP1**	**$ 429,360 USD**	**2,651.27**	**$ 161.95 USD**	**November 1, 2012**

Hardware	TPC-Energy	Average Power of REC	Idle Power of REC
Fujitsu PRIMERGY RX500 S7	**0.68 Watts/tpsE**	**1,802.33 Watts**	**1,131.54 Watts**

The benchmark implementation and results were audited by Francois Raab for InfoSizing Inc. (www.sizing.com). The auditor's attestation letter is contained in Section 8 of this report.

FUJITSU	PRIMERGY RX500 S7	TPC-E 1.12.0 TPC Pricing 1.7.0 TPC-Energy 1.4.2 Report Date November 5, 2012

TPC-E Throughput **2,651.27 tpsE**	Price/Performance **$ 161.95 USD per tpsE**	Availability Date **November 1, 2012**	Total System Cost **$ 429,360 USD**	TPC-Energy Metric **0.68 Watts/tpsE**

Database Server Configuration

Operating System **Microsoft Windows Server 2008 R2 Enterprise Edition SP1**	Database Manager **Microsoft SQL Server 2012 Enterprise Edition**	Processors/Cores/Threads **4/32/64**	Memory **512 GB**

SUT

Tier A
PRIMERGY RX200 S7
2x Intel Xeon E5-2660 2.20 GHz
32 GB Memory
1x 250 GB 7.2k rpm SATA Drive
2x onboard LAN 1 Gb/s
1x Dual Port LAN 1 Gb/s

Tier B
PRIMERGY RX500 S7
4x Intel Xeon E5-4650 2.70 GHz
512 GB Memory
2x 146 GB 15k rpm SAS Drives
6x 300 GB 15k rpm SAS Drives
2x onboard LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40
90x 200 GB SSD Drives

Initial Database Size **10,904 GB**	Redundancy Level 1 **RAID-5 data and RAID-10 log**	Storage **90 x 200 GB SSD** **6 x 300 GB 15k rpm HDD**

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3-yr. Maint. Price
Database Server (Tier B) Hardware						
PRIMERGY RX500S7		1	50,345.00	1	50,345.00	
PY RX500S7	S26361-K1425-V200	1		1		
Modular PSU 800W platinum hp new rev	S26113-F574-E11	1		2		
Cable power cord rack, 4m, grey	T26139-Y1968-E100	1		2		
CPU Mezzanine Board RX500S7	S26361-F4570-E100	1		1		
Intel Xeon E5-4650 8C/16T 2.70 GHz 20MB	S26361-F4570-E650	1		4		
16GB(1x16GB)2Rx4 L DDR3-1600 R ECC	S26361-F3697-E516	1		32		
Performance Mode Installation	S26361-F3694-E2	1		4		
DVD-RW supermulti slimline SATA	S26361-F3269-E2	1		1		
HD SAS 6G 146GB 15K HOT PL 2.5" EP	S26361-F4482-E514	1		2		
HD SAS 6G 300GB 15K HOT PL 2.5" EP	S26361-F4482-E530	1		6		
RAID Ctrl SAS 6G 1GB (D3116)	S26361-F3669-E1	1		1		
RAID Ctrl SAS 6G 8Port ex 1GB FH/LP LSI	S26361-F3713-E1	1		5		
Rack-Mount Kit F2-C S7 LV	S26361-F2735-E285	1		1		
Rack Cable Arm 2U	S26361-F2735-E82	1		1		
Mounting in symmetrical Racks	S26361-F4530-E10	1		1		
Power Supply Dummy	S26113-F574-E99	1		2		
Region kit APAC/America/EMEA/Indien	S26361-F1452-E100	1		1		
PRIMERGY RX500S7 Installation, normal business hours	PYR500-N038005-0NA	1	350.00	1		350.00
PY RX500 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYR500-U004361-0NA)	PYR500-U004361-0NA	1	1,309.00	1		1,309.00
				Subtotal (*)	50,345.00	1,659.00
Storage						
PRIMECENTER RACK		1	2,400.00	1	2,400.00	
PRIMECENTER M1 Rack 724S 24U-1050x700	S26361-K827-V220			1		
Dummy panel, plastics, 1U + assembly	S26361-F4530-L131			3		
Dummy panel, plastics, 2U + assembly	S26361-F4530-L132			6		
Socket strip 3phase 3x 8 sockets	S26361-F2262-L31	1	210.00	1	210.00	
PY PRIMECENTER during normal business hours, PRIMERGY Installation, Racks, One Time billing	PYPCTR-N076005-0NA		280.00	1		280.00
PY PRIMECENTER Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYPCTR-U004361-0NA)	PYPCTR-U004361-0NA	1	720.00	1		720.00
ETERNUS JX40						
ETERNUS JX40	FTS:ETJXS11BG		3,500.00	5	17,500.00	
SSD SAS 6G 200GB MLC HOT PL 2.5" EP PERF	S26361-F4581-L200	1	2,150.00	90	193,500.00	
SAS CABLE 1X SFF 8088-1X SFF 8088 2M	D:KBSAS1S-1S-2M	1	70.00	5	350.00	
PY JX40 Warranty Uplift, 12 Months, Enhanced Plus Level, 24x7x365 Phone Support (Sev1 - Live Transfer), 24x7x365 Onsite and Parts (Sev1 Resp. Time - 4 Hours), Incl. Holidays, Prepaid billing	PYJX40-U004121-0NA	1	639.00	5		3,195.00
PY JX40 Post Warranty, 24 Months, Enhanced Plus Level, 24x7x365 Phone Support (Sev1 - Live Transfer), 24x7x365 Onsite and Parts (Sev1 Resp. Time - 4 Hours), Incl. Holidays, Prepaid billing	PYJX40-P004241-0NA	1	1,218.00	5		6,090.00
PY JX40 during normal business hours, Primergy storage installation, One Time billing	PYJX40-N043005-0NA	1	450.00	5		2,250.00
				Subtotal(*)	213,960.00	12,535.00

FUJITSU	PRIMERGY RX500 S7	TPC-E 1.12.0 TPC Pricing 1.7.0 TPC-Energy 1.4.2 Report Date November 5, 2012 Availability Date November 1, 2012

Database Server (Tier B) Software						
SQL Server 2012 Enterprise Edition 2Core License	7JQ-00256	2	13,472.50	16	215,560.00	
Windows Server 2008 R2 Enterprise Edition	P72-04217	2	2,280.00	1	2,280.00	
Microsoft Problem Resolution Services	n/a	2	259.00	1		259.00
				Subtotal	217,840.00	259.00
Application Server (Tier A) Hardware						
Primergy RX200 S7		1	6,454.00	1	6,454.00	
PY RX200 S7, 4x2.5	S26361-K1386-V101	1		1		
Modulare SV 450W platin hp	S26113-F575-E10	1		1		
Power Supply Dummy	S26113-F574-E99	1		1		
Intel Xeon E5-2660 8C/16T 2.20 GHz 20MB	S26361-F3691-E220	1		2		
Fan upgrade kit 2nd CPU	S26361-F1386-E120			1		
4GB (1x4GB) 2Rx8 L DDR3-1600 U ECC	S26361-F3694-E514	1		8		
Performance Mode Installation	S26361-F3694-E2	1		2		
DVD-RW supermulti slimline SATA	S26361-F3269-E2	1		1		
HD SATA 6G 250GB 7.2K HOT PL 2.5" BC	S26361-F3708-E250	1		1		
Eth Ctrl 2x1Gbit PCIe x4 D2735-2 Cu lp	S26361-F3610-E202	1		1		
Rack Mount Kit F1-C S7 LV	S26361-F2735-E175	1		1		
Rack Cable Arm 1U	S26361-F2735-E81	1		1		
Cable power cord rack, 4m, grey	T26139-Y1968-E100	1		1		
Mounting in symmetrical Racks	S26361-F4530-E10	1		1		
region kit APAC/America/EMEA/Indien	S26361-F1452-E100	1		1		
PRIMERGY RX200S7 Installation, normal business hours	PYR200-N038005-0NA	1	200.00	1		200.00
PYRX200 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYR200-U004361-0NA)	PYR200-U004361-0NA	1	750.00	1		750.00
				Subtotal(*)	6,454.00	950.00
Application Server (Tier A) Software						
Windows Server 2008 R2 Standard x64 Edition	P73-04980	2	711.00	1	711.00	
				Subtotal	711.00	
Miscellaneous						
DISPLAY B20T-6 LED (incl 2spares)	S26361-K1416-V140	1	187.20	3	561.60	
Infrastructure or Connectivity						
KB400 USB grey INT USA (incl 2 spares)	S26381-K550-E102	1	14.00	3	42.00	
Mouse M480 grey (incl 2 spares)	S26381-K431-E101	1	8.00	3	24.00	
LAN-CAT 5 Enhanced, l=3m	T26139-Y2425-M3	1	5.00	2	10.00	
				Subtotal(*)	637.60	0.00
				Total	489,947.60	15,403.00
Dollar Volume Discount (see Notes)	28%	1			75,991.05	
					413,956.55	

Notes:	**Three-Year Cost of Ownership USD**	$429,360
Price Source: 1=Fujitsu, 2=Microsoft Corporation	**TPC-E Throughput**	2651.27
Discount applies to all subtotal marked with(*) .	**$ USD/tpsE**	$161.95
Pricing is for these or similar quantities.Discounts for similary sized configurations will be similar to what is quoted here, but may vary based on the specific components priced.		

The benchmark results and test methodology were audited by Francois Raab for InfoSizing Inc. (www.sizing.com)

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 section of the TPC benchmark pricing specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.

Numerical Quantities Summary				
Reported Throughput:	**2,651.27 tpsE**	**Configured Customers:**		**1,330,000**
Response Times (in seconds)	**Minimum**	**Average**	**90th%tile**	**Maximum**
Broker Volume	0.00	0.02	0.03	0.82
Customer Position	0.00	0.01	0.02	0.92
Market Feed	0.00	0.01	0.04	0.98
Market Watch	0.00	0.01	0.02	0.95
Security Detail	0.00	0.01	0.01	0.90
Trade Lookup	0.00	0.08	0.12	1.12
Trade Order	0.00	0.03	0.04	0.92
Trade Result	0.00	0.03	0.05	2.34
Trade Status	0.00	0.01	0.02	0.91
Trade Update	0.01	0.09	0.13	1.10
Data Maintenance	0.00	0.02	N/A	0.12
Transaction Mix		**Transaction Count**		**Mix %**
Broker Volume		9,353,458		4.900%
Customer Position		24,815,426		13.000%
Market Feed		1,908,922		1.000%
Market Watch		34,359,736		18.000%
Security Detail		26,724,354		14.000%
Trade Lookup		15,270,911		8.000%
Trade Order		19,279,763		10.100%
Trade Result		19,089,191		10.000%
Trade Status		36,268,354		19.000%
Trade Update		3,817,719		2.000%
Data Maintenance		120		N/A
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)		00:20:15		
Measurement Interval (hh:mm:ss)		02:00:00		
Business Recovery Time (hh:mm:ss)		00:15:14		
Total Number of Transactions Completed		190,887,834		

PRIMERGY RX500 S7	Energy Summary	TPC-E 1.12.0 TPC Pricing 1.7.0 TPC-Energy 1.4.2 Report Date November 5, 2012 Availability Date November 1, 2012

TPC-E Throughput	Price/Performance	Availability Date	Total System Cost	TPC-Energy Metric
2,651.27 tpsE	**$ 161.95 USD per tpsE**	**November 1, 2012**	**$ 429,360 USD**	**0.68 Watts/tpsE**

Numerical Quantities For Reported Energy Configuration:

REC Idle Power: **1,131.54 Watts**
Average Power of REC : **1,802.33 Watts**

Subsystem Reporting:

	Secondary Metrics	Additional Numerical Quantities			
	watts/tpsE	Full Load Avg Watts	Full Load % of REC	Idle Avg Watts	Idle % of REC
Database Server *)	0.31	832.75	46.20%	285.35	25.22%
Storage *)	0.30	796.20	44.18%	765.14	67.62%
Application Server *)	0.06	156.37	8.68%	80.65	7.13%
Miscellaneous *)	0.01	17.00	0.94%	0.40	0.04%
Total REC	0.68	1,802.33	100.00%	1,131.54	100.00%

*) see pricing for list of components

Lowest ambient temperature at air inlet: **21.31 Degrees Celsius**

Items in Priced Configuration not in the Reported Energy Configuration
None

Items in the Reported Energy Configuration not in the Measured Energy Configuration
Fujitsu Display B20T-6 LED

Table of Contents

ABSTRACT 3

CLAUSE 0: PREAMBLE 11

Introduction 11
Goal of the TPC-E Benchmark 11
Restrictions and Limitations 12

CLAUSE 1: OVERVIEW 13

Order and Titles 13
Executive Summary Statement 13
Benchmark Sponsor 13
Configuration Diagram 14
Hardware Configuration 15
Software Configuration 16

CLAUSE 2: DATABASE DESIGN, SCALING AND POPULATION 17

Database Creation 17
Partitioning 17
Replication and Duplicated Attributes 17
Cardinality of Tables 18
Distribution of Tables, Partitions and Logs 19
Database Interface, Data Model and Load Methodology 20

CLAUSE 3: TRANSACTIONS 21

Vendor-Supplied Code 21
Database Footprint Requirements 21

CLAUSE 4: SUT, DRIVER AND NETWORK 22

Network Configuration 22

CLAUSE 5: EGEN 23

EGen Version 23
EGen Code 23
EGen Modifications 23

CLAUSE 6: PERFORMANCE METRICS AND RESPONSE TIME 24

EGen Driver 24
Measured Throughput 24
Test Run Graph 24
Steady State 25
Work Performed During Steady State 25
Transaction Input Parameter Averages 26

CLAUSE 7: TRANSACTION AND SYSTEM PROPERTIES 27

ACID Tests 27
Redundancy Level and Data Accessibility 27
Business Recovery 28

CLAUSE 8: PRICING RELATED ITEMS 30

60-Day Space 30
Attestation Letter 31

CLAUSE 9: SUPPORTING FILES 33

Supporting Files Index table 33
APPENDIX: THIRD PARTY PRICE QUOTATIONS 38
APPENDIX B: TPC-ENERGY DISCLOSURE REPORT 39
TPC-Energy Clause 2-related items (Methodology) 39
TPC-Energy Clause 3-related items (Metrics) 39
TPC-Energy Clause 4-related items (Drivers/Controller) 42
TPC-Energy Clause 6-related items (Instrumentation) 42
TPC-Energy Clause 8-related items 43

Clause 0: Preamble

Introduction

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 modelled 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 modelled by the TPC-E benchmark, any of the transactions may be executed against the database at anytime, especially in relation to each other.

Goal of the TPC-E Benchmark

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.
The benchmark defines:

- Two types of transactions to simulate Consumer-to-Business as well as Business-to-Business activities
- Several transactions for each transaction type
- Different execution profiles for each transaction type
- A specific run-time mix for all defined transactions

For example, the database will simultaneously execute transactions generated by systems that interact with customers along with transactions that are generated by systems that interact with financial markets as well as administrative systems. The benchmark system will interact with a set of driver systems that simulate the various sources of transactions without requiring the benchmark to implement the complex environment.
The Performance Metric reported by TPC-E is a "business throughput" measure of the number of completed Trade-Result transactions processed per second (see Clause 6.7.1). Multiple Transactions are used to simulate the business activity of processing a trade, and each Transaction is subject to a Response Time constraint. The Performance Metric for the benchmark is expressed in transactions-per-second-E (tpsE). To be compliant with the TPC-E standard, all references to tpsE Results must include the tpsE rate, the associated price-per-tpsE, and the Availability Date of the Priced Configuration (See Clause 6.7.3 for more detail).

Although this specification defines the implementation in terms of a relational data model, the database may be implemented using any commercially available Database Management System (DBMS), Database Server, file

system, or other data repository that provides a functionally equivalent implementation. The terms "table", "row", and "column" are used in this document only as examples of logical data structures.

TPC-E uses terminology and metrics that are similar to other benchmarks, originated by the TPC and others. Such similarity in terminology does not imply that TPC-E Results are comparable to other benchmarks. The only benchmark Results comparable to TPC-E are other TPC-E Results that conform to a comparable version of the TPC-E specification.

Restrictions and Limitations

Despite the fact that this benchmark offers a rich environment that represents many OLTP applications, this benchmark does not reflect the entire range of OLTP requirements. In addition, the extent to which a customer can achieve the Results reported by a vendor is highly dependent on how closely TPC-E approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.
Benchmark Results are highly dependent upon workload, specific application requirements, and systems design and implementation. Relative system performance will vary because of these and other factors. Therefore, TPC-E should not be used as a substitute for specific customer application benchmarking when critical capacity planning and/or product evaluation decisions are contemplated.
Benchmark Sponsors are permitted various possible implementation designs, insofar as they adhere to the model described and pictorially illustrated in this specification. A Full Disclosure Report (FDR) of the implementation details, as specified in Clause 9.1, must be made available along with the reported Results.

Clause 1: Overview

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 TPC-E specification.

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.

Benchmark Sponsor

A statement identifying the benchmark sponsor(s) and other participating companies must be provided (9.3.1.1).

Fujitsu is the sponsor of this TPC Benchmark™ E result.

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 measured and priced configurations are shown in the following figures. There are differences between both configurations at additional storage used for database setup and backup in the measured configuration. This storage is not used during measurement and not required for pricing.

Figure 1-1: Priced Configuration

Tier A
PRIMERGY RX200 S7
2x Intel Xeon E5-2660 2.20 GHz
32 GB Memory
1x 250 GB 7.2k rpm SATA Drive
2x onboard LAN 1 Gb/s
1x Dual Port LAN 1 Gb/s

Tier B
PRIMERGY RX500 S7
4x Intel Xeon E5-4650 2.70 GHz
512 GB Memory
2x 146 GB 15k rpm SAS Drives
6x 300 GB 15k rpm SAS Drives
2x onboard LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40
90x 200 GB SSD Drives

Figure 1-2: Measured Configuration

Tier A
PRIMERGY RX200 S7
2x Intel Xeon E5-2660 2.20 GHz
32 GB Memory
1x 250 GB 7.2k rpm SATA Drive
2x onboard LAN 1 Gb/s
1x Dual Port LAN 1 Gb/s

Tier B
PRIMERGY RX500 S7
4x Intel Xeon E5-4650 2.70 GHz
512 GB Memory
2x 146 GB 15k rpm SAS Drives
6x 300 GB 15k rpm SAS Drives
2x onboard LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40
90x 200 GB SSD Drives
2x 1 TB 7.2k rpm SATA Drives
14x FibreCat SX40
120x 146 GB 15k rpm SAS Drives
48x 73 GB 15k rpm SAS Drives

Hardware Configuration

A description of the steps taken to configure all the hardware must be reported in the Report (9.3.1.4).

Driver
The driver system is not part of the System Under Test (SUT) and priced configuration. This system was connected with Tier A system, using onboard LAN with 2 x 1 Gb/s Ethernet. There are two LAN segments for these connections.

Tier A
The Tier A server is a Fujitsu PRIMERGY RX200 S7 with two Intel Xeon E5-2660 Eight-Core Processor and 32 GB of memory. One SATA 250 GB 7.2k rpm disk drive is connected to the onboard controller. One 1 Gb/s dual port Ethernet LAN card is plugged in the PCI-E slot. Each of the two ports is directly connected with one of the 1 Gb/s Ethernet onboard LAN ports of Tier B using a LAN crossover cable. There are two LAN segments for these connections. The two onboard 1 Gb/s LAN ports are used for driver connection.

Tier B
The Tier B or database server is a Fujitsu PRIMERGY RX500 S7 with four Intel Xeon E5-4650 Eight-Core Processors and 512 GB memory. All of the eight onboard 2.5" disk bays are used with 2x SAS 146 GB 15k rpm; 6x SAS 300 GB 15k rpm disk drives and RAID controller SAS 6G 1GB (D3116). Two drives are configured with RAID1 for OS and database. The six drives with 300 GB are configured with RAID10 for database log. Five RAID controllers SAS 6G 8Port ex 1GB are used to connect the external disk drives to the server. The controller cache of all 6 RAID controllers is configured with Write Through. The two onboard 1 Gb/s Ethernet LAN ports are connected to the Tier A system as described above.

Storage
5 Fujitsu ETERNUS JX40 are used, each with 18x 200GB SSD 2.5" RAID5. The enclosures are connected to the controllers SAS 6G 8Port ex 1GB. For details see table 2-2 Disk Configuration. The disk configuration can be done with the ServerView RAID Manager, which is shipped on ServerStart DVD together with the Server.

Software Configuration

A description of the steps taken to configure all the software must be reported in the Report (9.3.1.5).

The default installation of the operating system was executed on Tier A and B as well as the installation of the database SW on Tier B and the database client connectivity on Tier A. Information about changes to the software, settings and BenchCraft can be found in the SupportingFiles directory Introduction - Software.
SQL Server 2012 has been updated with cumulative update package 1. For details and how to obtain the SW see http://support.microsoft.com/kb/2679368.
In addition SQL Server 2012 has been updated with hotfix ID 2768720. For details and how to obtain the SW see http://support.microsoft.com/kb/2768720.

Clause 2: Database Design, Scaling and Population

Database Creation

A description of the steps taken to create the database for the Reported Throughput must be reported in the Report (9.3.2).
The physical organization of tables and indices, within the database, must be reported in the Report. (9.3.2.1)

The database has been created for 1,330,000 customers. The SQL Server scripts and setup command files are included in the SupportingFiles\Clause2 folder. Two file groups are used for the tables and indices. The distribution is shown in table 2-1.

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)

There is no partitioning implemented in this configuration.

Replication and Duplicated Attributes

Replication of tables, if used, must be reported in the Report (9.3.2.3).
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).

There is no replication implemented in this configuration.
No duplications or additional attributes were used.

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 1,330,000 customers. The cardinality of the tables after database load is as shown in the following table 2-1.

Table 2-1: Table Cardinality and File Groups

Table	Cardinality after database load	File Group
ACCOUNT_PERMISSION	9442929	1
ADDRESS	1995004	1
BROKER	13300	1
CASH_TRANSACTION	21143862457	2
CHARGE	15	1
COMMISSION_RATE	240	1
COMPANY	665000	1
COMPANY_COMPETITOR	1995000	1
CUSTOMER	**1330000**	1
CUSTOMER_ACCOUNT	6650000	1
CUSTOMER_TAXRATE	2660000	1
DAILY_MARKET	1188920250	1
EXCHANGE	4	1
FINANCIAL	13300000	1
HOLDING	1176625518	2
HOLDING_HISTORY	30800254482	2
HOLDING_SUMMARY	66143562	2
INDUSTRY	102	1
LAST_TRADE	911050	1
NEWS_ITEM	1330000	1
NEWS_XREF	1330000	1
SECTOR	12	1
SECURITY	911050	1
SETTLEMENT	22982400000	2
STATUS_TYPE	5	1
TAXRATE	320	1
TRADE	22982400000	2
TRADE_HISTORY	55157818887	2
TRADE_REQUEST	0	2
TRADE_TYPE	5	1
WATCH_ITEM	133040995	1
WATCH_LIST	1330000	1
ZIP_CODE	14741	1

Distribution of Tables, Partitions and Logs

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 2-2: Disk Configuration

HBA - Port	Disk	Drives	Partition	Size	Use
Crtl 0	0 – onboard	2x146GB 15K SAS, RAID1	C:\	136 GB	OS, DB
	1 – onboard	6x300GB 15K SAS, RAID10	L:\	836 GB	DB Log
Crtl 1 Port 0	2 – JX40	18x200GB SSD, RAID5	C:\jp\tpce011 C:\jp\tpce012 C:\jp\tpce013 C:\jp\tpce014	73.83 GB 1024 GB 1024 GB 1024 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 1 Port 1	3 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help01	1498 GB	DB setup Backup
	4 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help02	1498 GB	DB setup Backup
	5 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help03	1498 GB	DB setup Backup
Crtl 2 Port 0	6 – JX40	18x200GB SSD, RAID5	C:\jp\tpce021 C:\jp\tpce022 C:\jp\tpce023 C:\jp\tpce024	73.83 GB 1024 GB 1024 GB 1024 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 2 Port 1	7 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help04	1498 GB	DB setup Backup
	8 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help05	1498 GB	DB setup Backup
	9 – SX40	24x73GB, 15K SAS, RAID5	C:\jp\help06	1560 GB	DB setup Backup
Crtl 3 Port 0	10 – JX40	18x200GB SSD, RAID5	C:\jp\tpce031 C:\jp\tpce032 C:\jp\tpce033 C:\jp\tpce034	73.83 GB 1024 GB 1024 GB 1024 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 3 Port 1	11 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help07	1498 GB	DB setup Backup
	12 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help08	1498 GB	DB setup Backup
	13 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help09	1498 GB	DB setup Backup
Crtl 4 Port 0	14 – JX40	18x200GB SSD, RAID5	C:\jp\tpce051 C:\jp\tpce052 C:\jp\tpce053 C:\jp\tpce054	73.83 GB 1024 GB 1024 GB 1024 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 4 Port 1	15 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help10	1498 GB	DB setup Backup
	16 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help11	1498 GB	DB setup Backup
	17 – SX40	24x73GB, 15K SAS, RAID5	C:\jp\help12	1560 GB	DB setup Backup
Crtl 5 Port 0	18 – JX40	18x200GB SSD, RAID5	C:\jp\tpce061 C:\jp\tpce062 C:\jp\tpce063 C:\jp\tpce064	73.83 GB 1024 GB 1024 GB 1024 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
	19 – JX40	2x1TB 7.2k rpm SATA, RAID1	C:\jp\addon	931 GB	DB setup Backup

Database Interface, Data Model and Load Methodology

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).

Microsoft SQL Server 2012 Enterprise Edition is a relational database. The interface used was Microsoft SQL Server stored procedures accessed with Remote Procedure Calls embedded in C++ code using the Microsoft ODBC interface.
The methodology used to load the database is described in Clause2 of the SupportingFiles directory.

Clause 3: Transactions

Vendor-Supplied Code

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.

Database Footprint 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

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):

Figures 1-1 and 1-2 show the configuration of the measured and priced configurations. Both are identical in case of the network configuration. Tier B system PRIMERGY RX500 S7 has an onboard Ethernet controller with two 1Gb/s ports. Tier A system PRIMERGY RX200 S7 has an onboard Ethernet controller with two 1Gb/s ports used for driver system connection. Tier A system was extended with one dual-port 1Gb/s Ethernet controller card. These two ports were directly connected with the two onboard ports of Tier B using different LAN segments.

Clause 5: EGen

EGen Version

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

The EGen version used was 1.12.0.

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.

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).
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).

EGen was not modified for this benchmark. EGenLoader was not extended for this benchmark.

Clause 6: Performance Metrics and Response time

EGen Driver

The number of EGenDriverMEE and EGenDriverCE instances used in the benchmark must be reported in the Report (see Clause 6.2.5) (9.3.1.1).

One Tier A system was used and configured to drive 16 EGenDriverMEE and 16 EGenDriverCE instances.

Measured Throughput

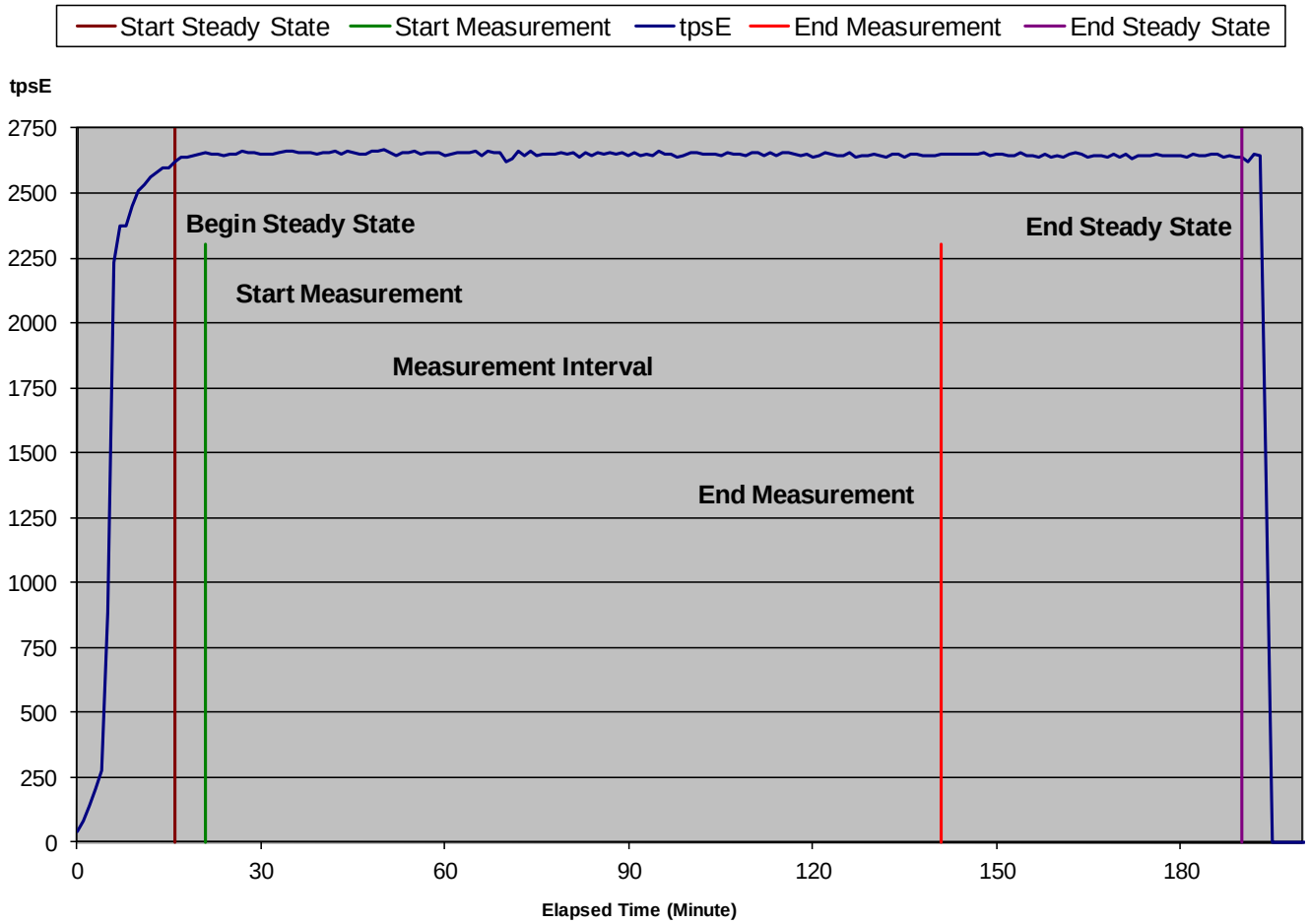
The Measured Throughput must be reported in the Report (see Clause 6.7.1.2) (9.3.6.2).

The measured throughput was 2,651.27 tpsE.

Test Run Graph

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) (9.3.6.3).

Figure 6-1: Test Run Graph



Steady State

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).

During the run the tpsE throughput was observed to determine steady state. After the run steady state was confirmed by:

1. Looked at the Test Run Graph and verified that tpsE was steady prior to commencing the Measurement Interval.
2. Calculated 60 minute average tpsE during the Steady State moving the time window 10 minutes each time. Then confirmed that the minimum 60 minute average tpsE was not less than 98% of the Reported Throughput, and that the maximum 60 minute average tpsE was not greater than 102% of the Reported Throughput.
3. Calculated 10 minute average tpsE during the Steady State moving the window 1 minute each time. Then confirmed that the minimum 10 minute average tpsE was not less than 80% of the Reported Throughput, and that the maximum 10 minute average tpsE was not greater than 120% of the Reported Throughput.
4. Two completed full checkpoints.

Work Performed During Steady State

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.) (9.3.6.5).

The Microsoft SQL Server recovery interval parameter was set to the maximum allowable value to perform checkpoint at specific intervals. Checkpoints were automatically issued at specified intervals (448 seconds) and specified duration (435 seconds). 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 and duration during steady state.

Transaction Input Parameter Averages

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

Table 6-2: Transaction Input Parameter Averages.

Transaction	Parameter	Range Min	Range Max	Value	Check
Customer Po	By Tax ID	48.00%	52.00%	50.00%	Ok
	Get History	48.00%	52.00%	50.00%	Ok
	Overall				Ok
Market Watcl	By Watch List	57.00%	63.00%	59.99%	Ok
	By Customer Account	33.00%	37.00%	35.01%	Ok
	By Industry	4.50%	5.50%	5.00%	Ok
	Overall				Ok
Security Deta	Access LOB	0.90%	1.10%	1.00%	Ok
	Overall				Ok
Trade Lookup	Frame 1	28.50%	31.50%	30.02%	Ok
	Frame 2	28.50%	31.50%	30.00%	Ok
	Frame 3	28.50%	31.50%	29.98%	Ok
	Frame 4	9.50%	10.50%	10.00%	Ok
	Overall				Ok
Trade Update	Frame 1	31.00%	35.00%	32.98%	Ok
	Frame 2	31.00%	35.00%	33.00%	Ok
	Frame 3	32.00%	36.00%	34.02%	Ok
	Overall				Ok
Trade Order	By Non-Owner	9.50%	10.50%	9.99%	Ok
	By Company Name	38.00%	42.00%	40.00%	Ok
	Buy On Margin	7.50%	8.50%	7.99%	Ok
	Rollback	0.94%	1.04%	0.99%	Ok
	LIFO	33.00%	37.00%	35.00%	Ok
	Trade Qty 100	24.00%	26.00%	25.00%	Ok
	Trade Qty 200	24.00%	26.00%	24.99%	Ok
	Trade Qty 400	24.00%	26.00%	25.00%	Ok
	Trade Qty 800	24.00%	26.00%	25.01%	Ok
	Market Buy	29.70%	30.30%	30.00%	Ok
	Market Sell	29.70%	30.30%	30.01%	Ok
	Limit Buy	19.80%	20.20%	20.00%	Ok
	Limit Sell	9.90%	10.10%	9.99%	Ok
	Stop Loss	9.90%	10.10%	10.00%	Ok
	Overall				Ok

Clause 7: Transaction and System Properties

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 TPC Benchmark™ E Standard Specification defines a set of transaction processing system properties that a system under test (SUT) must support during the execution of the benchmark. Those properties are Atomicity, Consistency, Isolation and Durability (ACID). This section quotes the specification definition of each of those properties and describes the tests done as specified and monitored by the auditor, to demonstrate compliance. See also file MSTPCE ACID Procedures.pdf in the SupportingFiles directory.

Redundancy Level and Data Accessibility

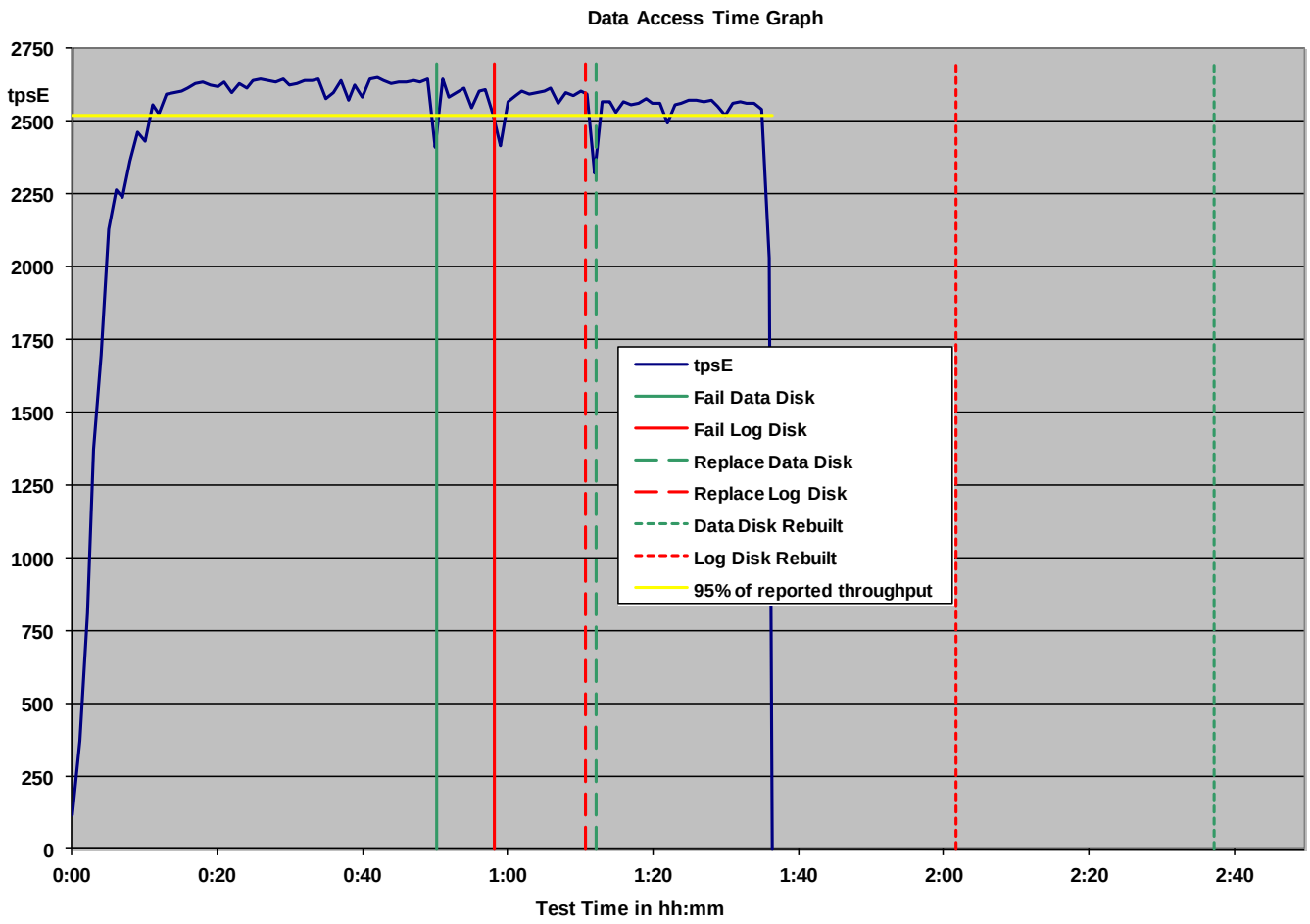
The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.5.7.1) and describe the Data Accessibility test(s) used to demonstrate compliance (9.3.7.2).
A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.5.7.2) (9.3.7.3).

Redundancy Level 1 was used for the storage system. To prove Redundancy Level 1, the following steps were successfully performed on a database data and log disk. The test for Redundancy Level 1 is the test for Permanent Irrecoverable Failure of any single Durable Medium. The different steps and the various states of the two disks are reported by ServerView RAID and written to the system event (see SupportingFiles).

1. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 5 minutes.
3. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in a database data array. Since RAID5 is used, the transactions continue for at least 5 minutes.
4. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in the database log array. Since RAID10 is used, the transactions continue for at least 5 minutes.
5. Begin the necessary recovery process, by replacing the failed drives in the database data array and start the rebuild process.
6. Begin the necessary recovery process, by replacing the failed drives in the database log array and start the rebuild.
7. Continue running the Driver for at least 20 minutes with throughput above 95% of reported throughput.
8. Terminate the run gracefully from the Driver.
9. Wait until rebuild process has finished.
10. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
11. Run the evaluation of Trade-Result Transactions executed and compare it with the difference of the SETTLEMENT rows counted.

The Graph in Figure 7-1 show the measured throughput versus time and the different test stated.

Figure 7-1: Redundancy Level and Data Accessibility Graph



Business Recovery

The Test Sponsor must describe in the Report the test(s) used to demonstrate Business Recovery (9.3.4.7). 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 Server 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). 9.3.7.6 The Business Recovery Time Graph (see Clause 7.5.7.4) must be reported in the Report for all Business Recovery tests (9.3.7.7).

The tests for “Instantaneous interrupt,” “Failure of all or part of memory,” and “Loss of external power to the SUT” were combined by power off Tier A and B.

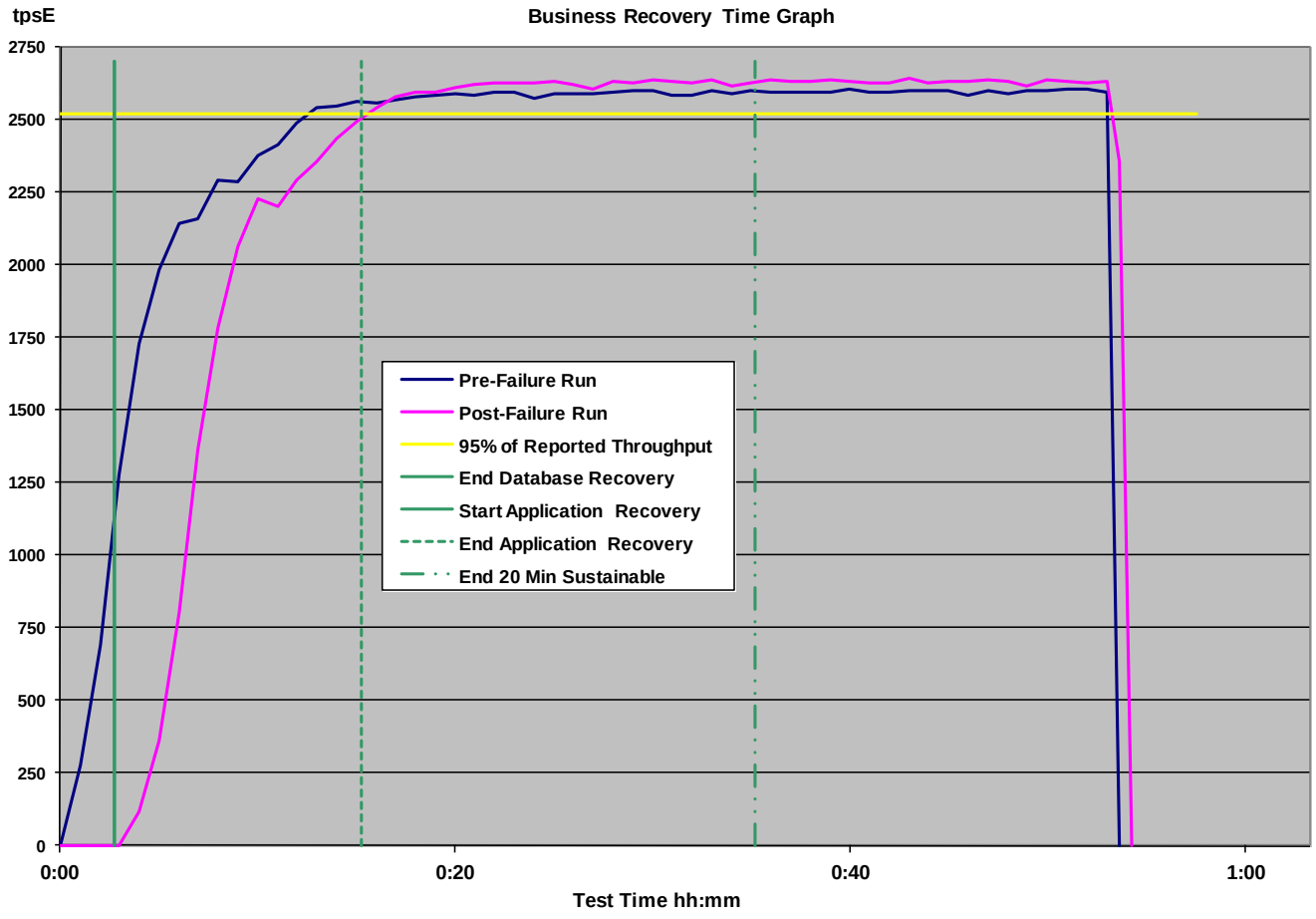
1. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
2. Start submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes.
3. Induce the failures by power off Tier B.
4. On the driver side the number of MEE connections is captured and after transaction failures is noted by the drivers, terminate the run and collect the data for Pre-Failure Run.
5. Re-power and restart Tier B.

6. When restarting the database on Tier B, it automatically starts the recovery and records timestamps. The Database Recovery Time was 00:02:43 (hh:mm.ss).
7. After recovery has completed Trade-Cleanup has been executed. A new run started again submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes. The Application Recovery Time was 00:12:31 (hh:mm:ss).
8. Terminate the run gracefully from the Driver and collect the data for Post-Failure Run.
9. Verify that there are no errors in the Post-Failure run and check the consistency of the database as specified in Clause 7.3.1.1.
10. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
11. Run the evaluation of Trade-Result Transactions executed in both runs and compare it with the difference of the SETTLEMENT rows counted. The difference must be less than or equal to the maximum number of Transactions which can be simultaneously in-flight from the Driver to the SUT.

The Business Recovery Time (per Clause 7.5.7 Step15) was 00:15:14 (hh:mm:ss).

The Graph in Figure 7-2 shows the measured throughput versus time and the Business Recovery.

Figure 7-2: Business Recovery Graph



Clause 8: Pricing Related Items

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 (9.3.8.1).

Table 8-1: Space Requirements

			TPC-E Disk Space Requirements				
Customers Used	1,330,000						
Performance	**2651.27**	**tpsE**	**settlements after 8 hours (Busines Day)**			76,356,576	
					initinal size	grow size	
Table	**Initial Rows**	**Data (KB)**	**Index size (KB)**	**Extra 5% (KB)**	**Total + 5% (KB)**	**After run (KB)**	**Growth (KB)**
ACCOUNT_PERMISSION	9442929	520032	3592	26181	549805	523728	104
ADDRESS	1995004	115112	1080	5810	122002	116256	64
BROKER	13300	976	1056	102	2134	2032	0
CASH_TRANSACTION	21145587925	2188500680	4619712	109656020	2302776412	2198358584	5238192
CHARGE	15	8	8	1	17	16	0
COMMISSION_RATE	240	16	16	2	34	32	0
COMPANY	665000	141632	43944	9279	194855	185576	0
COMPANY_COMPETITOR	1995000	53632	49776	5170	108578	103408	0
CUSTOMER	1330000	218048	65784	14192	298024	283840	8
CUSTOMER_ACCOUNT	6650000	602672	148696			751368	0
CUSTOMER_TAXRATE	2660000	55536	1080	2831	59447	56760	144
DAILY_MARKET	1188920250	55622368	162320	2789234	58573922	55785944	1256
EXCHANGE	4	8	8	1	17	16	0
FINANCIAL	13300000	1498880	5088	75198	1579166	1504264	296
HOLDING	1176675015	78634880	53645096	6613999	138893975	134061648	1781672
HOLDING_HISTORY	30802783239	1120095944	748379536	93423774	1961899254	1874726288	6250808
HOLDING_SUMMARY	66143644	2890568	11528	145105	3047201	2902096	0
INDUSTRY	102	8	24	2	34	32	0
LAST_TRADE	911050	56808	1080	2894	60782	57888	0
NEWS_ITEM	1330000	144196384	2528			144198968	56
NEWS_XREF	1330000	33192	1080	1714	35986	34272	0
SECTOR	12	8	24	2	34	32	0
SECURITY	911050	125848	36144	8100	170092	162016	24
SETTLEMENT	22984275363	1096085336	2312360	54919885	1153317581	1101318760	2921064
STATUS_TYPE	5	8	8	1	17	16	0
TAXRATE	320	24	16	2	42	56	16
TRADE	22984433116	2743172376	1535249144	213921076	4492342596	4283411808	4990288
TRADE_HISTORY	55162698542	1659233464	4328632	83178105	1746740201	1668783216	5221120
TRADE_REQUEST	0	0	0	0	0	458288	458288
TRADE_TYPE	5	8	1032	52	1092	1040	0
WATCH_ITEM	133040995	3720280	14400	186734	3921414	3734960	280
WATCH_LIST	1330000	33192	31344	3227	67763	64536	0
ZIP_CODE	14741	488	48	27	563	536	0
			Initial Database Size			Settlements	29,972,090
			11,176,489	(MB)		**Grown Database Size**	
			10,915	(GB)		11,202,723	(MB)

DB filegroups	partition size (MB)	file size (MB)	alloc total (MB)	loaded (MB)	loaded +5% (MB)	after run (MB)	Business Day (MB)
5	3,234,080	15,903,000	16,170,400	11,176,489	11,735,313	11,202,723	11,243,322
		Number of disks	90				
		Disk Capacity (MB)	190,240				
		RAID5 Overhead	6%				
Initial Growing Space (MB)	10,973,788	Total Space (MB)	16,170,400				
Final Growing Space (MB)	11,000,020	Number of disks	-	Initial Log Size (MB)	24,119	Log units	1
Delta (MB)	26,232	Disk Capacity (MB)	953,344	Final Log Size (MB)	217,812	Disks per unit	6
Data Space per Trade (MB	0.000875	RAID1 Overhead	50%	Log Growth (MB)	193,692	Disk Capacity (MB)	285,568
1 Day Data Growth (MB)	66,828	Total Space (MB)	-	Log Space per Trade	0.006462	RAID10 Overhead	50.0%
60 Day Space (MB)	15,186,170	Total Space (MB)	16,170,400	1 Day Log Space (MB	493,449	Log Space (MB)	856,704

Attestation Letter

The Auditor's Attestation Letter, which indicates compliance, must be included in the Report (9.3.8.2).

INFO SIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Benchmark Sponsors: Detlev Seidel
Primary TPC Representative
Fujitsu Technology Solutions
Heinz-Nixdorf-Ring 1
33106 Paderborn, Germany

November 2, 2012

I verified the TPC Benchmark™ E performance and the TPC-Energy measurement of the following configuration:

Platform: PRIMERGY RX500 S7
Operating system: Microsoft Windows Server 2008 R2 Enterprise Edition SP1
Database Manager: Microsoft SQL Server 2012 Enterprise Edition

The TPC-E results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
Tier B: PRIMERGY RX500 S7				
4 x Intel Xeon E5-4650 (2.70 GHz)	512 GB	90 x 200 GB SSD 6 x 300 GB 15Krpm SAS (int.) 2 x 146 GB 15Krpm SAS (int.)	0.05 Seconds	**2,651.27**
Tier A: PRIMERGY RX200 S7				
2 x Intel Xeon E5-2660 (2.20 GHz)	32 GB	1 x 250 GB 7.2Krpm SATA (int.)	n/a	n/a

In my opinion, these performance results were produced in compliance with the TPC-E benchmark requirements and the following verification items were given special attention:

- All EGen components were verified to be v1.12.0
- The transactions were correctly implemented.
- The database was properly scaled and populated for 1,330,000 Customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.
- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.

531 Crystal Hills Blvd • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 00:15:14 was correctly measured.
- The 60 day storage requirement was correctly computed and configured.
- The system pricing was verified for major components and maintenance.

The TPC-Energy measurements were:

TPC-Energy Metric	REC Idle Power	Average REC Power	Temperature
0.68 Watts/tpsE	1,131.54 Watts	1,802.33 Watts	21.31 C

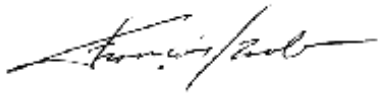
In my opinion, these energy measurements were produced in compliance with the TPC-Energy benchmark requirements and the following verification items were given special attention:

- The power analyzers used met the benchmark requirements and were correctly calibrated.
- The primary metric, secondary metrics and the idle power were calculated correctly.
- Version 1.4.2 of the EMS software package was used.

Additional Audit Notes:

None.

Respectfully Yours,



François Raab, President

531 Crystal Hills Blvd • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

Clause 9: Supporting Files

Supporting Files Index table

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).

Clause	Description	Path	Filename
	overview	SupportingFiles	SupportingFiles.doc
Introduction	System Configuration	SupportingFiles/Introduction/	SysInfo_TierA.txt SysInfo_TierB.txt
	Disk Configuration	SupportingFiles/Introduction/Hardware/	DiskConfiguration.doc flatfilelocations.txt makehelpdirff.cmd Readme.txt tempdb12.sql
	Parameter OS Tunables Database Setup	SupportingFiles/Introduction/Software/	CountOperations.reg MemoryManagement.reg MSTPCE Database Setup Reference.doc SQL_IP.reg SQL_LargePages.req SQL_Nodes.reg SQL_Server_Configuration.ver TierA_SQL2012_client_connection_all.reg TierA_W32Time.reg
	Startup Scripts Tier A	SupportingFiles/Introduction/Software/	start_all_RX500S7.cmd
	Startup Scripts Tier B	SupportingFiles/Introduction/Software/	StartSQL2012.cmd
Clause 2	Create Database	SupportingFiles/Clause2	Backup_Database.sql Check_tempdb.sql Checkpoint_TPCE_Database.SQL Count_Customers.sql Create_Database.sql Create_DM_Audit_Table.sql Create_TID_Ranges_Table.sql Create_Timer_Table.sql Create_TL_TU_Warnings_Table.sql Create_TPCE_VERSIONS_Table.sql Database_Options_1.sql Database_Options_2.sql Drop_and_Create_TPCE_INFO.sql End_Load_Timer.sql Get_Next_T_ID.sql Install_Load_Timer_Proc.sql Load_TPCE_Info.sql Output_TPCE_VERSIONS_Table.SQL Remove_Database.sql Restore_Database.sql SQL_Server_Configuration.sql tempdb12.sql TPCE_Setup.cmd Trade_Cleanup.cmd Trade_Cleanup.sql Version.sql
	Create Database output	SupportingFiles/Clause2/DB_setup	1330000Customers_Load_Timer.log Backup_Database.log BrokerVolume.log Build_Steps.log

			BulkInsert_1.out … BulkInsert_64.out Check_Constraints_Fixed.log Check_Constraints_Growing.log Check_Constraints_Scaling.log Convert_NI_ITEM_Data.log Create_DB_Audit_Tables.log Create_DM_Audit_Tables.log Create_Indexes_Fixed_Tables.log Create_Indexes_Growing_Tables.log Create_Indexes_Scaling_Tables.log Create_TID_Ranges_Table.log Create_TL_TU_Warnings_Table.log Create_TPCE_VERSIONS_Table.log CreateDB.log CustomerPosition.log Database_Options_1.log Database_Options_2.log DataMaintenance.log DB_Check.log DB_FK_Constraints.log DB_Primary_Key_Check.log DB_RI_Check.log DB_Tables.log Drop_DB_Audit_Tables.log Drop_Fixed_Tables.log Drop_FK_Constraints.log Drop_Growing_Tables.log Drop_Scaling_Tables.log EGenLoaderFrom1To21000.log EGenLoaderFrom21001To42000.log …. EGenLoaderFrom1309001To1330000.log ERRORLOG FK_Constraints.log Get_Next_T_ID.log Insert_Duplicates_Tests.log Load_Timer.log Load_Timer_Proc.log Load_TPCE_Info.log MarketFeed.log MarketWatch.log Referential_Integrity_Tests.log RemoveDB.log SecurityDetail.log spfiles.ver splog.ver spused.ver SQL_Server_Configuration.log Tables_Fixed.log Tables_Growing.log Tables_Scaling.log TPCE_VERSIONS.log TradeLookup.log TradeOrder.log TradeResult.log TradeStatus.log TradeUpdate.log Version.log
	Index Creation Scripts	SupportingFiles/Clause2/DDL	BulkInsert_<1..64>.sql Convert_NI_ITEM_Data.SQL Create_Check_Constraints_Fixed.sql Create_Check_Constraints_Growing.sql Create_Check_Constraints_Scaling.sql Create_FK_Constraints.sql Create_Indexes_Fixed_Tables.sql Create_Indexes_Growing_Tables.sql Create_Indexes_Scaling_Tables.sql Create_Tables_Fixed.sql Create_Tables_Growing.sql Create_Tables_Scaling.sql

			Drop_FK_Constraints.sql Drop_Tables_Fixed.sql Drop_Tables_Growing.sql Drop_Tables_Scaling.sql
	Database Audit Scripts	SupportingFiles/Clause2/Audit_Scripts/Database	Create_DB_Audit_Tables.SQL DB_Check.sql DB_FK_Constraints.sql DB_Primary_Key_Check.SQL DB_Tables.sql Drop_DB_Audit_Tables.SQL Insert_Duplicates_Tests.sql Referential_Integrity_Tests.sql
	Database Space Scripts	SupportingFiles/Clause2/Audit_Scripts/Space	SPFiles.sql SPLog.sql SPUsed.sql
Clause3	Transaction Frames	SupportingFiles/Clause3	BrokerVolume.sql CustomerPosition.sql DataMaintenance.sql MarketFeed.sql MarketWatch.sql SecurityDetail.sql TradeLookup.sql TradeOrder.sql TradeResult.sql TradeStatus.sql TradeUpdate.sql
	BaseServer	SupportingFiles/Clause3/BaseServer	BaseServer.cpp BaseServer.h BaseServer.vcproj BaseServer.vcxproj stdafx.cpp stdafx.h SUTServersLocals.h
	SUT_CE_Server	SupportingFiles/Clause3/SUT_CE_Server	Release\SUT_CE_Server.exe CEServer.cpp CEServer.h CEServerMain.cpp PortDefinitions.h stdafx.cpp stdafx.h SUT_CE_Server.vcproj SUT_CE_Server.vcxproj SUTServer.sln SUTStructs.h
	SUT_MEE_Server	SupportingFiles/Clause3/SUT_MEE_Server	Release\SUT_MEE_Server.exe MEEServer.cpp MEEServer.h MEEServerMain.cpp stdafx.cpp stdafx.h SUT_MEE_Server.vcproj SUT_MEE_Server.vcxproj
	TransactionsSP	SupportingFiles/Clause3/TransactionsSP	BrokerVolumeDB_SP.cpp BrokerVolumeDB_SP.h CheckpointDB_SP.cpp CheckpointDB_SP.h CustomerPositionDB_SP.cpp CustomerPositionDB_SP.h DataMaintenanceDB_SP.cpp DataMaintenanceDB_SP.h MarketFeedDB_SP.cpp MarketFeedDB_SP.h MarketWatchDB_SP.cpp MarketWatchDB_SP.h SecurityDetailDB_SP.cpp SecurityDetailDB_SP.h stdafx.cpp stdafx.h TradeLookupDB_SP.cpp TradeLookupDB_SP.h TradeOrderDB_SP.cpp

			TradeOrderDB_SP.h TradeResultDB_SP.cpp TradeResultDB_SP.h TradeStatusDB_SP.cpp TradeStatusDB_SP.h TradeUpdateDB_SP.cpp TradeUpdateDB_SP.h TransactionsSP.vcproj TransactionsSP.vcxproj TxnHarnessDBBase.cpp TxnHarnessDBBase.h TxnHarnessDBConn.cpp TxnHarnessDBConn.h
	TxnHarness	SupportingFiles/Clause3/TxnHarnes	TxnHarness.vcproj TxnHarness.vcxproj TxnHarness_stdafx.cpp TxnHarness_stdafx.h TxnHarnessSendToMarket.cpp TxnHarnessSendToMarket.h
Clause4			
Clause5	EGen Driver Configuration	SupportingFiles/Clause5	RX500S7_1330KCus_16x28p_spiderc_RTE01.xml
	EGenLoader Parameter	SupportingFiles/Clause5	BuildSteps.log EGenLoaderFrom1To21000.log EGenLoaderFrom21001To42000.log …. EGenLoaderFrom1309001To1330000.log
	EGenLogger Output	SupportingFiles/Clause5	TxnReportE-MI.xls
Clause6	EGenValidate	SupportingFiles/Clause6	EGenValidate.txt
Clause7	ACID	SupportingFiles/Clause7	MSTPCE ACID Procedures.doc
	ACID Procedures	SupportingFiles/Clause7/AcidProcs	AcidProc.cmd AcidProc.out Remove_AcidProcs.cmd
	ACID Scripts	SupportingFiles/Clause7/AcidProcs/Scripts	AcidProc.vbs CustomerPosition_Iso3.sql CustomerPosition_Iso4.sql Drop_SPROC.sql Remove_AcidProcs.vbs TradeOrder_C.sql TradeOrder_Iso1_1.sql TradeOrder_Iso1_2.sql TradeOrder_Iso2.sql TradeOrder_Iso3.sql TradeOrder_Iso4.sql TradeOrder_RB.sql TradeResult_Iso1_1.sql TradeResult_Iso1_2.sql TradeResult_Iso2_1.sql TradeResult_Iso2_2.sql TradeResult_Iso3.sql TradeResult_Iso4.sql
	Atomicity	SupportingFiles/Clause7/Atomicity	Atomicity.cmd Atomicity_C.out Atomicity_RB.out
		SupportingFiles/Clause7/Atomicity/Scripts	atom.vbs Atomicity_C.sql Atomicity_RB.sql
	Consistency	SupportingFiles/Clause7/Consistency	Consistency.cmd Consistency.out
		SupportingFiles/Clause7/Consistency/Scripts	Consistency.sql Consistency.vbs
	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery	BR_BenchCraft_Config.xml BR_Consistency.out BR_Count_Settlement1.ver BR_Count_Settlement2.ver BR_ERRORLOG1.txt BR_ERRORLOG2a.txt BR_ERRORLOG2b.txt

			BR_SystemEvents_TierB.txt BusinessRecov_Part1_step60.xlt BusinessRecov_Part1_TxnReportE_20.xls BusinessRecov_Part1_TxnReportE_all.xls BusinessRecov_Part2_step60.xlt BusinessRecov_Part2_TxnReportE_20.xls BusinessRecov_Part2_TxnReportE_all.xls BusinessRecov_TimeGraph.xls
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/Data Accessibility	DA_BenchCraft_Config.xml DA_Count_Settlement1.ver DA_Count_Settlement2.ver DA_ERRORLOG.txt DataAccess_TimeGraph.xls DataAccess_TxnReportE_5min1.xls DataAccess_TxnReportE_5min2.xls DataAccess_TxnReportE_20min.xls DataAccess_TxnReportE_all.xls SystemEvents_Application.txt
	Isolation	SupportingFiles/Clause7/Isolation	Isolation1_S1.rpt Isolation1_S2.rpt Isolation1_S3.rpt Isolation1_S4.rpt Isolation2_S1.rpt Isolation2_S2.rpt Isolation2_S3.rpt Isolation2_S4.rpt Isolation3_S1.rpt Isolation3_S2.rpt Isolation3_S3.rpt Isolation4_S1.rpt Isolation4_S2.rpt Isolation4_S3.rpt
		SupportingFiles/Clause7/Isolation/Scripts	Isolation1_S1.sql Isolation1_S2.sql Isolation1_S3.sql Isolation1_S4.sql Isolation2_S1.sql Isolation2_S2.sql Isolation2_S3.sql Isolation2_S4.sql Isolation3_S1.sql Isolation3_S2.sql Isolation3_S3.sql Isolation4_S1.sql Isolation4_S2.sql Isolation4_S3.sql
Clause8	60-Day Space Calculations	SupportingFiles/Clause8	tpce_space.xls

Appendix: Third Party Price Quotations

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

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

Microsoft

October 10, 2012

Fujitsu
Detlev Seidel
Heinz-Nixdorf-Ring 1
Paderborn, Germany 33106

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
Database Management System				
7JQ-00256	**SQL Server 2012 Enterprise Edition** *2 Core License* *Open Program - Level C*	$13,472.50	16	$215,560.00
Database Server Operating System				
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.*	$2,280.00	1	$2,280.00
Tier-A Operating System(s)				
P73-04980	**Windows Server 2008 R2 Standard Edition** *Server License with 10 CALs* *Open Program - Level C* *Unit Price reflects a 31% discount from the retail unit price of $1,029.*	$711.00	1	$711.00
Support				
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident).*	$259.00	1	$259.00

SQL Server 2012 Enterprise Edition, Windows Server 2008 R2 Enterprise Edition, and Windows Server 2008 R2 Standard Edition are currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found in 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 call.

This quote is valid for the next 90 days.

Reference ID: TPCE_qhtplylGYLKTVUKf85757fihiHjhiJhqiHmj.

Appendix B: TPC-Energy Disclosure Report

TPC-Energy Clause 2-related items (Methodology)

The minimum ambient temperature must be disclosed. (7.3.2.1)

The Minimum Temperature reported by EMS : 21.31 Degrees Celsius

The characteristics of the external electric power source must be disclosed. In particular, the voltage, frequency in Hertz, and phase information must be reported. (7.3.2.2)

The external electric power source has the following characteristics: 230V, 50Hz, single phase

A statement is required that assures that nothing was done to alter the air-pressure in the measurement environment. (7.3.2.3)

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

A description of where the temperature was measured and how it was determined that this was representative of the lowest ambient temperature is required. (7.3.2.4)

The temperature was measured for several air inlets located on different components of SUT and the lowest temperature is reported.

If a method of cooling other than circulation of ambient air is employed in the REC, a statement describing this method must be included. (7.3.2.5)

No other method of cooling was used

7.3.2.6 To be compliant with licenses associated with EMS, the following statement must be included in every FDR which contains a TPC-Energy Metric: (7.3.2.6)

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).

TPC-Energy Clause 3-related items (Metrics)

Primary Metric. (7.3.3.1)

1) *The normalized work derived from the Performance Metric (as described in Clause 3.2.1) must be disclosed*
2) *The computation for total energy used (REC Energy Consumption) 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 which were not measured must be disclosed (See Clause 7.3.3.4)*
3) *The duration of each measurement that produces a Performance Metric must be disclosed*.
4) *The average power requirement for each measurement that produces one of these metrics*
5) *The TPC-Energy Primary Metric must be disclosed, including the calculation that is used to derive it.*

PMU-1 = Tier B (Database Server)		Device: HIOKI 3334				Calibrated: 10-May-12	
Measurement Interval		**Meter**		**Delta**		**PMU Energy**	
Average (watt)	828.92	% of Reading	0.10%	Reading Delta	0.8289	Accuracy Factor	0.46%
Total (watt-sec)	5,968,261.89	% of Range	0.10%	Range Delta	3.0000	Adjusted (watt-sec)	5,995,830.29
Duration (sec)	7,200	Range (watt)	3,000.00	Total Delta	3.8289	Avg Power (watt)	832.75

PMU-2 = Tier A (Application Server)		Device: HIOKI 3334				Calibrated: 10-May-12	
Measurement Interval		**Meter**		**Delta**		**PMU Energy**	
Average (watt)	156.06	% of Reading	0.20%	Reading Delta	0.31	Accuracy Factor	0.20%
Total (watt-sec)	1,123,646.75	% of Range	0.00%	Range Delta	0.00	Adjusted (watt-sec)	1,125,894.04
Duration (sec)	7,200	Range (watt)	300.00	Total Delta	0.31	Avg Power (watt)	156.37

PMU-3 = Storage		Device: HIOKI 3334				Calibrated: 10-May-12	
Measurement Interval		**Meter**		**Delta**		**PMU Energy**	
Average (watt)	792.41	% of Reading	0.10%	Reading Delta	0.79	Accuracy Factor	0.48%
Total (watt-sec)	5,705,328.94	% of Range	0.10%	Range Delta	3.00	Adjusted (watt-sec)	5,732,634.18
Duration (sec)	7,200	Range (watt)	3,000.00	Total Delta	3.79	Avg Power (watt)	796.20

PMU-4 = Monitor (Nameplate) (Misc)	
PMU Energy	
Average (watt)	17.00
Duration (sec)	7,200
Total Energy (watt-sec)	122,400.00

Avg REC Energy (watt)	1,802.33
Total REC Energy (watt-sec)	12,976,759
Run Duration (sec)	7,200
Reported tpsE	2,651.27
Total Transactions	19,089,144.00
Energy (watts/tpsE)	**0.68**

Total REC Energy Consumption = 12,976,759 watt-seconds

SUT Total Work = Run Duration * Reported tpsE
SUT Total Work = 19,089,144 transactions

12,976,759 watt-seconds / 19,089,144 transactions = 0.68 watts/tpsE

Secondary Metrics At Reported Performance. (7.3.3.2)

If the TPC-Energy Secondary Metrics are reported, the components of the REC which 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.
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 Quantities			
	watts/tpsE	Full Load Avg Watts	Full Load % of REC	Idle Avg Watts	Idle % of REC
Database Server *)	0.31	832.75	46.20%	285.35	25.22%
Storage *)	0.30	796.20	44.18%	765.14	67.62%
Application Server *)	0.06	156.37	8.68%	80.65	7.13%
Miscellaneous *)	0.01	17.00	0.94%	0.40	0.04%
Total REC	0.68	1,802.33	100.00%	1,131.54	100.00%

*)See pricing for list of components

Database Server	5,995,830.29 watt-seconds/	19,089,144 transactions =	0.31 watts/tpsE
Storage	5,732,634.18 watt-seconds/	19,089,144 transactions =	0.30 watts/tpsE
Application Server	1,125,894.04 watt-seconds/	19,089,144 transactions =	0.06 watts/tpsE
Miscellaneous	122,400.00 watt-seconds/	19,089,144 transactions =	0.01 watts/tpsE

Idle Power reporting. (7.3.3.3)

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

2) If TPC-Energy Secondary Metrics are reported, then the Idle Power measurement/calculation for each subsystem must also be reported as numerical quantities.
3) The length of time between the conclusion of the performance measurement and the start of the idle measurement must be reported.

4) The duration of the idle measurement must be reported

5) 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.

PMU-1 = Tier B (Database Server)		**Device: HIOKI 3334**				**Calibrated: 10-May-12**	
Idle Interval		**Meter**		**Delta**		**PMU Energy**	
Average (watt)	282.07	% of Reading	0.10%	Reading Delta	0.2821	Accuracy Factor	1.16%
Total (watt-sec)	169,236.16	% of Range	0.10%	Range Delta	3.0000	Adjusted (watt-sec)	171,205.34
Duration (sec)	600	Range (watt)	3,000.00	Total Delta	3.2821	Avg Power (watt)	285.35

PMU-2 = Tier A (Application Server)		**Device: HIOKI 3334**				**Calibrated: 10-May-12**	
Idle Interval		**Meter**		**Delta**		**PMU Energy**	
Average (watt)	80.27	% of Reading	0.10%	Reading Delta	0.08	Accuracy Factor	0.47%
Total (watt-sec)	48,162.24	% of Range	0.10%	Range Delta	0.30	Adjusted (watt-sec)	48,390.41
Duration (sec)	600	Range (watt)	300.00	Total Delta	0.38	Avg Power (watt)	80.65

PMU-3 = Storage		**Device: HIOKI 3334**				**Calibrated: 10-May-12**	
Idle Interval		**Meter**		**Delta**		**PMU Energy**	
Average (watt)	761.38	% of Reading	0.10%	Reading Delta	0.76	Accuracy Factor	0.49%
Total (watt-sec)	456,807.87	% of Range	0.10%	Range Delta	3.00	Adjusted (watt-sec)	459,064.60
Duration (sec)	600	Range (watt)	3,000.00	Total Delta	3.76	Avg Power (watt)	765.14

PMU-4 = Monitor (Nameplate) (Misc)	
PMU Energy	
Average (watt)	0.40

Idle Power (watt)	**1,131.54**

Idle power measurement for REC = 1,131.54 Watts
The Idle measurement was started 11 minutes after all data processing was completed.
Idle measurement duration was 600 seconds
The system was in a state that was ready to run the applications 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 specification.

Disclosure requirements when only part of the REC is measured for power. (7.3.3.4)

The monitor power consumption in the PMU-4 was calculated using the Nameplate

Disclosure requirements when component substitution is used. (7.3.3.5)

The Priced Configuration was identical to the Measured Configuration

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, EMS Report Generator, and EMS-controller. (7.3.4.1)

The TPC Energy Management System V1.4.2 was used

Input parameters for the EMS software must be disclosed. (7.3.4.2)

See supporting files

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. (7.3.4.3)

No changes to EMS components were made

TPC-Energy Clause 6-related items (Instrumentation)

For each separate energy measurement (each subset measurement for each distinct measurement period), the following must be reported:
1) Analyzer used (make, model)
2) Date of certification of the analyzer (NIST or equivalent)
3) Range settings for Amperage, Voltage, and other settings for the measurement period
4) Specifications of any additional probes used in the energy measurement
5) The accuracy percentages used in the calculations and the source of those percentages. (7.3.6.1)

Power Analyzer Specifications and Settings										
							Full Load		Idle	
	Make	Model	Serial Number	Calibration date	Range Settings Current [A]	Range Settings Voltage[V]	% of reading	% of range	% of reading	% of range
PMU1 - Database Server	HIOKI	3334	90604934	10-May-12	10	300	0.10%	0.10%	0.10%	0.10%
PMU2 - Application Server	HIOKI	3334	90604933	10-May-12	1	300	0.20%	0.00%	0.10%	0.10%
PMU3 - Storage	HIOKI	3334	90604932	10-May-12	10	300	0.10%	0.10%	0.10%	0.10%

Accuracy percentages are taken from the HIOKI Instruction Manual 3334 3334-01 AC/DC POWER HiTESTER

The make and model of the temperature sensor and/or probe must be disclosed. (7.3.6.2)

Digi WatchportH

The accuracy percentage for the temperature sensor and/or probe and the source of this information must be disclosed. (7.3.6.3)

Temperature accuracy from Manufacturer's Datasheet:
+/- 0.5° C at -10° C to 85° C

TPC-Energy Clause 8-related items

INFO SIZING

TPC CERTIFIED AUDITOR

Benchmark Sponsors: Detlev Seidel
Primary TPC Representative
Fujitsu Technology Solutions
Heinz-Nixdorf-Ring 1
33106 Paderborn, Germany

November 2, 2012

I verified the TPC Benchmark™ E performance and the TPC-Energy measurement of the following configuration:

Platform: PRIMERGY RX500 S7
Operating system: Microsoft Windows Server 2008 R2 Enterprise Edition SP1
Database Manager: Microsoft SQL Server 2012 Enterprise Edition

The TPC-E results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
Tier B: PRIMERGY RX500 S7				
4 x Intel Xeon E5-4650 (2.70 GHz)	512 GB	90 x 200 GB SSD 6 x 300 GB 15Krpm SAS (int.) 2 x 146 GB 15Krpm SAS (int.)	0.05 Seconds	**2,651.27**
Tier A: PRIMERGY RX200 S7				
2 x Intel Xeon E5-2660 (2.20 GHz)	32 GB	1 x 250 GB 7.2Krpm SATA (int.)	n/a	n/a

In my opinion, these performance results were produced in compliance with the TPC-E benchmark requirements and the following verification items were given special attention:

- All EGen components were verified to be v1.12.0
- The transactions were correctly implemented.
- The database was properly scaled and populated for 1,330,000 Customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.
- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.

531 Crystal Hills Blvd • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 00:15:14 was correctly measured.
- The 60 day storage requirement was correctly computed and configured.
- The system pricing was verified for major components and maintenance.

The TPC-Energy measurements were:

TPC-Energy Metric	REC Idle Power	Average REC Power	Temperature
0.68 Watts/tpsE	1,131.54 Watts	1,802.33 Watts	21.31 C

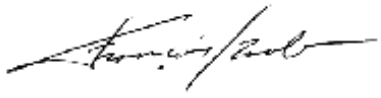
In my opinion, these energy measurements were produced in compliance with the TPC-Energy benchmark requirements and the following verification items were given special attention:

- The power analyzers used met the benchmark requirements and were correctly calibrated.
- The primary metric, secondary metrics and the idle power were calculated correctly.
- Version 1.4.2 of the EMS software package was used.

Additional Audit Notes:

None.

Respectfully Yours,



François Raab, President

531 Crystal Hills Blvd • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

Supporting Files Index (7.4.4)

Clause	Description	Path
7.4.1	Energy Measurement Logfiles	Clause7.4.1\ptdmanager-logs\001.A-Power.xml Clause7.4.1\ptdmanager-logs\001.B-Power.xml Clause7.4.1\ptdmanager-logs\001.S-Power.xml Clause7.4.1\ptdmanager-logs\001.A-Temperature.xml Clause7.4.1\ptdmanager-logs\001.B-Temperature.xml Clause7.4.1\ptdmanager-logs\001.S-Temperature.xml Clause7.4.1\RUN-REPORTS\rgen-A-Power.txt Clause7.4.1\RUN-REPORTS\rgen-B-Power.txt Clause7.4.1\RUN-REPORTS\rgen-S-Power.txt Clause7.4.1\RUN-REPORTS\rgen-A-Temperature.txt Clause7.4.1\RUN-REPORTS\rgen-B-Temperature.txt Clause7.4.1\RUN-REPORTS\rgen-S-Temperature.txt Clause7.4.1\IDLE-REPORTS\rgen-A-Power.txt Clause7.4.1\IDLE-REPORTS\rgen-B-Power.txt Clause7.4.1\IDLE-REPORTS\rgen-S-Power.txt Clause7.4.1\IDLE-REPORTS\rgen-A-Temperature.txt Clause7.4.1\IDLE-REPORTS\rgen-B-Temperature.txt Clause7.4.1\IDLE-REPORTS\rgen-S-Temperature.txt Clause7.4.1\RX500S7_TPC-E-Energy-Calculation.xlsx
7.4.2	Energy Measurement Controller Files	Clause7.4.2\emsc.log Clause7.4.2\emsc_commands.ems
7.4.3	Energy Measurement Configuration Files	Clause7.4.3\A-Power-ptd.cmd Clause7.4.3\B-Power-ptd.cmd Clause7.4.3\S-Power-ptd.cmd Clause7.4.3\A-Temperature-ptd.cmd Clause7.4.3\B-Temperature-ptd.cmd Clause7.4.3\S-Temperature-ptd.cmd Clause7.4.3\A-Power-ptdm.cmd Clause7.4.3\B-Power-ptdm.cmd Clause7.4.3\S-Power-ptdm.cmd Clause7.4.3\A-Temperature-ptdm.cmd Clause7.4.3\B-Temperature-ptdm.cmd Clause7.4.3\S-Temperature-ptdm.cmd