



TPC Benchmark™ E

Full Disclosure Report for

**FUJITSU Server**  
**PRIMEQUEST 2800E2**

Using

**Microsoft SQL Server 2014**  
**Enterprise Edition**

Using

**Microsoft Windows Server 2012 R2**  
**Standard Edition**

**TPC-E Version 1.14.0**

**Submitted for Review**

**November 11, 2015**

## **First Edition November 2015**

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.

### **Copyright © 2015 Fujitsu. All rights reserved.**

Permission is hereby granted to reproduce this document in whole or in part provided the copyright notice printed above is set forth in full text on the title page of each item reproduced.

FUJITSU Server PRIMEQUEST 2800E2, FUJITSU Server PRIMERGY RX2530 M1 and FUJITSU Storage ETERNUS JX40 are trademarks of Fujitsu.

Microsoft Windows Server 2012 R2, Microsoft SQL Server 2014 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 2014 Enterprise Edition.

The TPC Benchmark™ E tests were run on a PRIMEQUEST 2800E2 system using the Microsoft Windows Server 2012 R2 Standard Edition operating system.

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

Hardware	Software	Total System Cost	tpsE	\$ USD/tpsE	Availability Date
<b>FUJITSU Server PRIMEQUEST 2800E2</b>	<b>Microsoft SQL Server 2014 Enterprise Edition  Microsoft Windows Server 2012 R2 Standard Edition</b>	<b>\$ 1,886,164 USD</b>	<b>10,058.28</b>	<b>\$ 187.53 USD</b>	<b>November 11, 2015</b>

The benchmark implementation and results were audited by Doug Johnson for InfoSizing Inc. ([www.sizing.com](http://www.sizing.com)). The auditor's attestation letter is contained in Section 8 of this report.

		<b>FUJITSU Server PRIMEQUEST 2800E2</b>		<b>TPC-E 1.14.0 TPC Pricing 2.0.0</b>
				Report Date November 11, 2015
TPC-E Throughput <b>10,058.28 tpsE</b>	Price/Performance <b>\$ 187.53 USD per tpsE</b>	Availability Date <b>November 11, 2015</b>	Total System Cost <b>\$ 1,886,164 USD</b>	
<b>Database Server Configuration</b>				
Operating System <b>Microsoft Windows Server 2012 R2 Standard Edition</b>	Database Manager <b>Microsoft SQL Server 2014 Enterprise Edition</b>	Processors/Cores/Threads <b>8/128/256</b>	Memory <b>4 TB</b>	
<b>SUT</b>			<div style="border: 1px solid black; padding: 5px;"> <p><b>Tier A</b>            PRIMERGY RX2530 M1            2x Intel Xeon E5-2699 v3 2.30 GHz            64 GB Memory            2x 300 GB 15k rpm SAS Drive            2x Onboard LAN 10 Gb/s            1x Dual Port LAN 1 Gb/s            1x SAS RAID controller</p> <p><b>Tier B</b>            PRIMEQUEST 2800E2            8x Intel Xeon E7-8890 v3 2.50 GHz            4 TB Memory            2x 300 GB 10k rpm SAS Drives            2x 400 GB SSD Drives            2x Onboard LAN 10 Gb/s            15x SAS RAID Controller</p> <p><b>Storage</b>            1x PRIMECENTER Rack            15x ETERNUS JX40            210x 400 GB SSD Drives            10x 900 GB 10k rpm SAS Drives</p> </div>	
Initial Database Size <b>42,571 GB</b>	Redundancy Level 1 <b>RAID-5 data and RAID-10 log</b>		Storage <b>210 x 400 GB SSD 10 x 900 GB 10k rpm HDD</b>	



# FUJITSU Server PRIMEQUEST 2800E2

**TPC-E 1.14.0  
TPC Pricing 2.0.0**

Report Date  
November 11, 2015

Availability Date  
November 11, 2015

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3-yr. Maint. Price
<b>Database Server (Tier B) Hardware</b>			\$		\$	\$
<b>PRIMEQUEST 2800E2</b>						
Base Unit PQ2800E2	MCG3AC111	1	47,900.00	1	47,900.00	
PQ 2x00E Management Board_1	MC-5HMM21	1	4,270.00	2	8,540.00	
Power Supply 2.880W platinum hp	MC-5HPS41	1	1,240.00	4	4,960.00	
UL/CSA/PSE, Plug:IEC60320-C20, connector:IEC60320-C19	MC-0HCA83	1	60.00	4	240.00	
Power Cord IEC320 C19 -> US NEMA L6-20p	S26361-F3151-E500	1	60.00	4	240.00	
Fan Unit	MC-5HFA41	1	325.00	2	650.00	
System Board PQ2800E2	MC-3HSB71	1	43,000.00	4	172,000.00	
Memory Extension Board PQ2800E2	MC-3HMB21	1	1,400.00	4	5,600.00	
Intel Xeon E7-8890v3 18C/36T 2.50GHz	MC-3BDA11	1	16,115.00	8	128,920.00	
64GB (2x32GB) 4Rx4 DDR4-2133 LR ECC	MC-3CD711	1	4,218.00	64	269,952.00	
PRAID EP420i	MC-0JSR51	1	630.00	1	630.00	
Mounting kit for Raid contr. on SB (E2)	MC-0HCK31	1	60.00	1	60.00	
HD SAS 6G 300GB 10K HOT PL 2.5" EP	MC-5DS741	1	310.00	2	620.00	
IO Unit F (10GbE, 2xbaseTports) PQ2800E	MC-3HUX41	1	8,260.00	1	8,260.00	
IO Unit (1GbE) PQ2800E	MC-3HUX31	1	5,610.00	3	16,830.00	
PRAID EP420e FH	MC-0JSR62	1	791.00	2	1,582.00	
PRAID EP420e LP	MC-0JSR61	1	791.00	13	10,283.00	
JX40 SSD SAS 12G 400GB MLC 2.5" (tempdb)	FTS:JX40-SSD400	1	2,536.00	2	5,072.00	
Rack Mount Kit F1-C S7 LV	S26361-F2735-E175	1	144.00	1	144.00	
Rack Cable Arm 2U	S26361-F2735-E82	1	40.00	1	40.00	
Mounting of RMK in symmetrical racks	S26361-F4530-E10	1	126.00	1	126.00	
Region-Kit APA/C/America/EMEA/Indien	S26361-F1452-E100	1	13.00	1	13.00	
PRIMEQUEST PQ2800E Installation, normal business hours	PQ280E-A046005-ABL	1	5,000.00	1		5,000.00
PQ2800E Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	PQ280E-U004361-ABL	1	53,717.00	1		53,717.00
<b>Subtotal (*)</b>					<b>682,662.00</b>	<b>58,717.00</b>
<b>Storage</b>						
<b>PRIMECENTER RACK</b>						
PRIMECENTER M1 Rack 742S 42U-1050x700	S26361-K827-V240	1	2,795.00	1	2,795.00	
Dummy panel, plastics, 1U + assembly	S26361-F4530-L131	1	12.00	1	12.00	
Socket strip 3phase 3x 8 sockets	S26361-F2262-E31	1	240.00	2	480.00	
PY PRIMECENTER during normal business hours, PRIMERGY Installation, Racks, One Time billing	PYPCTR-N076005-ONA	1	280.00	1		280.00
PY PRIMECENTER Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYPCTR-U004361-ONA)	PYPCTR-U004361-ONA	1	750.00	1		750.00
<b>ETERNUS JX40</b>						
ETERNUS JX40	FTS:ETJXS11BG	1	2,594.00	15	38,910.00	
JX40 SAS 6G Disk 900GB 10k 2.5"	FTS:ETJSA9MBG	1	336.00	10	3,360.00	
JX40 SSD SAS 12G 400GB MLC 2.5"	FTS:JX40-SSD400	1	2,536.00	210	532,560.00	
SAS Cable 6Gb 1x SFF 8088-1x SFF 8088 4m	D:KBSAS6G-1S-1S-4M	1	94.00	15	1,410.00	
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-ONA	1	639.00	15		9,585.00
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-ONA	1	1,218.00	15		18,270.00
PY JX40 during normal business hours, Primergy storage installation, One Time billing	PYJX40-N043005-ONA	1	450.00	15		6,750.00
<b>Subtotal(*)</b>					<b>579,527.00</b>	<b>35,635.00</b>



## FUJITSU Server PRIMEQUEST 2800E2

**TPC-E 1.14.0  
TPC Pricing 2.0.0**

Report Date  
November 11, 2015

Availability Date  
November 11, 2015

Database Server (Tier B) Software						
SQL Server 2014 Enterprise Edition 2 Core License	7JQ-00750	2	13,472.50	64	862,240.00	
Microsoft Windows Server 2012 R2 Standard Edition 2 Processor License	P72-06284	2	735.00	4	2,940.00	
Microsoft Problem Resolution Services	n/a	2	259.00	1		259.00
				<b>Subtotal</b>	865,180.00	259.00
Application Server (Tier A) Hardware						
<b>PRIMERGY RX2530 M1</b>						
PY RX2530 M1 4x 2.5" expandable	S26361-K1492-V301	1	1,249.00	1	1,249.00	
Modular PSU 450W platinum hp	S26113-F575-E13	1	275.00	2	550.00	
Cable power cord rack, 4m, grey	T26139-Y1968-E100	1	13.00	2	26.00	
Cool-safe Advanced Thermal Design	S26361-F3776-E101	1	4.00	1	4.00	
Intel Xeon E5-2699v3 18C/36T 2.30 GHz	S26361-F3849-E199	1	6,237.00	2	12,474.00	
Cooler Kit 2nd CPU	S26361-F3849-E100	1	35.00	1	35.00	
8GB (1x8GB) 2Rx8 DDR4-2133 R ECC	S26361-F3843-E515	1	252.00	8	2,016.00	
Performance Mode Installation	S26361-F3694-E2	1	7.00	2	14.00	
DVD ROM Ultralim	S26361-F3718-E2	1	104.00	1	104.00	
HD SAS 12G 300GB 15K HOT PL 2.5" EP	S26361-F4530-E530	1	554.00	2	1,108.00	
PRAID EP400i	S26361-F5243-E1	1	514.00	1	514.00	
PLAN EM 2x10Gb T OCH14000-LOM interface	S26361-F5302-E210	1	189.00	1	189.00	
PLAN CP 2x1Gbit Cu Intel I350-T2 LP	S26361-F4610-E202	1	268.00	1	268.00	
Rack Mount Kit F1-CMA Slim Line	S26361-F2735-E400	1	92.00	1	92.00	
Mounting of RMK in symmetrical racks region-kit America	S26361-F4530-E10	1	7.00	1	7.00	
	S26361-F1452-E130	1	13.00	1	13.00	
PYRX2530 M1 during normal business hours, Primergy Installation, Midrange Server, w/o OS, One Time billing	PYR253-N038005-ONA	1	350.00	2		700.00
PYRX2530 M1 Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	PYR253_S26361-K1492-V301	1	931.00	2		1,862.00
				<b>Subtotal(*)</b>	18,663.00	2,562.00
Application Server (Tier A) Software						
Microsoft Windows Server 2012 R2 Standard Edition 2 Processor License	P72-06284	2	735.00	1	735.00	
				<b>Subtotal</b>	735.00	
Miscellaneous						
Display E24T-7 LED, Cross Trade (incl 2spares)	S26361-K1543-V140	1	332.00	3	996.00	
Infrastructure or Connectivity						
KB900 Keyboard USB USA (incl 2 spares)	S26381-K560-L402	1	27.00	3	81.00	
Mouse MC200 (incl 2 spares)	S26381-K463-L100	1	16.00	3	48.00	
StarTech.com 7 ft Blue Shielded Snagless 10Gb RJ45 STP Cat6a Patch Cable (incl 2 spares)	C6ASPAT7BL	3	12.99	4	51.96	
				<b>Subtotal(*)</b>	1,176.96	0.00
				<b>Total</b>	2,147,943.96	97,173.00
Dollar Volume Discount (see Notes)		28%	1		358,953.56	
					1,788,990.40	

Notes: Price Source: 1=FUJITSU, 2=Microsoft Corporation, 3=www.cdw.com. Discount applies to all Extended Price Subtotal marked with(*) and Price Source = 1. Pricing is for these or similar quantities. Discounts for similar sized configurations will be similar to what is quoted here, but may vary based on the specific components priced.	<b>Three-Year Cost of Ownership USD</b>	\$1,886,164
	<b>TPC-E Throughput</b>	10,058.28
	<b>\$ USD/tpsE</b>	\$187.53

The benchmark results and test methodology were audited by Doug Johnson 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.



**FUJITSU Server  
PRIMEQUEST 2800E2**

**TPC-E 1.14.0  
TPC Pricing 2.0.0**

Report Date  
November 11, 2015

Availability Date  
November 11, 2015

**Numerical Quantities Summary**

<b>Reported Throughput:</b>	<b>10,058.28 tpsE</b>	<b>Configured Customers:</b>	<b>5,184,000</b>	
<b>Response Times (in seconds)</b>	<b>Minimum</b>	<b>Average</b>	<b>90th%tile</b>	<b>Maximum</b>
Broker Volume	0.01	0.01	0.02	0.97
Customer Position	0.01	0.01	0.01	3.17
Market Feed	0.01	0.01	0.02	3.16
Market Watch	0.01	0.01	0.01	0.95
Security Detail	0.01	0.01	0.01	0.88
Trade Lookup	0.01	0.04	0.07	0.99
Trade Order	0.01	0.05	0.14	1.14
Trade Result	0.01	0.01	0.02	0.95
Trade Status	0.01	0.01	0.01	0.95
Trade Update	0.01	0.05	0.08	1.02
Data Maintenance	0.01	0.01	N/A	0.14
<b>Transaction Mix</b>	<b>Transaction Count</b>		<b>Mix %</b>	
Broker Volume	35,486,687		4.900%	
Customer Position	94,149,128		13.000%	
Market Feed	7,241,967		1.000%	
Market Watch	130,359,570		18.000%	
Security Detail	101,391,285		14.000%	
Trade Lookup	57,937,621		8.000%	
Trade Order	73,146,173		10.100%	
Trade Result	72,419,665		10.000%	
Trade Status	137,602,233		19.000%	
Trade Update	14,484,345		2.000%	
Data Maintenance	120		N/A	
<b>Test Duration and Timings</b>				
Ramp-up Time (hh:mm:ss)	0:20:00			
Measurement Interval (hh:mm:ss)	2:00:00			
Business Recovery Time (hh:mm:ss)	0:43:10			
Total Number of Transactions Completed in Measurement Interval	724,218,674			

## Table of Contents

<b>ABSTRACT .....</b>	<b>3</b>
<b>CLAUSE 0: PREAMBLE.....</b>	<b>10</b>
Introduction .....	10
Goal of the TPC-E Benchmark .....	10
Restrictions and Limitations .....	11
<b>CLAUSE 1: OVERVIEW.....</b>	<b>12</b>
Order and Titles .....	12
Executive Summary Statement .....	12
Benchmark Sponsor .....	12
Configuration Diagram.....	13
Hardware Configuration.....	14
Software Configuration .....	15
<b>CLAUSE 2: DATABASE DESIGN, SCALING AND POPULATION .....</b>	<b>16</b>
Database Creation.....	16
Partitioning.....	16
Replication and Duplicated Attributes.....	16
Cardinality of Tables .....	17
Distribution of Tables, Partitions and Logs .....	18
Database Interface, Data Model and Load Methodology .....	19
<b>CLAUSE 3: TRANSACTIONS .....</b>	<b>20</b>
Vendor-Supplied Code .....	20
Database Footprint Requirements.....	20
<b>CLAUSE 4: SUT, DRIVER AND NETWORK.....</b>	<b>21</b>
Network Configuration .....	21
<b>CLAUSE 5: EGEN.....</b>	<b>22</b>
EGen Version .....	22
EGen Code .....	22
EGen Modifications.....	22
<b>CLAUSE 6: PERFORMANCE METRICS AND RESPONSE TIME.....</b>	<b>23</b>
EGen Driver .....	23
Measured Throughput .....	23
Test Run Graph .....	23
Steady State .....	24
Work Performed During Steady State .....	24
Transaction Input Parameter Averages.....	25
<b>CLAUSE 7: TRANSACTION AND SYSTEM PROPERTIES.....</b>	<b>26</b>
ACID Tests .....	26
Redundancy Level and Data Accessibility.....	26
Business Recovery .....	27
<b>CLAUSE 8: PRICING RELATED ITEMS.....</b>	<b>29</b>
60-Day Space .....	29
Attestation Letter.....	30
<b>CLAUSE 9: SUPPORTING FILES.....</b>	<b>32</b>



Supporting Files Index table .....	32
<b>APPENDIX: THIRD PARTY PRICE QUOTATIONS .....</b>	<b>37</b>

# 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 any time, 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 RX2530 M1  
2x Intel Xeon E5-2699 v3 2.30 GHz  
64 GB Memory  
2x 300 GB 15k rpm SAS Drive  
2x Onboard LAN 10 Gb/s  
1x Dual Port LAN 1 Gb/s  
1x SAS RAID controller

### Tier B

PRIMEQUEST 2800E2  
8x Intel Xeon E7-8890 v3 2.50 GHz  
4 TB Memory  
2x 300 GB 10k rpm SAS Drives  
2x 400 GB SSD Drives  
2x Onboard LAN 10 Gb/s  
15x SAS RAID Controller

### Storage

1x PRIMECENTER Rack  
15x ETERNUS JX40  
210x 400 GB SSD Drives  
10x 900 GB 10k rpm SAS Drives

Figure 1-2: Measured Configuration



#### **Tier A**

PRIMERGY RX2530 M1  
2x Intel Xeon E5-2699 v3 2.30 GHz  
64 GB Memory  
2x 300 GB 15k rpm SAS Drive  
2x Onboard LAN 10 Gb/s  
1x Dual Port LAN 1 Gb/s  
1x SAS RAID controller

#### **Tier B**

PRIMEQUEST 2800E2  
8x Intel Xeon E7-8890 v3 2.50 GHz  
4 TB Memory  
2x 300 GB 10k rpm SAS Drives  
2x 400 GB SSD Drives  
2x Onboard LAN 10 Gb/s  
15x SAS RAID Controller

#### **Storage**

1x PRIMECENTER Rack  
15x ETERNUS JX40  
210x 400 GB SSD Drives  
10x 900 GB 10k rpm SAS Drives  
For backup:  
96x 1200 GB 10k 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 RX2530 M1 system with two Intel Xeon E5-2699 v3 Eighteen-Core Processor and 64 GB of memory. Two SAS 300 GB 15k rpm disk drives are connected with RAID controller 12 Gb/s SAS3.0 (PRAID EP400i) and configured with RAID1 for OS. One dual port 1 Gb/s Ethernet LAN card is plugged in the PCI-E slot. These two 1 Gb/s LAN ports are used for driver connection. There are two onboard 10 Gb/s LAN ports. Each of the two ports is directly connected with one of the 10 Gb/s Ethernet onboard LAN ports of Tier B using a LAN crossover cable.

## **Tier B**

The Tier B or database server is a Fujitsu PRIMEQUEST 2800E2 system with eight Intel Xeon E7-8890 v3 18-Core Processors and 4 TB memory. Two of the 18 cores are disabled in BIOS. The four onboard 2.5" disk bays of system board 0 are used with 2x SAS 300 GB 10k rpm 2.5" and 2x SAS 400 GB SSD 2.5" disk drives connected with RAID controller 12 Gb/s SAS3.0 (PRAID EP420i). The first pair of drives is configured with RAID1 for OS and database. The second pair of drives is configured with RAID1 for database tempdb. Fifteen RAID Controllers 12G SAS3.0 (PRAID EP420e) are used to connect the external disk drives to the server. The controller cache of all 16 RAID controllers is configured with Write Through. The two onboard 10 Gb/s Ethernet LAN ports are connected to the Tier A system as described above.

## **Storage**

14 Fujitsu ETERNUS JX40 are used, each with 15x 400GB SSD 2.5" RAID5. The enclosures are connected to the RAID Controllers 12G SAS3.0 (PRAID EP420e). One additional Fujitsu ETERNUS JX40 is used for log with 10x 900GB 10K rpm 2.5" RAID10. The enclosure is connected to the RAID Controllers 12G SAS3.0 (PRAID EP420e). 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.

## 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 5,184,000 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 5,184,000 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	36805756	1
ADDRESS	7776004	1
BROKER	51840	1
CASH_TRANSACTION	82413163414	2
CHARGE	15	1
COMMISSION_RATE	240	1
COMPANY	2592000	1
COMPANY_COMPETITOR	7776000	1
CUSTOMER	5184000	1
CUSTOMER_ACCOUNT	25920000	1
CUSTOMER_TAXRATE	10368000	1
DAILY_MARKET	4634107200	1
EXCHANGE	4	1
FINANCIAL	51840000	1
HOLDING	4586417171	2
HOLDING_HISTORY	120051957604	2
HOLDING_SUMMARY	257815909	2
INDUSTRY	102	1
LAST_TRADE	3551040	1
NEWS_ITEM	5184000	1
NEWS_XREF	5184000	1
SECTOR	12	1
SECURITY	3551040	1
SETTLEMENT	89579520000	2
STATUS_TYPE	5	1
TAXRATE	320	1
TRADE	89579520000	2
TRADE_HISTORY	214990654460	2
TRADE_REQUEST	0	2
TRADE_TYPE	5	1
WATCH_ITEM	518422180	1
WATCH_LIST	5184000	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
Ctrl 0 Port 0 JX40	0	15x400GB SSD, RAID5	C:\jp\tpce011 C:\jp\tpce012	102.5 GB 5106 GB	Filegroup1 Filegroup2
	1	8x1200GB HDD, RAID5	C:\jp\help01	7821 GB	DB Setup,Backup
Ctrl 1 Port 0 JX40	2	15x400GB SSD, RAID5	C:\jp\tpce021 C:\jp\tpce022	102.5 GB 5106 GB	Filegroup1 Filegroup2
	3	8x1200GB HDD, RAID5	C:\jp\help02	7821 GB	DB Setup,Backup
Ctrl 2 Port 0 JX40	4	15x400GB SSD, RAID5	C:\jp\tpce031 C:\jp\tpce032	102.5 GB 5106 GB	Filegroup1 Filegroup2
	5	8x1200GB HDD, RAID5	C:\jp\help03	7821 GB	DB Setup,Backup
Ctrl 3 Port 0 JX40	6	15x400GB SSD, RAID5	C:\jp\tpce041 C:\jp\tpce042	102.5 GB 5106 GB	Filegroup1 Filegroup2
	7	8x1200GB HDD, RAID5	C:\jp\help04	7821 GB	DB Setup,Backup
Ctrl 4 Port 0 JX40	8	15x400GB SSD, RAID5	C:\jp\tpce051 C:\jp\tpce052	102.5 GB 5106 GB	Filegroup1 Filegroup2
	9	8x1200GB HDD, RAID5	C:\jp\help05	7821 GB	DB Setup,Backup
Ctrl 5 Port 0 JX40	10	15x400GB SSD, RAID5	C:\jp\tpce061 C:\jp\tpce062	102.5 GB 5106 GB	Filegroup1 Filegroup2
	11	8x1200GB HDD, RAID5	C:\jp\help06	7821 GB	DB Setup,Backup
Ctrl 6 Port 0 JX40	12	15x400GB SSD, RAID5	C:\jp\tpce071 C:\jp\tpce072	102.5 GB 5106 GB	Filegroup1 Filegroup2
	13	8x1200GB HDD, RAID5	C:\jp\help07	7821 GB	DB Setup,Backup
Ctrl 7 Port 0 JX40	14	15x400GB SSD, RAID5	C:\jp\tpce081 C:\jp\tpce082	102.5 GB 5106 GB	Filegroup1 Filegroup2
Ctrl 8 Port 0 JX40	15	15x400GB SSD, RAID5	C:\jp\tpce091 C:\jp\tpce092	102.5 GB 5106 GB	Filegroup1 Filegroup2
	16	8x1200GB HDD, RAID5	C:\jp\help09	7821 GB	DB Setup,Backup
Ctrl 9 Port 0 JX40	17	15x400GB SSD, RAID5	C:\jp\tpce101 C:\jp\tpce102	102.5 GB 5106 GB	Filegroup1 Filegroup2
	18	8x1200GB HDD, RAID5	C:\jp\help10	7821 GB	DB Setup,Backup
Ctrl 10 Port 0 JX40	19	15x400GB SSD, RAID5	C:\jp\tpce111 C:\jp\tpce112	102.5 GB 5106 GB	Filegroup1 Filegroup2
	20	8x1200GB HDD, RAID5	C:\jp\help11	7821 GB	DB Setup,Backup
Ctrl 11 Port 0 JX40	21	15x400GB SSD, RAID5	C:\jp\tpce121 C:\jp\tpce122	102.5 GB 5106 GB	Filegroup1 Filegroup2
	22	8x1200GB HDD, RAID5	C:\jp\help12	7821 GB	DB Setup,Backup
Ctrl 12 Port 0 JX40	23	15x400GB SSD, RAID5	C:\jp\tpce131 C:\jp\tpce132	102.5 GB 5106 GB	Filegroup1 Filegroup2
	24	8x1200GB HDD, RAID5	C:\jp\help13	7821 GB	DB Setup,Backup
Ctrl 13 Port 0 JX40	25	15x400GB SSD, RAID5	C:\jp\tpce141 C:\jp\tpce142	102.5 GB 5106 GB	Filegroup1 Filegroup2
Ctrl 14 Port 0 JX40	26	10x900GB 10K SAS, RAID10	L:\	4189 GB	DB Log
Ctrl 15 onboard	27	2x300GB 15K SAS, RAID1	C:\	278 GB	OS, DB
	28	2x400GB SSD, RAID1	T:\	371 GB	tempdb

## **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 2014 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 PRIMEQUEST 2800E2 has an onboard Ethernet controller with two 10 Gb/s ports. Tier A system PRIMERGY RX2530 M1 has an onboard Ethernet controller with two 10 Gb/s ports. These two ports were directly connected with the two onboard ports of Tier B using different LAN segments. Tier A system was extended with one dual-port 1 Gb/s Ethernet controller card used for driver system connection.

## 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 1.14.0.

### **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).*

# 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 32 EGenDriverMEE and 32 EGenDriverCE instances.

## Measured Throughput

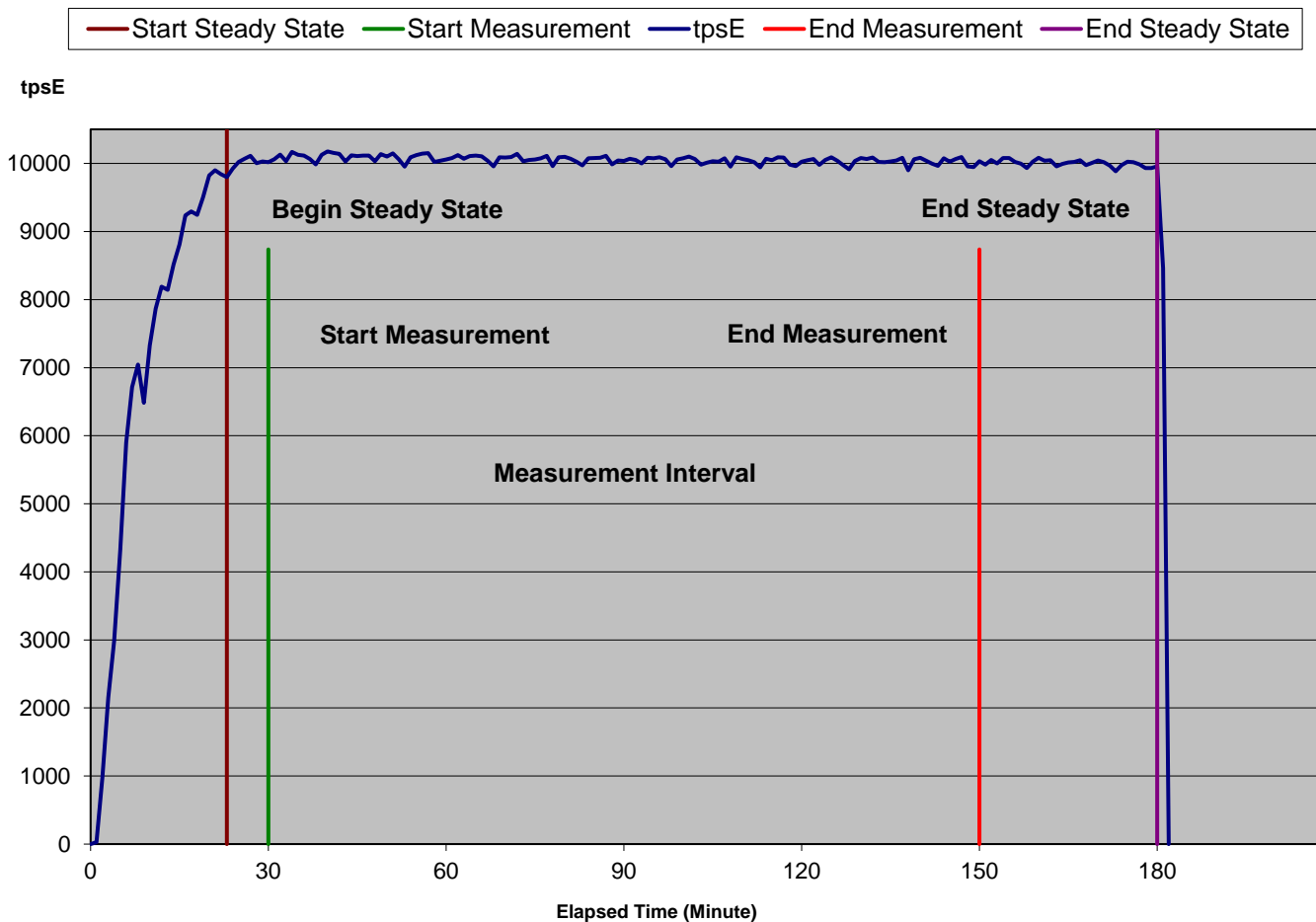
The Measured Throughput must be reported in the Report (see Clause 6.7.1.2) (9.3.6.2).

The measured throughput was 10,058.28 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.

## 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 (449 seconds) and specified duration (440 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 Position	By Tax ID	48.00%	52.00%	50.00%	Ok
	Get History	48.00%	52.00%	50.00%	Ok
	Overall				Ok
Market Watch	By Watch List	57.00%	63.00%	60.00%	Ok
	By Customer Account	33.00%	37.00%	35.00%	Ok
	By Industry	4.50%	5.50%	5.00%	Ok
	Overall				Ok
Security Detail	Access LOB	0.90%	1.10%	1.00%	Ok
	Overall				Ok
Trade Lookup	Frame 1	28.50%	31.50%	30.00%	Ok
	Frame 2	28.50%	31.50%	30.00%	Ok
	Frame 3	28.50%	31.50%	30.00%	Ok
	Frame 4	9.50%	10.50%	10.00%	Ok
	Overall				Ok
Trade Update	Frame 1	31.00%	35.00%	32.99%	Ok
	Frame 2	31.00%	35.00%	33.02%	Ok
	Frame 3	32.00%	36.00%	33.99%	Ok
	Overall				Ok
Trade Order	By Non-Owner	9.50%	10.50%	10.00%	Ok
	By Company Name	38.00%	42.00%	40.01%	Ok
	Buy On Margin	7.50%	8.50%	8.00%	Ok
	Rollback	0.94%	1.04%	0.99%	Ok
	LIFO	33.00%	37.00%	35.00%	Ok
	Trade Qty 100	24.00%	26.00%	24.99%	Ok
	Trade Qty 200	24.00%	26.00%	25.00%	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%	30.01%	Ok
	Market Sell	29.70%	30.30%	30.00%	Ok
	Limit Buy	19.80%	20.20%	20.00%	Ok
	Limit Sell	9.90%	10.10%	10.00%	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).*

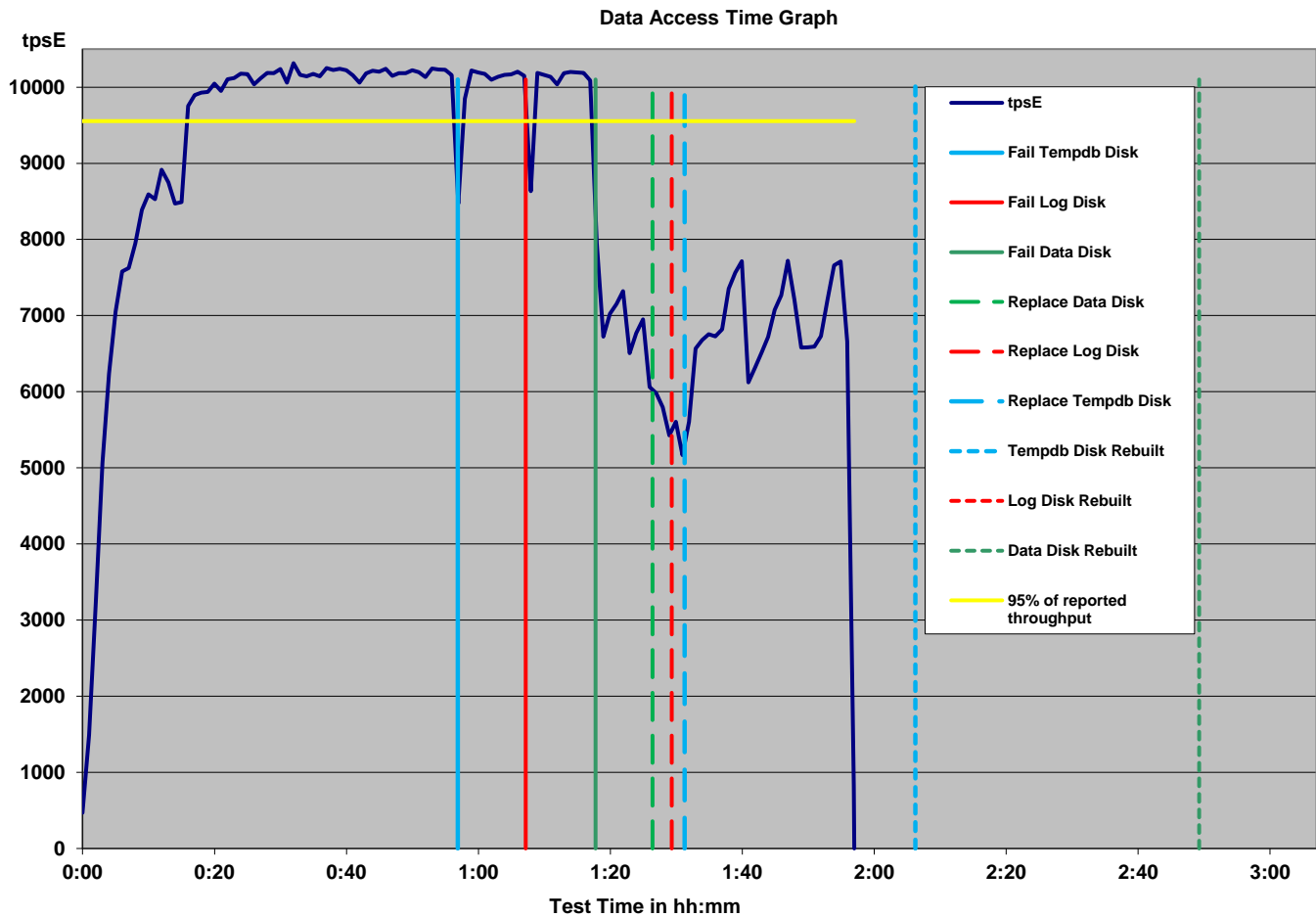
*A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.5.7.2) (9.3.7.3).*

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 with a throughput above 95% of reported throughput.
3. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in the database temp array. Since RAID1 is used, the transactions continue. Run for at least 5 minutes with throughput above 95% of reported throughput.
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. Run for at least 5 minutes with throughput above 95% of reported throughput.
5. 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. Run for at least 5 minutes.
6. Begin the necessary recovery process, by replacing the failed drives in the database data, log and temp array and start the rebuild process.
7. Continue running the Driver for at least 20 minutes.
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 B.

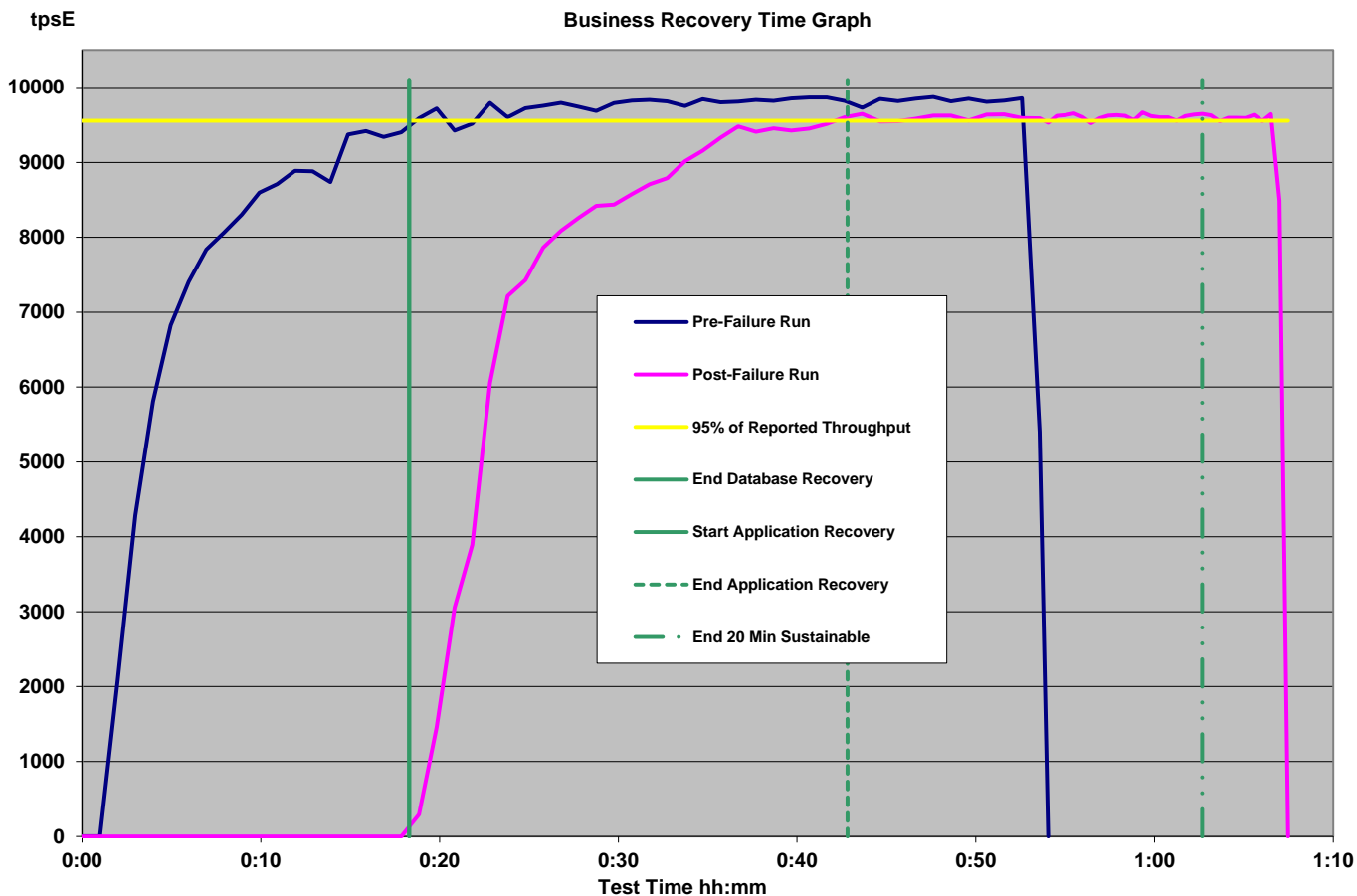
1. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
2. Start submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes.
3. Induce the failures by 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 00:18:27 (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 00:24:43 (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 00:43:10 (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

Customers Used		TPC-E Disk Space Requirements								
Performance		10058.28	TPsE	settlements after 8 hours (Business Day)			289,678,464			
Table	Initial Rows	Data (KB)	Index size (KB)	Extra 5% (KB)	initial size Total + 5% (KB)	grow size After run (KB)	Growth (KB)	1 Day Growth (KB)	Req. Add. (KB)	
ACCOUNT_PERMISSION	36,805,756	2,026,656	10,888	101,877	2,139,421	2,037,656	112	310	101,877	
ADDRESS	7,776,004	448,520	1,696	22,511	472,727	450,280	64	177	22,511	
BROKER	51,840	4,608	5,888	525	11,021	10,496	0	0	525	
CASH_TRANSACTION	82,413,163,414	8,582,275,256	18,087,568	430,018,141	9,030,380,965	8,618,536,168	18,173,344	50,214,908	50,214,908	
CHARGE	15	8	8	1	17	16	0	0	1	
COMMISSION_RATE	240	16	16	2	34	32	0	0	2	
COMPANY	2,592,000	553,624	163,632	35,863	753,119	717,280	24	67	35,863	
COMPANY_COMPETITOR	7,776,000	208,816	189,168	19,899	417,883	397,984	0	0	19,899	
CUSTOMER	5,184,000	849,504	248,960	54,923	1,153,387	1,098,488	24	67	54,923	
CUSTOMER_ACCOUNT	25,920,000	2,348,760	573,360	146,106	3,068,226	2,922,120	0	0	146,106	
CUSTOMER_TAXRATE	10,368,000	216,192	1,656	10,892	228,740	217,984	136	376	10,892	
DAILY_MARKET	4,634,107,200	217,558,408	635,664	10,909,704	229,103,776	218,195,352	1,280	3,537	10,909,704	
EXCHANGE	4	8	8	1	17	16	0	0	1	
FINANCIAL	51,840,000	5,841,880	16,624	292,925	6,151,429	5,858,784	280	774	292,925	
HOLDING	4,586,417,171	307,059,352	209,917,920	25,848,864	542,826,136	523,168,920	6,191,648	17,108,191	17,108,191	
HOLDING_HISTORY	120,051,957,604	4,365,526,560	2,916,338,128	364,093,234	7,645,957,922	7,302,660,568	20,795,880	57,461,258	57,461,258	
HOLDING_SUMMARY	257,815,909	11,321,424	42,152	568,179	11,931,755	11,363,576	0	0	568,179	
INDUSTRY	102	8	24	2	34	32	0	0	2	
LAST_TRADE	3,551,040	221,448	1,448	11,145	234,041	222,896	0	0	11,145	
NEWS_ITEM	5,184,000	562,040,304	5,832	28,102,307	590,148,443	562,046,192	56	155	28,102,307	
NEWS_XREF	5,184,000	129,096	1,640	6,537	137,273	130,736	0	0	6,537	
SECTOR	12	8	24	2	34	32	0	0	2	
SECURITY	3,551,040	492,960	135,856	31,441	660,257	628,848	32	89	31,441	
SETTLEMENT	89,579,520,000	4,271,496,176	9,004,096	214,025,114	4,494,527,386	4,290,621,904	10,119,632	27,961,634	27,961,634	
STATUS_TYPE	5	8	8	1	17	16	0	0	1	
TAXRATE	320	24	16	2	42	56	16	45	45	
TRADE	89,579,520,000	10,695,324,640	5,960,385,200	832,785,492	17,488,495,332	16,711,515,448	55,805,608	154,196,909	154,196,909	
TRADE_HISTORY	214,990,654,460	6,465,885,128	16,854,144	324,136,964	6,806,876,236	6,500,851,296	18,112,024	50,045,474	50,045,474	
TRADE_REQUEST	0	8	40	2	50	1,763,848	1,763,800	4,873,570	4,873,570	
TRADE_TYPE	5	8	1,032	52	1,092	1,040	0	0	52	
WATCH_ITEM	518,422,180	14,579,632	53,816	731,672	15,365,120	14,633,712	264	730	731,672	
WATCH_LIST	5,184,000	129,208	116,760	12,298	258,266	245,968	0	0	12,298	
ZIP_CODE	14,741	488	104	30	622	592	0	0	30	
Growing Tables		Initial Database Size			43,593,100 (MB)	Settlements	104,837,918			
				42,571 (GB)		Grown Database Size	43,720,994 (MB)			
	number	partition size (MB)	file size (MB)	alloc total (MB)	loaded (MB)	required (MB)				
filegroup1	14	104,960	1,442,000	1,469,440	790,834	830,376		space OK		
filegroup2	14	5,228,544	72,660,000	73,199,616	42,802,265	43,155,646		space OK		
		Number of disks	210							
		Disk Capacity (MB)	381,024							
		RAID5 Overhead	7%							
Initial Growing Space (MB)	42,802,265	Total Space-1 (MB)	74,680,704							
Final Growing Space (MB)	42,930,158	Number of disks	-	Initial Log Size (MB)	59,533	Log units	1			
Delta (MB)	127,893	Disk Capacity (MB)	-	Final Log Size (MB)	772,452	Disks per unit	10			
Data Space per Trade (MB)	0.001220	RAID5 Overhead	-	Log Growth (MB)	712,920	Disk Capacity (MB)	857,952			
1 Day Data Growth (MB)	353,381	Total Space-2 (MB)	-	Log Space per Trade	0.006800	RAID10 Overhead	50.0%			
60 Day Space (MB)	64,795,948	Total Space (MB)	74,680,704	1 Day Log Space (MB)	1,969,874	Log Space (MB)	4,289,760			

# Attestation Letter

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



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

November 9, 2015

I verified the TPC Benchmark™ E v1.14.0 performance of the following configuration:

Platform: Fujitsu Server PRIMEQUEST 2800E2  
Operating System: Microsoft Windows Server 2012 R2 Standard Edition  
Database Manager: Microsoft SQL Server 2014 Enterprise Edition

The results were:

**Performance Metric** 10,058.28 tpsE  
**Trade-Result 90<sup>th</sup> %-tile** 0.14 Seconds

<b><u>Tier B (Server)</u></b>	<b><u>Fujitsu Server PRIMEQUEST 2800E2</u></b>		
CPU	8 x Intel Xeon E7-8890 v3 (2.50 GHz, 18-core, 45 MB L3)		
Memory	4096 GB		
Storage	<b>Qty</b>	<b>Size</b>	<b>Type</b>
	2	300 GB	10K rpm SAS HDD
	2	400 GB	SAS SSD
	10	900 GB	10K rpm SAS HDD
	210	400 GB	SAS SSD

<b><u>Tier A (Client)</u></b>	<b><u>PRIMERGY RX2530 M1</u></b>		
CPU	2 x Intel Xeon E5-2699 v3 (2.30 GHz, 18-core, 45 MB L3)		
Memory	64 GB		
Storage	2 x 300 GB 15K rpm SAS HDD		

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark.

The following verification items were given special attention:

- All EGen components were verified to be v1.14.0
- The transaction were correctly implemented
- The database was properly scaled and populated for 5,184,000 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
- All 90% response times were under the specified maximums
- The measurement interval was 120 minutes
- The implementation used Redundancy Level 1
- The Business Recovery Time of 00:43:10 was correctly measured
- The 60-day storage requirement was correctly computed
- The system pricing was verified for major components and maintenance

**Additional Audit Notes:**

None.

Respectfully Yours,



Doug Johnson, Auditor



François Raab, President

## 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.docx flatfilelocations.txt makehelpdir.cmd makehelpdirff.cmd maketpcdir.cmd Readme.txt tempdb17.sql
	Parameter OS Tunables Database Setup	SupportingFiles/Introduction/Software/	15-RAID.jpg CountOperations.reg DiskManagement01.jpg DiskManagement02.jpg DiskManagement03.jpg DiskManagement04.jpg DiskManagement05.jpg MemoryManagement.reg MSTPCE Database Setup Reference.doc NUMA.reg SQL_IP.reg SQL_LargePages.req SQL_Nodes.reg SQL_Server_Configuration.ver TierA_MSSQL_ConnectTo.reg TierA_W32Time.reg
	Startup Scripts Tier A	SupportingFiles/Introduction/Software/	start_all_PQ2800E2-32-2DR-affinity.cmd
	Startup Scripts Tier B	SupportingFiles/Introduction/Software/	Sqlstart2014.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 SpaceUsed_Extended.sql



			SQL_Server_Configuration.sql TPCE_Setup.cmd Trade_Cleanup.sql Version.sql
	Create Database output	SupportingFiles/Clause2/DB_setup	5184000Customers_Load_Timer.log Backup_Database.log BrokerVolume.log Build_Steps.log BulkInsert_1.out ... BulkInsert_288.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_Tables.log Drop_DB_Audit_Tables.log Drop_Fixed_Tables.log Drop_FK_Constraints.log Drop_Growing_Tables.log Drop_Scaling_Tables.log EGenLoaderFrom1To18000.log EGenLoaderFrom18001To36000.log .... EGenLoaderFrom 5166001To5184000.log ERRORLOG.txt FK_Constraints.log Get_Next_T_ID.log Insert_Duplicates_Tests.log Install_SpaceUsed_Extended.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.log splog.log SQL_Server_Configuration.log Tables_Fixed.log Tables_Growing.log Tables_Scaling.log TPCE_Table_Sizes.log TPCE_VERSIONS.log TradeLookup.log TradeOrder.log TradeResult.log TradeStatus.log TradeUpdate.log Version.log
	Index Creation Scripts	SupportingFiles/Clause2/DDL	BulkInsert_<1..288>.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	Get_Table_Sizes.sql 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 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.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.vcxproj TransactionsSP.vcxproj TxnHarnessDBBase.cpp TxnHarnessDBBase.h TxnHarnessDBConn.cpp TxnHarnessDBConn.h
	TxnHarness	SupportingFiles/Clause3/TxnHarnes	TxnHarness.vcxproj TxnHarness.vcxproj TxnHarness_stdafx.cpp TxnHarness_stdafx.h TxnHarnessSendToMarket.cpp TxnHarnessSendToMarket.h
Clause4			
Clause5	EGen Driver Configuration	SupportingFiles/Clause5	PQ2800_5184KCus_4x27_28x41_spiderc-V3.xml EGenTxnHarnessStructs.h
	EGenLoader Parameter	SupportingFiles/Clause5	BuildSteps.log EGenLoaderFrom1To18000.log EGenLoaderFrom18001To36000.log .... EGenLoaderFrom5166001To5184000.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_ERRORLOG2.txt BR_ERRORLOG3.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_5min3.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.xlsx

# 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**

November 4, 2015

Fujitsu  
 Detlev Seidel  
 Heinz-Nixdorf-Ring 18001  
 Paderborn, Germany 33126

Here is the information you requested regarding pricing for several Microsoft products to be used in conjunction with your TPC-E benchmark testing.

All pricing shown is in US Dollars (\$).

Part Number	Description	Unit Price	Quantity	Price
<b>Database Management System</b>				
7JQ-00750	<b>SQL Server 2014 Enterprise Edition</b> 2 Core License Open Program - Level C	\$13,472.50	64	\$862,240.00
<b>Database Server Operating System</b>				
P72-06284	<b>Windows Server 2012 R2 Standard Edition</b> 2 Processor License Open Program - Level C Unit Price reflects a 17% discount from the retail unit price of \$882.	\$735.00	4	\$2,940.00
<b>Tier-A Operating System(s)</b>				
P72-06284	<b>Windows Server 2012 R2 Standard Edition</b> 2 Processor License Open Program - Level C Unit Price reflects a 17% discount from the retail unit price of \$882.	\$735.00	1	\$735.00
<b>Support</b>				
N/A	<b>Microsoft Problem Resolution Services</b> Professional Support (1 Incident).	\$259.00	1	\$259.00

SQL Server 2014 Enterprise Edition and Windows Server 2012 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\_qhtplyIGYLKTVGB45823ddlw\_2015\_fds.



[Products](#)

[Solutions & Services](#)

[Account Center](#)

All Product Catalog

Search for...



[More search options](#)

[Hardware](#)

[Software](#)

[Cloud](#)

[Product Finders](#)

[Brands](#)

[Best Deals](#)

[Home](#) > [Cables](#) > [Networking Cables](#) > [Category 6 TP Cables \(Ethernet\)](#)



## StarTech.com 7 ft Blue Shielded Snagless 10Gb RJ45 STP Cat6a Patch Cable



Mfg. Part: C6ASPAT7BL | CDW Part: 1973556 | UNSPSC: 26121609

★★★★★ [Write the first review](#)



1

~~\$15.99~~

**\$12.99**

Advertised Price

**Availability: In Stock**

Ships today if ordered within **10 hrs 30 mins**

- Make 10Gb Ethernet connections with PoE support
- 7ft Cat 6a Patch Cable
- 7ft Cat6a Patch Cable
- 7ft Shielded Patch Cable
- 10 Gigabit Patch Cable
- 7' RJ45 Patch Cable
- Shielded Cat6a patch cable with snagless...

[View More](#)

[Add To Cart](#)

[Log On to Email this page](#) or [Save as Favorite](#)

[Product Overview](#)