TPC Benchmark™ E

Full Disclosure Report for

FUJITSU Server PRIMERGY RX2540 M5

Using

Microsoft SQL Server 2017 Enterprise Edition

Using

Microsoft Windows Server 2016 Standard Edition

TPC-E Version 1.14.0

Submitted for Review

October 24, 2019

First Edition October 2019

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.

Abstract

This report documents the TPC Benchmark™ E results achieved by Fujitsu using Microsoft SQL Server 2017 Enterprise Edition.

The TPC Benchmark™ E tests were run on a FUJITSU Server PRIMERGY RX2540 M5 system using the Microsoft Windows Server 2016 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
FUJITSU Server PRIMERGY RX2540 M5	**Microsoft SQL Server 2017 Enterprise Edition** **Microsoft Windows Server 2016 Standard Edition**	**$ 582,623 USD**	**6,844.20**	**$ 85.13 USD**	**October 24, 2019**

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

FUJITSU	**FUJITSU Server PRIMERGY RX2540 M5**	**TPC-E™ 1.14.0** **TPC Pricing 2.4.0** Report Date: Oct 24, 2019 Revision Date: Oct 24, 2019

TPC-E Throughput	Price/Performance	Availability Date	Total System Cost
6,844.20 tpsE	**$ 85.13 USD per tpsE**	**Oct 24, 2019**	**$ 582,623 USD**

Database Server Configuration

Operating System	Database Manager	Processors/Cores/Threads	Memory
Microsoft Windows Server 2016 Standard Edition	**Microsoft SQL Server 2017 Enterprise Edition**	**2/56/112**	**1,536 GB**

SUT

Tier A
PRIMERGY RX2530 M5
2x Intel Xeon Platinum 8280 2.70 GHz
192 GB Memory
2x 300 GB 10k rpm SAS Drive
1x onboard dual port LAN 10 Gb/s
1x onboard dual port LAN 1 Gb/s
1x SAS RAID controller

Tier B
PRIMERGY RX2540 M5
2x Intel Xeon Platinum 8280 2.70 GHz
1,536 GB Memory
2x 300 GB 15k rpm SAS Drives
6x 1.6 TB SAS SSD
1x onboard dual port LAN 10 Gb/s
1x onboard dual port LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40 S2
49x 1.6 TB SSD Drives

Initial Database Size	Redundancy Level 1	Storage
33,336 GB	**RAID-5 for data** **RAID-10 for tempDB and log**	**55 x 1.6 TB SSD**

FUJITSU Server PRIMERGY RX2540 M5

TPC-E™ 1.14.0
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Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3-yr. Maint. Price
Database Server (Tier B) Hardware			$		$	$
PRIMERGY RX2540 M5						
PY RX2540 M5 8x 2.5' expandable	S26361-K1655-V408	1	$ 1,455.00	1	1,455.00	
Modular PSU 1200W platinum hp	S26113-F616-E10	1	$ 451.00	2	902.00	
Cable power cord rack, 4m, grey	T26139-Y1968-E100	1	$ 22.00	2	44.00	
Intel Xeon Platinum 8280 28C/56T 2.70 GHz	S26361-F4082-E380	1	$ 19,800.00	2	39,600.00	
Cooler Kit 2nd CPU	S26361-F3849-E100	1	$ 35.00	1	35.00	
64GB (1x64GB) 2Rx4 DDR4-2933 R ECC	S26361-F4083-E364	1	$ 2,730.00	24	65,520.00	
Independent Mode Installation	S26361-F3694-E10	1	$ 5.00	2	10.00	
PLAN EM 2x 10Gb T OCP interface Intel	S26361-F3953-E210	1	$ 685.00	1	685.00	
DVD-RW supermulti ultraslim SATA	S26361-F3778-E1	1	$ 140.00	1	140.00	
HD SAS 12G 300GB 15K HOT PL 2.5' EP	S26361-F5727-E530	1	$ 540.00	2	1,080.00	
SSD SAS 12G 1.6TB HOT PL 2.5' EP	S26361-F5713-E160	1	$ 5,150.00	6	30,900.00	
PRAID EP420i	S26361-F5243-E12	1	$ 515.00	1	515.00	
PRAID EP540e LP	S26361-F4063-E204	1	$ 1,145.00	5	5,725.00	
Rack Mount Kit F1 CMA QRL LV	S26361-F2735-E175	1	$ 105.00	1	105.00	
Mounting of RMK in symmetrical racks	S26361-F4530-E10	1	$ 2.00	1	2.00	
region-kit America	S26361-F1452-E130	1	$ 11.00	1	11.00	
PYRX2540 Series during normal business hours, Primergy Installation, Midrange Server, w/o OS, One Time billing	PYR254-N038005-0NA	1	$ 350.00	1		350.00
PYRX2540 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	PYR254-U004361-0NA	1	$ 1,152.00	1		1,152.00
				Subtotal (*)	146,729.00	1,502.00
Storage						
PRIMECENTER RACK						
PRIMECENTER M1 Rack 724S 24U-1050x700	S26361-K827-V220	1	$ 2,740.00	1	2,740.00	
Dummy panel, plastics, 1U + assembly	S26361-F4530-L131	1	$ 17.00	3	51.00	
Dummy panel, plastics, 2U + assembly	S26361-F4530-L132	1	$ 22.00	6	132.00	
Socket strip 2x12 outlets f. USA/CAN	S26361-F2262-L411	1	$ 650.00	1	650.00	
PYPRIMECENTER during normal business hours, PRIMERGY Installation, Racks, One Time billing	PYPCTR-N076005-0NA	1	$ 280.00	1		280.00
PYPRIMECENTER Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	PYPCTR-U004361-0NA	1	$ 324.00	1		324.00
ETERNUS JX40 S2						
ETERNUS JX40 S2 Enclosure w 1x IOM	FTS:ETJEADU	1	$ 2,995.00	5	14,975.00	
JX40 S2 TLC SSD 1.6TB	FTS:ETJ4SBHD	1	$ 5,150.00	49	252,350.00	
MiniSAS-HD cable1.1m	FTS:ETJ4KM11-L	1	$ 85.00	5	425.00	
ETJX40 Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	ETJX40-U004361-ABC	1	$ 826.00	5		4,130.00
ETJX40 during normal business hours, Eternus Installation, One Time billing	ETJX40-N043005-ABC	1	$ 650.00	5		3,250.00
						0.00
				Subtotal(*)	271,323.00	7,984.00
Database Server (Tier B) Software						
SQL Server 2017 Enterprise Edition 2 Core License	n/a	2	$ 13,472.50	28	377,230.00	
Microsoft Windows Server 2016 Standard Edition 2 Core License	n/a	2	$ 92.00	28	2,576.00	
Microsoft Problem Resolution Services	n/a	2	$ 259.00	1		259.00
				Subtotal	379,806.00	259.00

FUJITSU Server PRIMERGY RX2540 M5

TPC-E™ 1.14.0
TPC Pricing 2.4.0
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Application Server (Tier A) Hardware						
PRIMERGY RX2530 M5						
PY RX2530 M5 4x 2.5" expandable	S26361-K1659-V301	1	$ 1,392.00	1	1,392.00	
Modular PSU 800W platinum hp	S26113-F574-E13	1	$ 330.00	1	330.00	
Cable pow ercord rack, 4m, grey	T26139-Y1968-E100	1	$ 22.00	1	22.00	
Pow er Supply Dummy	S26113-F574-E99	1	$ 6.00	1	6.00	
Intel Xeon Platinum 8280 28C/56T 2.70 GHz	S26361-F4082-E380	1	$ 19,800.00	2	39,600.00	
Cooler Kit 2nd CPU	S26361-F3849-E100	1	$ 35.00	1	35.00	
16GB (1x16GB) 1Rx4 DDR4-2666 R ECC	S26361-F4083-E316	1	$ 595.00	12	7,140.00	
Independent Mode Installation	S26361-F3694-E10	1	$ 5.00	2	10.00	
DVD ROM Ulltraslim	S26361-F3718-E2	1	$ 115.00	1	115.00	
HD SAS 12G 300GB 10K HOT PL 2.5' EP	S26361-F5581-E130	1	$ 365.00	2	730.00	
PRAID EP400i	S26361-F5243-E11	1	$ 485.00	1	485.00	
PLAN EM 2x 10Gb T OCP interface Intel	S26361-F3953-E210	1	$ 685.00	1	685.00	
Rack Mount Kit F1-CMA Slim Line	S26361-F2735-E400	1	$ 88.00	1	88.00	
Mounting of RMK in symmetrical racks	S26361-F4530-E10	1	$ 2.00	1	2.00	
region-kit America	S26361-F1452-E130	1	$ 11.00	1	11.00	
PYRX2530 Series during normal business hours, Primergy Installation, Midrange Server, w/o OS, One Time billing	PYR253-N038005-0NA	1	$ 350.00	1		350.00
PYRX2530 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	PYR253-U004361-0NA	1	$ 454.00	1		454.00
				Subtotal(*)	50,651.00	804.00
Application Server (Tier A) Software						
Microsoft Windows Server 2016 Standard Edition 2 Core License	n/a	2	$ 92.00	28	2,576.00	
				Subtotal	2,576.00	
Miscellaneous						
Display E22-8 TS Pro (incl 2spares)	S26361-K1603-V160	1	$ 149.00	3	447.00	
Infrastructure or Connectivity						
Keyboard KB521 US 104 key (incl 2 spares)	S26381-K521-L110	1	$ 26.00	3	78.00	
MOUSE M520 BLACK (incl 2 spares)	S26381-K467-L100	1	$ 15.00	3	45.00	
StarTech.com 7 ft Gray Cat6a Sheilded Patch Cable 7ft - gray (incl 2 spares)	C6ASPAT7GR	3	$ 14.99	4	59.96	
				Subtotal(*)	629.96	0.00
				Total	851,714.96	10,549.00
Dollar Volume Discount (see Notes)	59%	1			276,476.41	
Support Discount	30%					3,164.70

Notes:
Price Source: 1=Fujitsu, 2=Microsoft Corporation, 3=Insight
Discount applies to all subtotal marked with(*) .
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.

Three-Year Cost of Ownership USD	$582,623.00
TPC-E Throughput	6844.20
$ USD/tpsE	$85.13

The benchmark results and test methodology were audited by Doug Johnson, InfoSizing (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:	**6,844.20 tpsE**	**Configured Customers:**		**4,060,000**
Response Times (in seconds)	**Minimum**	**Average**	**90th%tile**	**Maximum**
Broker Volume	0.01	0.01	0.02	0.48
Customer Position	0.01	0.01	0.02	0.55
Market Feed	0.01	0.02	0.05	0.72
Market Watch	0.01	0.01	0.02	0.55
Security Detail	0.01	0.01	0.01	0.46
Trade Lookup	0.01	0.04	0.06	0.55
Trade Order	0.01	0.03	0.05	0.78
Trade Result	0.01	0.03	0.05	0.59
Trade Status	0.01	0.01	0.01	0.42
Trade Update	0.01	0.06	0.08	0.53
Data Maintenance	0.01	0.02	N/A	0.04
Transaction Mix		**Transaction Count**		**Mix %**
Broker Volume		24,147,999		4.900%
Customer Position		64,065,696		13.000%
Market Feed		4,927,841		1.000%
Market Watch		88,706,888		18.000%
Security Detail		68,994,065		14.000%
Trade Lookup		39,425,269		8.000%
Trade Order		49,774,355		10.100%
Trade Result		49,278,290		9.999%
Trade Status		93,634,893		19.000%
Trade Update		9,856,200		2.000%
Data Maintenance		120		N/A
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)		0:29:11		
Measurement Interval (hh:mm:ss)		2:00:00		
Business Recovery Time (hh:mm:ss)		1:25:31		
Total Number of Transactions Completed in Measurement Interval		492,811,496		

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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.

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 figures 1-1 and 1-2.

Figure 1-1: Priced Configuration

Tier A
PRIMERGY RX2530 M5
2x Intel Xeon Platinum 8280 2.70 GHz
192 GB Memory
2x 300 GB 10k rpm SAS Drive
1x onboard dual port LAN 10 Gb/s
1x onboard dual port LAN 1 Gb/s
1x SAS RAID controller

Tier B
PRIMERGY RX2540 M5
2x Intel Xeon Platinum 8280 2.70 GHz
1,536 GB Memory
2x 300 GB 15k rpm SAS Drives
6x 1.6 TB SAS SSD
1x onboard dual port LAN 10 Gb/s
1x onboard dual port LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40 S2
49x 1.6 TB SSD Drives

Compared to the priced configuration, the measured configuration included additional storage used exclusively to host flat files for the database build process and to store a backup of the database. This additional storage was not used or accessed during the benchmark runs.

Figure 1-2: Measured Configuration

Tier A
PRIMERGY RX2530 M5
2x Intel Xeon Platinum 8280 2.70 GHz
192 GB Memory
2x 300 GB 10k rpm SAS Drive
1x onboard dual port LAN 10 Gb/s
1x onboard dual port LAN 1 Gb/s
1x SAS RAID controller

Tier B
PRIMERGY RX2540 M5
2x Intel Xeon Platinum 8280 2.70 GHz
1,536 GB Memory
2x 300 GB 15k rpm SAS Drives
6x 1.6 TB SAS SSD
1x onboard dual port LAN 10 Gb/s
1x onboard dual port LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40 S2
49x 1.6 TB SSD Drives
(for setup, backup and not used)
5x ETERNUS JX40 S2
5x 1.6TB SSD Drives
100x 960GB SSD Drives
50x 1200GB 10K rpm HDD Drives

Hardware Configuration

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

The Measured Configuration included external storage components used exclusively for staging backup files and flat files during the benchmark database load process. These components were not used during the benchmark tests and were excluded from the Priced Configuration.

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 1 x 10 Gb/s Ethernet. There is one LAN segment for these connections.

Tier A
The Tier A server is a Fujitsu PRIMERGY RX2530 M5 system with two Intel Xeon Platinum 8280 Twenty-eight-Core Processor and 192 GB of memory. Two SAS 300 GB 10k rpm disk drives are connected with RAID controller 12 Gb/s SAS3.0 (PRAID EP400i) and configured with RAID1 for OS. These are two onboard 1 Gb/s LAN ports and 1 port is

used for driver connection. One dual port 10 Gb/s Ethernet LAN card is plugged in the onboard LoM slot. There are two 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 PRIMERGY RX2540 M5 with two Intel Xeon Platinum 8280 Twenty-eight-Core Processors and 1,536 GB memory. Eight of the sixteen onboard 2.5" disk bays are used with 2x SAS 300 GB 15k rpm; 6x SAS 1.6 TB SSD disk drives and SAS/SATA RAID Controller 12 Gb/s SAS3.0 (PRAID EP420i). Two drives with 300GB are configured with RAID1 for OS and database. The six drives with 1.6 TB are configured with RAID10 for database log. Five RAID Controllers 12G SAS3.0 (PRAID EP540e) 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 10 Gb/s Ethernet LAN ports are connected to the Tier A system as described above.

Storage
5 Fujitsu ETERNUS JX40 S2 are used, each has 9x 1.6 TB SSD 2.5" RAID5 volumes. One JX40 S2 has additional 4x 1.6 TB SSD 2.5" RAID10 volume. The enclosures are connected to the RAID Controllers 12G SAS3.0 (PRAID EP540e). 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 User-Defined Objects, within the database, must be reported in the Report. (9.3.2.1)

The database has been created for 4,060,000 customers. The SQL Server scripts and setup command files are included in the SupportingFiles\Clause2 folder. Three 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 4,060,000 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	28,827,293	1
ADDRESS	6,090,004	1
BROKER	40,600	1
CASH_TRANSACTION	64,544,275,444	2
CHARGE	15	3
COMMISSION_RATE	240	3
COMPANY	2,030,000	1
COMPANY_COMPETITOR	6,090,000	1
CUSTOMER	4,060,000	1
CUSTOMER_ACCOUNT	20,300,000	1
CUSTOMER_TAXRATE	8,120,000	1
DAILY_MARKET	3,629,335,500	1
EXCHANGE	4	3
FINANCIAL	40,600,000	1
HOLDING	3,592,013,715	2
HOLDING_HISTORY	94,022,017,013	2
HOLDING_SUMMARY	201,918,931	2
INDUSTRY	102	3
LAST_TRADE	2,781,100	1
NEWS_ITEM	4,060,000	1
NEWS_XREF	4,060,000	1
SECTOR	12	3
SECURITY	2,781,100	1
SETTLEMENT	70,156,800,000	2
STATUS_TYPE	5	3
TAXRATE	320	3
TRADE	70,156,800,000	2
TRADE_HISTORY	168,376,265,739	2
TRADE_REQUEST	0	2
TRADE_TYPE	5	3
WATCH_ITEM	406,004,721	1
WATCH_LIST	4,060,000	1
ZIP_CODE	14,741	3

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 Port 0 JX40 S2	6	5x1600GB,SSD SAS RAID5		5,959 GB	Not used
	3	10x960GB,SSD SAS RAID5		8,937 GB	DB-setup
	7	5x960GB,SSD SAS RAID5	C:\jp\backup1_1	2,681 GB	Backup
	4	5x1200GB,SAS RAID5		4,469 GB	Not used
Crtl 0 Port 1 JX40 S2	2	9x1600GB,SSD SAS RAID5	C:\jp\Fixed1 C:\jp\Scaling1 C:\jp\Growing1	2 GB 200 GB 11,717 GB	DB
	5	5x1200GB,SAS RAID5		4,469 GB	Not used
	8	5x960GB,SSD SAS RAID5	C:\jp\backup1_2	2,681 GB	Backup
Crtl 1 Port 0 JX40 S2	10	9x1600GB,SSD SAS RAID5	C:\jp\Fixed2 C:\jp\Scaling2 C:\jp\Growing2	2 GB 200 GB 11,717 GB	DB
	13	5x960GB,SSD SAS RAID5	C:\jp\backup2_2	2,681 GB	Backup
Crtl 1 Port 1 JX40 S2	12	10x960GB,SSD SAS RAID5		8,937 GB	DB-setup
	11	5x960GB,SSD SAS RAID5	C:\jp\backup2_1	2,681 GB	Backup
	9	5x1200GB,SAS RAID5		4,469 GB	Not used
Crtl 2 Port 0 JX40 S2	0	2x300GB 15K SAS, RAID1	C:\	278 GB	OS
	1	6x1600GB SAS SSD, RAID10	G:\	4,469 GB	DB Log
Crtl 3 Port 0 JX40 S2	15	5x1200GB,10K SAS RAID5		4,469 GB	Not used
	16	9x1600GB,SSD SAS RAID5	C:\jp\Fixed3 C:\jp\Scaling3 C:\jp\Growing3	2 GB 200 GB 11,717 GB	DB
	19	5x960GB,SSD SAS RAID5	C:\jp\backup3_1	4,469 GB	Backup
Crtl 3 Port 1 JX40 S2	14	5x1200GB,10K SAS RAID5		4,469 GB	Not used
	17	5x960GB,SSD SAS RAID5	C:\jp\backup3_1	4,469 GB	Backup
	18	10x960GB,SSD SAS RAID5	J:\	8,937 GB	DB setup
Crtl 4 Port 0 JX40 S2	20	5x1200GB,10K SAS RAID5		4,469 GB	Not used
	23	10x960GB,SSD SAS RAID5	K:\	8,937 GB	DB setup
	24	5x960GB,SSD SAS RAID5	C:\jp\backup4_1	2,681 GB	Backup
Crtl 4 Port 1 JX40 S2	21	5x1200GB,10K SAS RAID5		4,469 GB	Not used
	22	9x1600GB,SSD SAS RAID5	C:\jp\Fixed4 C:\jp\Scaling4 C:\jp\Growing4	2 GB 200 GB 11,717 GB	DB
	25	5x960GB,SSD SAS RAID5	C:\jp\backup4_2	2,681 GB	Backup
	26	4x1600GB,10K SAS RAID10	E:\	2,979 GB	Tempdb-run
Crtl 5 Port 0 JX40 S2	27	5x1200GB,10K SAS RAID5		4,469 GB	Not used
	30	10x960GB,SSD SAS RAID5	L:\	8,937 GB	DB setup
	32	5x960GB,SSD SAS RAID5	C:\jp\backup5_2	2,681 GB	Backup
Crtl 5 Port 1 JX40 S2	28	5x1200GB,10K SAS RAID5		4,469 GB	Not used
	29	9x1600GB,SSD SAS RAID5	C:\jp\Fixed5 C:\jp\Scaling5 C:\jp\Growing5	2 GB 200 GB 11,717 GB	DB
	31	5x960GB,SSD SAS RAID5	C:\jp\backup5_1	2,681 GB	Backup

	33	5x1200GB,10K SAS RAID5		4,469 GB	Not used

Disk# 3, 12, 18, 23 and 30 are used for database setup.
Disk# 7, 8,11,13,17,19,24,25,31 and 32 are only used for database build process and database backup.
Disk# 4,5,6,9,14,15,20,21,27.28 and 33 are not used.

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 2017 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 stored procedures code for the transactions 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 (see Clause 4.1.3.12) (9.3.4.1).

Figures 1-1 and 1-2 show the configuration of the measured and priced configurations. They both have identical network configuration.

Tier A system PRIMERGY RX2530 M5 has an onboard Ethernet controller with two 1Gb/s ports. One port is used to connect to the driver system.

Tier B system PRIMERGY RX2540 M5 and Tier A system PRIMERGY RX2530 M5 have a dual-port 10 Gb/s Ethernet LAN card plugged in the LoM onboard slot. The two 10Gb/s ports of Tier A were directly connected to the two 10Gb/s ports of Tier B using different LAN segments.

Clause 5: EGen

EGen Version

The version of EGen used in the benchmark must be reported in the Report (see Clause 5.3.1) (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 in the Report (9.3.5.2).

All the required TPC-provided EGen 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 in the Report (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 in the Report (see Clause 5.7.4) (9.3.5.4).

The EGen used for this benchmark was not modified.

The EGenLoader used for this benchmark was not extended.

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) (9.3.6.1).

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

Reported Throughput

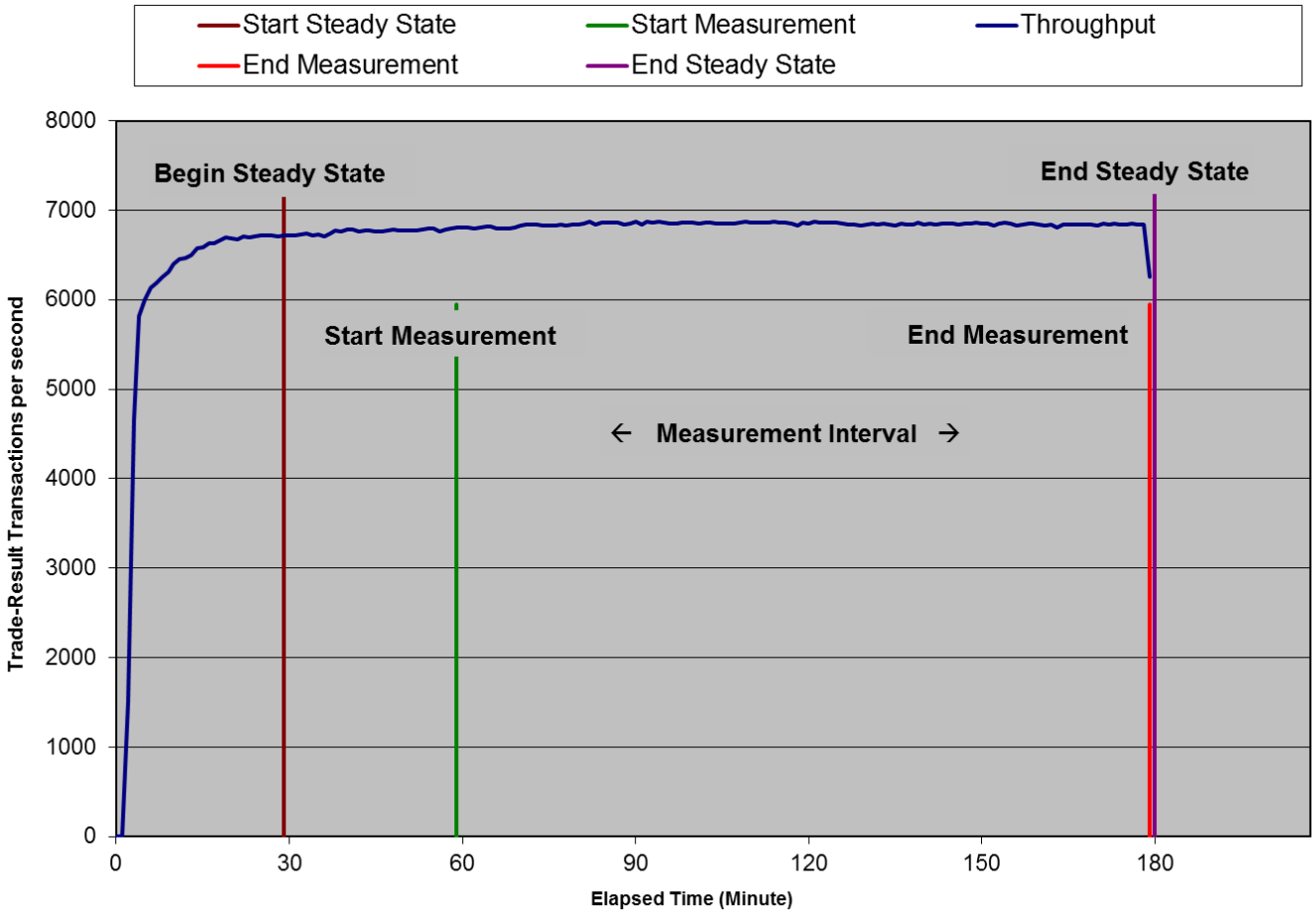
The Reported Throughput must be reported in the Report (see Clause 6.7.1.2) (9.3.6.2).

The Reported throughput was 6,844.20 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).

Checkpoints were invoked by a script running on Tier B at specified intervals (447 seconds) and specified duration (430 seconds). A copy of this script is provided in the Supporting Files.

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 in the Report (9.3.6.6).

Table 6-2: Transaction Input Parameter Averages.

Transaction	Parameter	Required Minimum	Required Maximum	Actual Percentage
Customer Position	By Tax ID	48.00%	52.00%	50.00%
	Get History	48.00%	52.00%	49.99%
Market Watch	By Watch List	57.00%	63.00%	59.99%
	By Customer Account	33.00%	37.00%	35.00%
	By Industry	4.50%	5.50%	5.00%
Security Detail	Access LOB	0.90%	1.10%	1.00%
Trade Lookup	Frame 1	28.50%	31.50%	30.00%
	Frame 2	28.50%	31.50%	30.00%
	Frame 3	28.50%	31.50%	30.00%
	Frame 4	9.50%	10.50%	10.00%
Trade Update	Frame 1	31.00%	35.00%	33.01%
	Frame 2	31.00%	35.00%	32.97%
	Frame 3	32.00%	36.00%	34.01%
Trade Order	By Non-Owner	9.50%	10.50%	10.00%
	By Company Name	38.00%	42.00%	39.99%
	Buy On Margin	7.50%	8.50%	8.00%
	Rollback	0.94%	1.04%	0.99%
	LIFO	33.00%	37.00%	34.99%
	Trade Qty 100	24.00%	26.00%	25.00%
	Trade Qty 200	24.00%	26.00%	25.00%
	Trade Qty 400	24.00%	26.00%	25.00%
	Trade Qty 800	24.00%	26.00%	24.99%
	Market Buy	29.70%	30.30%	30.00%
	Market Sell	29.70%	30.30%	30.00%
	Limit Buy	19.80%	20.20%	20.00%
	Limit Sell	9.90%	10.10%	9.99%
	Stop Loss	9.90%	10.10%	10.01%

Clause 7: Transaction and System Properties

The ACID (Atomicity, Consistency, Isolation, and Durability) properties of transaction processing systems must be supported by the System Under Test during the running of this benchmark (7.1.1). It is the intent of this section to define the ACID properties informally and to specify a series of tests that must be performed to demonstrate that these properties are met (7.1.2).

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).

All ACID tests were conducted according to the specification.

Atomicity Requirements

The System Under Test must guarantee that Database Transactions are atomic; the system will either perform all individual operations on the data, or will ensure that no partially completed operations leave any effects on the data (7.2.1).

The following steps were performed to verify the Atomicity of the Trade-Order transactions:

- *Perform a market Trade-Order Transaction with the roll_it_back flag set to 0. Verify that the appropriate rows have been inserted in the TRADE and TRADE_HISTORY tables.*
- *Perform a market Trade-Order Transaction with the roll_it_backflag set to 1. Verify that no rows associated with the rolled back Trade-Order have been added to the TRADE and TRADE_HISTORY tables.*

The Procedure for running the atomicity tests is documented in the file SupportingFiles\Clause7\MSTPCE ACID Procedures.pdf.

The atomicity scripts and outputs are located in the directory SupportingFiles\Clause7\Atomicity.

Consistency Requirements

Consistency is the property of the Application that requires any execution of a Database Transaction to take the database from one consistent state to another (7.3.1). A TPC-E database when first populated by EGenLoader must meet these consistency conditions (7.3.1.1).
The three consistency conditions must be tested after initial database population and after any Business Recovery tests (7.3.3).

Consistency condition 1

Entries in the BROKER and TRADE tables must satisfy the relationship:
B_NUM_TRADES = count(*)
For each broker defined by:
(B_ID = CA_B_ID) and (CA_ID = T_CA_ID) and (T_ST_ID = 'CMPT').

Consistency condition 2

Entries in the BROKER and TRADE tables must satisfy the relationship:
B_COMM_TOTAL = sum(T_COMM)
For each broker defined by:
(B_ID = CA_B_ID) and (CA_ID = T_CA_ID) and (T_ST_ID = 'CMPT').

Consistency condition 3

Entries in the HOLDING_SUMMARY and HOLDING tables must satisfy the relationship:
HS_QTY = sum(H_QTY)
For each holding summary defined by:
(HS_CA_ID = H_CA_ID) and (HS_S_SYMB = H_S_SYMB).

Consistency conditions 1, 2, and 3 were tested using a batch file which issues queries to the database after the database population and after the Business Recovery test. The results of the queries demonstrated that the database met the required three consistency conditions.

The procedure for running the consistency tests is documented in the file SupportingFiles\Clause7\MSTPCE ACID Procedures.pdf.

The consistency scripts and outputs are located in the directories SupportingFiles\Clause7\Concistency and SupportingFiles\Clause7\Durability\BusinessRecovery.

Isolation Requirements

The isolation property of a Transaction is the level to which it is isolated from the actions of other concurrently executing Transactions (7.4.1.2).
Systems that implement Transaction isolation using a locking and/or versioning scheme must demonstrate compliance with the isolation requirements by executing the tests described in Clause 7.4.2 (7.4.1.6). The following isolation tests are designed to verify that the configuration and implementation of the System Under Test provides the Transactions with the required isolation levels defined in Clause 7.4.1.3 (7.4.2).

Isolation tests 1 through 4 were successfully done following the procedure documented in the file SuppportingFiles\Clause7\MSTPCE ACID Procedures.pdf.

The isolation scripts and outputs are located in the directory SupportingFiles\Clause7\Isolation.

Durability Requirements

The SUT must provide Durability as defined in this clause.
Durable / Durability: In general, state that persists across failures is said to be Durable and an implementation that ensures state persists across failures is said to provide Durability. In the context of the benchmark, Durability is more tightly defined as the SUT's ability to ensure all Committed data persist across any Single Point of Failure (7.5.4).

Redundancy Level and Data Accessibility

The System Under Test must be configured to satisfy the requirements for Data Accessibility detailed in this clause. Data Accessibility is demonstrated by the SUT being able to maintain database operations with full data access after the permanent irrecoverable failures of any single Durable Medium containing database tables, recovery log data, or Database Metadata. Data Accessibility tests are conducted by inducing failures of Durable Media within the SUT. The failures of Clause 7.6.3 test the ability of the SUT to maintain access to the data. The specific failures addressed in Clause 7.6.3 are defined sufficiently significant to justify demonstration of Data Accessibility across such failures. However, the limited nature of the tests listed must not be interpreted to allow other unrecoverable single points of failure (7.6).
The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.6.3.4) and describe the Data Accessibility test(s) used to demonstrate compliance. A list of all combinations of Durable Media technologies tested in Clause 7.6.3.5 must be reported in the Report (9.3.7.2).
A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.6.4.2) (9.3.7.3).

The combinations of Durable Media technologies that were tested are shown in table7-1. All unique combinations that contained database data, the database log, and/or the tempdb database were tested.

Table 7-1. Combinations of Durable Media Technologies Tested for Data Accessibility

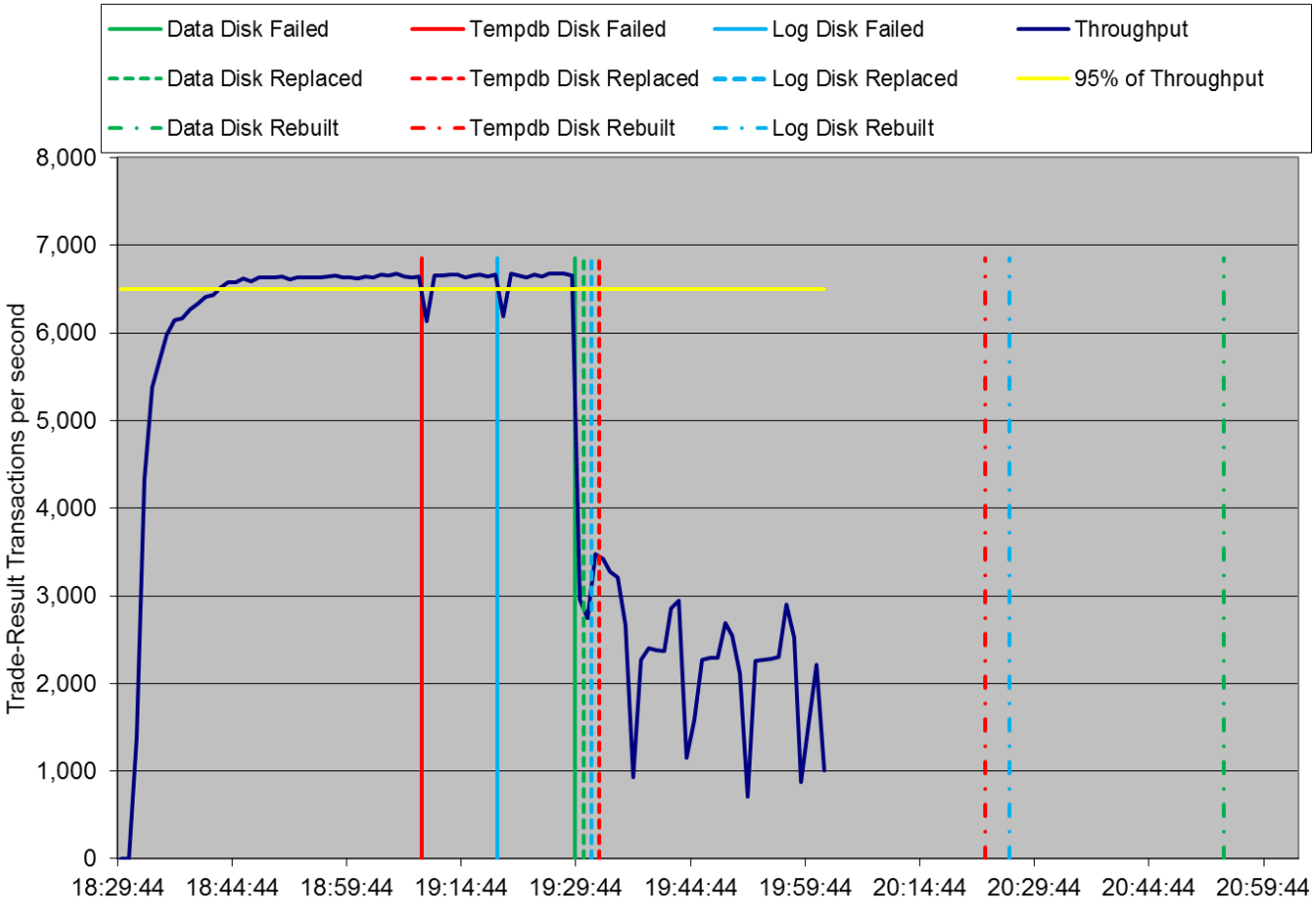
Contents	Durable Media Type	Bus Type	Array Redundancy	Controller
Database Data	SSD	SAS	RAID-5	PRAID EP540e
Database Log	SSD	SAS	RAID-10	PRAID EP420i
Database tempdb	SSD	SAS	RAID-10	PRAID EP540e

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 three disks are reported by ServerView RAID and written to the system event (see SupportingFiles).

1. The database was restored from the backup files in a consistent state.
2. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
3. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.6.2) and satisfy those requirements for at least 5 minutes with a 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 tempdb array by physically removing it from its enclosure. 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 the database log array by physically removing it from its enclosure. Since RAID10 is used, the transactions continue. Run for at least 5 minutes with throughput above 95% of reported throughput.
6. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in the database data array by physically removing it from its enclosure. Since RAID5 is used, the transactions continue.
7. Begin the necessary recovery process, by replacing the failed drives in the database data array and start the rebuild process.
8. Begin the necessary recovery process, by replacing the failed drives in the database log array and start the rebuild.
9. Begin the necessary recovery process, by replacing the failed drives in the database tempdb array and start the rebuild.
10. Continue running the Driver for at least 20 minutes.
11. Terminate the run gracefully from the Driver.
12. Wait until rebuild process has finished.
13. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
14. 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 elapsed time for Data Accessibility. The timings of the induced failures as well as the recovery process are indicated.

Figure 7-1: Data Accessibility Graph



The files related to this data accessibility test are located in SupportingFiles\Clause7\Durability\DataAccessibility.

Business Recovery

Business Recovery: the process of recovering from a Single Point of Failure and reaching a point where the business meets certain operational criteria (7.5.6.9).
The Test Sponsor must describe in the Report the test(s) used to demonstrate Business Recovery (9.3.7.4).
The Business Recovery Time must be reported on the Executive Summary Statement and in the Report. If the failures described in Clauses 7.5.3.1, 7.5.3.2 and 7.5.3.3 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 (7.5.8.1).
The Business Recovery Time Graph (see Clause 7.5.8.2) must be reported in the Report for all Business Recovery tests (9.3.7.5).

The tests for “Loss of Processing,” “Loss of Vulnerable Storage Component,” and “Loss of all External Power to the SUT” were combined by power off Tier B.

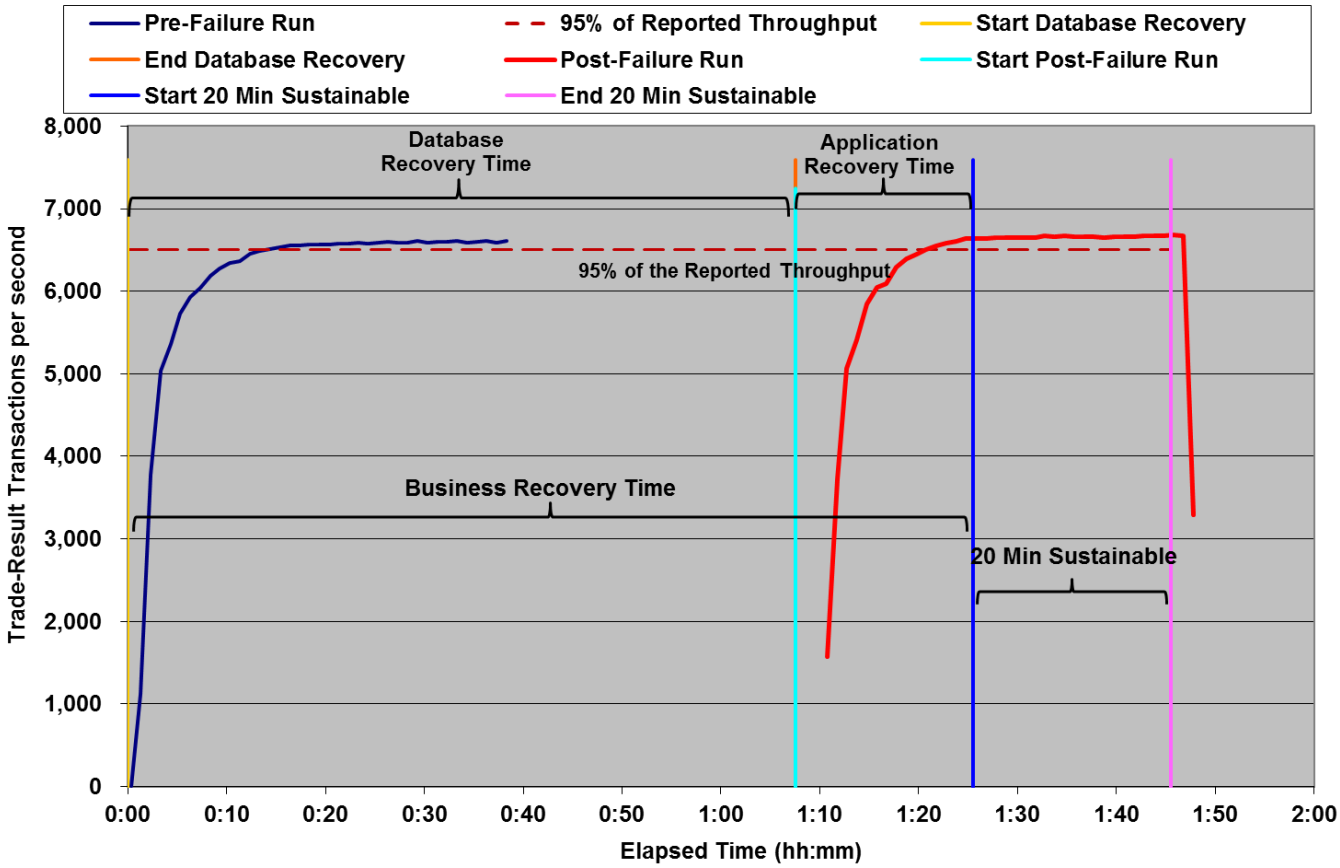
1. The database was restored from the backup files.
2. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
3. Start submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.5.1) and satisfy those requirements for at least 20 minutes.

4. On the driver side the number of MEE connections is captured just before the failures.
5. Induce the failures by simultaneously disconnecting the two power supply cords from the back of Tier B. This failure resulted in losing the contents of the server's main memory and caches. Since the RAID adapters were inside Tier B and since they were not equipped with battery-back up, the contents of the caches on the RAID adapters were also lost.
6. After transaction failures is noted by the drivers, terminate the run and collect the data for Pre-Failure Run.
7. Re-power and restart Tier B.
8. When restarting the database on Tier B, it automatically starts the recovery and records timestamps. The Database Recovery Time was 01:07:31 (hh:mm.ss).
9. 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 7.5.5.1) and satisfy those requirements for at least 20 minutes. The Application Recovery Time was 00:18:00 (hh:mm:ss).
10. Terminate the run gracefully from the Driver and collect the data for Post-Failure Run.
11. Verify that there are no errors in the Post-Failure run and check the consistency of the database as specified in Clause 7.3.3.
12. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
13. Run the evaluation of Trade-Result Transactions executed in both runs and compare it with the difference of the SETTLEMENT rows counted. The difference was verified to be less than or equal to the maximum number of Transactions which can be simultaneously in-flight from the Driver to the SUT.

The Database Recovery Time was 01:07:31. The Application Recovery Time was 00:18:00. The Business Recovery Time, which is the sum of the Database Recovery Time and the Application Recovery Time, was 01:25:31.

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

Figure 7-2: Business Recovery Graph



The files related to this business recovery test are located in SupportingFiles\Clause7\Durability\BusinessRecovery.

Clause 8: Pricing Related Items

60-Day Space

Details of the 60-Day Space computations (see Clause 6.6.6.6) along with proof that the database is configured to sustain a Business Day of growth (see Clause 6.6.6.1) must be reported in the Report (9.3.8.1).

Table 8-1: Space Requirements

TPC-E Disk Space Requirements

Customers	**4,060,000**	**Measured Throughput**		**6,844.20**	**Trade-Results/s**		**Reported Throughput**	**6,844.20**	**tpsE**	
Table	**Initial Rows**	**Data Size (KB)**	**Index Size (KB)**	**Extra 5% (KB)**	**Total + 5% (KB)**	**Rows After**	**After Run (KB)**	**Growth (KB)**	**Bus. Day Growth (KB)**	**Req. Add. (KB)**
BROKER	40,600	3,080	3,824	345	7,249	40,600	6,904	-	-	345
CASH_TRANSACTION	64,544,275,444	6,717,490,016	14,166,856	336,582,844	7,068,239,716	64,610,445,875	6,744,185,448	12,528,576	34,334,651	34,334,651
CHARGE	15	8	8	1	17	15	16	-	-	1
COMMISSION_RATE	240	16	48	3	67	240	64	-	-	3
SETTLEMENT	70,156,800,000	3,345,347,872	7,051,944	167,619,991	3,520,019,807	70,228,725,726	3,359,365,776	6,965,960	19,090,263	19,090,263
TRADE	70,156,800,000	8,376,134,232	4,666,931,808	652,153,302	13,695,219,342	70,229,135,398	13,085,208,768	42,142,728	115,492,444	115,492,444
TRADE_HISTORY	168,376,265,739	5,063,948,304	13,201,336	253,857,482	5,331,007,122	168,549,051,733	5,089,593,336	12,443,696	34,102,037	34,102,037
TRADE_REQUEST	-	8	8	1	17	409,672	1,182,840	1,182,824	3,241,538	3,241,538
TRADE_TYPE	5	8	1,032	52	1,092	5	1,040	-	-	52
ACCOUNT_PERMISSION	28,827,293	1,587,208	9,008	79,811	1,676,027	28,827,293	1,596,312	96	264	79,811
CUSTOMER	4,060,000	665,192	196,088	43,064	904,344	4,060,000	861,304	24	66	43,064
CUSTOMER_ACCOUNT	20,300,000	1,839,376	449,880	114,463	2,403,719	20,300,000	2,289,256	-	-	114,463
CUSTOMER_TAXRATE	8,120,000	169,168	1,840	8,550	179,558	8,120,000	171,136	128	351	8,550
HOLDING	3,592,013,715	240,389,736	164,342,624	20,236,618	424,968,978	3,593,851,732	408,991,176	4,258,816	11,671,316	11,671,316
HOLDING_HISTORY	94,022,017,013	3,418,982,888	2,284,011,464	285,149,718	5,988,144,070	94,118,997,911	5,716,998,408	14,004,056	38,378,215	38,378,215
HOLDING_SUMMARY	201,918,931	8,862,520	33,416	444,797	9,340,733	201,918,856	8,895,936	-	-	-
WATCH_ITEM	406,004,721	11,411,848	42,496	572,717	12,027,061	406,004,721	11,454,616	272	746	572,717
WATCH_LIST	4,060,000	101,024	92,344	9,668	203,036	4,060,000	193,368	-	-	9,668
COMPANY	2,030,000	433,232	130,384	28,181	591,797	2,030,000	563,656	40	110	28,181
COMPANY_COMPETITOR	6,090,000	163,408	149,000	15,620	328,028	6,090,000	312,408	-	-	15,620
DAILY_MARKET	3,629,335,500	170,330,400	498,032	8,541,422	179,369,854	3,629,335,500	170,829,648	1,216	3,333	8,541,422
EXCHANGE	4	8	8	1	17	4	16	-	-	1
FINANCIAL	40,600,000	4,575,088	13,368	229,423	4,817,879	40,600,000	4,588,752	296	812	229,423
INDUSTRY	102	8	24	2	34	102	32	-	-	2
LAST_TRADE	2,781,100	173,376	1,872	8,762	184,010	2,781,100	175,248	-	-	8,762
NEWS_ITEM	4,060,000	440,177,832	4,960	22,009,140	462,191,932	4,060,000	440,182,864	72	198	22,009,140
NEWS_XREF	4,060,000	100,984	1,832	5,141	107,957	4,060,000	102,816	-	-	5,141
SECTOR	12	8	24	2	34	12	32	-	-	2
SECURITY	2,781,100	385,784	107,592	24,669	518,045	2,781,100	493,424	48	132	24,669
STATUS_TYPE	5	8	8	1	17	5	16	-	-	1
ADDRESS	6,090,004	351,120	2,104	17,661	370,885	6,090,004	353,328	104	286	17,661
TAXRATE	320	24	48	4	76	320	88	16	44	44
ZIP_CODE	14,741	488	48	27	563	14,741	536	-	-	27
TOTALS (KB)		**27,803,624,272**	**7,151,445,328**	**1,747,753,480**	**36,702,823,080**		**35,048,598,568**	**93,528,968**	**256,316,806**	**288,019,233**
Initial Database Size (MB)		**34,135,810**	**33,336 GB**							

Database Filegroups	**LUN Count**	**Partition Size (MB)**	**MB Allocated**	**MB Loaded**	**MB Required**	
	0	-	-	-	-	OK
growing_fg	5	11,998,208	59,991,040	33,516,499	33,766,802	OK
scaling_fg	5	204,800	1,024,000	619,309	650,275	OK
fixed_fg	5	2,048	10,240	2	2	OK

Settlements **71,925,726**

Data Space Required (MB)		**Data Space Configured (MB)**					**Log Space Required (MB)**		**Log Space Configured (MB)**	
Initial Growing Space	33,516,499									
Final Growing Space	33,607,834	**Data LUNS**	5	-	-	-	**Initial Log Size**	119,446	**Log LUNS**	1
Delta	91,335	**Disks per LUN**	9	-	-	-	**Final Log Size**	604,375	**Log Disks**	6
Data Space per Trade	0.001269846	**Disk Capacity**	1,525,760	-	-	-	**Log Growth**	484,929	**Disk Capacity**	1,525,760
1 Day Data Growth	250,303	**RAID Overhead**	88.89%	0%	0%	0%	**Log Growth/Trade**	0.006742074	**RAID Overhead**	50%
60 Day Space	**49,154,001**	**Total Space**				**61,030,400**	**1 Day Log Space**	**1,448,397**	**Log Space**	**4,577,280**
						OK				OK

Hardware and Software Components

A detailed list of hardware, software, and/or Licensed Compute Services used in the Priced Configuration must be reported. The listing for each separately Orderable item must have:
- *vendor Part Number*
- *description and applicable release/revision level*
- *price source*
- *unit price*
- *quantity*
- *extended price*
- *applicable Discounted price*
- *3-year maintenance price*

If package-pricing is used, the vendor Part Number of the package and a description uniquely identifying each of the Components of the package must be disclosed to a sufficient level of detail to meet the requirements of Clause 5.2 (TPC Pricing, 5.4.1).

A detailed list of all hardware, software, and maintenance is provided in the Executive Summary.

Three-Year Cost of System Configuration

Rules for pricing the Priced Configuration and associated software and maintenance are included TPC Pricing Specification, located at www.tpc.org (Clause 8).
The price of the entire Priced Configuration must be used, including all hardware (purchase price), software (license charges), Licensed Compute Services, and hardware/software maintenance charges over a period of 3 years (36 months) (TPC Pricing, 1.7.1).
The justification of any Discounts applied must be disclosed in the price sheet. Sufficient detail of what items are being discounted and by how much they are being discounted must be provided so that the Discount amount used in the computation of the total system cost can be independently reproduced (TPC Pricing, 5.4.2).

A detailed list of all hardware, software and maintenance, including the total 3-year price and discount information, is provided in the Executive Summary. Price quotations are included in Appendix.

Availability Date

The committed Availability Date of Line Items used in the price calculations must be reported. The Availability Date must be reported on the first page of the Executive Summary and with a precision of one day. When the priced system includes products and/or Licensed Compute Services with different Availability Dates, the reported Availability Date for the priced system must be a date at which all Line Items are committed to be Generally Available. Each Line Item used in the Priced Configuration is considered to be Available on the Availability Date unless an earlier date is specified (TPC Pricing, 5.4.1).
For each of the Line Items that are not Orderable on the report date of the FDR, the following information must be included in the FDR:
- *Name and Part Number of the item that is not Orderable*
- *The date when the Line Item can be ordered (on or before the Availability Date)*
- *The method to be used to order the Component (at or below the quoted price) when the order date arrives*
- *The method for verifying the price (TPC Pricing, 5.4.2)*

The total solution as priced is generally available as of October 24th, 2019.

Country-Specific Pricing

Pricing must be reported in the currency of the country where the system is priced (TPC Pricing, 5.1.4).

The configuration is priced for the United States of America.

Pricing Calculations

The following items must be included in the Full Disclosure Report and Executive Summary:
• the benchmark performance metric
• respective calculations for the Pricing Methodology pricing time period (See Clauses 1.7 through 1.10)
• price/performance
• Availability Date (TPC Pricing, 5.4.8)

The performance metric, pricing calculation, and availability date are included in the Executive Summary and this Report.

Supporting Files Index

An index for all files required by Clause 9.4 Supporting Files must be provided in the Report (9.3.9).

The index for the files in Supporting Files is located in Clause 9 and SupportingFiles\SupportingFiles.doc

Attestation Letter

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

The Auditor's Attestation Letter is on the next two pages.

InfoSizing
The Right Metric For Sizing IT

TPC
Certified Auditor

Masakazu Yabe
Director, Firmware Development Dept. I, Technology Development Div.
System Platform Business Unit
Fujitsu Limited
4-1-1, Kami-Kodanaka, Nakahara-ku, Kawasaki-City,
Kanagawa-Pref., 211-8588, JAPAN

October 23, 2019

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

Platform:	FUJITSU Server PRIMERGY RX2540 M5
Operating System:	Microsoft Windows Server 2016 Standard Edition
Database Manager:	Microsoft SQL Server 2017 Enterprise Edition

The results were:

Performance Metric	**6,844.20 tpsE**
Trade-Result 90th %-tile	0.05 Seconds

Tier B (Server)	**FUJITSU Server PRIMERGY RX2540 M5**		
CPUs	2 x Intel® Xeon® Platinum 8280 (2.70 GHz, 28-core, 38.5 MB L3)		
Memory	1,536 GB		
Storage	***Qty***	***Size***	***Type***
	2	300 GB	15K SAS HDD
	6	1.6 TB	SAS SSD (internal)
	49	1.6 TB	SAS SSD (external, in 5 x ETERNUS JX40 S2)

Tier A (Client)	**FUJITSU Server PRIMERGY RX2530 M5**
CPUs	2 x Intel® Xeon® Platinum 8280 (2.70 GHz, 28-core, 38.5 MB L3)
Memory	192 GB
Storage	2 x 300 GB 10K 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 transactions were correctly implemented
- The database was properly scaled and populated for 4,060,000 customers

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- 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 01:25:31 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, Certified TPC Auditor

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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).

Clause	Description	Path	Filename
	overview	SupportingFiles	SupportingFiles.doc
Introduction	TierB system information	SupportingFiles/ Introduction/ TierB	SystemInformation_TierB.txt
	TierB disk configuration	SupportingFiles/ Introduction/ TierB	DiskConfiguration_RX2540M5.docx WindowsDiskLayout_1.png WindowsDiskLayout_2.png WindowsDiskLayout_3.png WindowsDiskLayout_4.png WindowsDiskLayout_5.png WindowsDiskLayout_6.png flatfilelocations.txt maketpcedir.cmd Readme.txt tempdb_for_createdb.sql tempdb_for_test.sql
	TierB Scripts and settings for SQL Server and OS configuration	SupportingFiles/ Introduction/ TierB	CountOperations.reg MSTPCE Database Setup Reference.pdf SoftNuma.REG SpConfigure.out SQLconfig.sql SQLServer_IPs.reg SQLServer_LargePages.reg StartSQL.bat StopSQL.bat
	TierB Time delay tool for BAT files	SupportingFiles/ Introduction/ TierB	sleep.exe
	TierB Script to synchronize system time with time server	SupportingFiles/ Introduction/ TierB	Synctime.bat SyncTimePerformenceRun.bat
	TierB Checkpoint scripts	SupportingFiles/ Introduction/ TierB/checkpoint	checkpoint.bat checkpoint.sql runRegularCheckPoints.bat sleep.exe
	TierA system information	SupportingFiles/ Introduction/ TierA	SystemInformation_TierA.txt
	TierA settings	SupportingFiles/ Introduction/ TierA	START-2LAN-tier16.reg TierA_W32Time.reg
	TierA Startup Scripts	SupportingFiles/ Introduction/ TierA	MEE_CE_Start_Param.cmd
	TierA Time delay tool for BAT files	SupportingFiles/ Introduction/ TierA	sleep.exe
	TierA Script to synchronize system time with time server	SupportingFiles/ Introduction/ TierA	Synctime.bat SyncTimePerformenceRun.bat
Clause 2	Microsoft TPC-E kit database load reference	SupportingFiles/Clause2	MSTPCE Database Setup Reference.pdf
	Main code to start a database	SupportingFiles/Clause2	TPCE_Setup.cmd

	load		
	Output from the database load & verification scripts. See BuildSteps. log for the flow of the database load.	SupportingFiles/Clause2/ DatabaseLoad_Outputs	4060000Customers_Load_Timer.log BrokerVolume.log BuildSteps.log BCP_OUTPUT/BCP_Account_Permission_1.out … BCP_OUTPUT/BCP_Account_Permission_145.out BCP_OUTPUT/BCP_Address_1.out … BCP_OUTPUT/BCP_Address_145.out BCP_OUTPUT/BCP_Broker_1.out … BCP_OUTPUT/BCP_Broker_145.out BCP_OUTPUT/BCP_Cash_Transaction_1.out … BCP_OUTPUT/BCP_Cash_Transaction_145.out BCP_OUTPUT/BCP_Charge_1.out BCP_OUTPUT/BCP_Commission_Rate_1.out BCP_OUTPUT/BCP_Company_1.out … BCP_OUTPUT/BCP_Company_145.out BCP_OUTPUT/BCP_Company_Competitor_1.out … BCP_OUTPUT/BCP_Company_Competitor_145.out BCP_OUTPUT/BCP_Customer_1.out … BCP_OUTPUT/BCP_Customer_145.out BCP_OUTPUT/BCP_Customer_Account_1.out … BCP_OUTPUT/BCP_Customer_Account_145.out BCP_OUTPUT/BCP_Customer_TaxRate_1.out … BCP_OUTPUT/BCP_Customer_TaxRate_145.out BCP_OUTPUT/BCP_Daily_Market_1.out … BCP_OUTPUT/BCP_Daily_Market_145.out BCP_OUTPUT/BCP_Exchange_1.out BCP_OUTPUT/BCP_Financial_1.out … BCP_OUTPUT/BCP_Financial_145.out BCP_OUTPUT/BCP_Holding_1.out … BCP_OUTPUT/BCP_Holding_145.out BCP_OUTPUT/BCP_Holding_History_1.out … BCP_OUTPUT/BCP_Holding_History_145.out BCP_OUTPUT/BCP_Holding_Summary_1.out … BCP_OUTPUT/BCP_Holding_Summary_145.out BCP_OUTPUT/BCP_Industry_1.out BCP_OUTPUT/BCP_Last_Trade_1.out … BCP_OUTPUT/BCP_Last_Trade_145.out BCP_OUTPUT/BCP_News_Item_Temp_1.out … BCP_OUTPUT/BCP_News_Item_Temp_145.out BCP_OUTPUT/BCP_News_XRef_1.out … BCP_OUTPUT/BCP_News_XRef_145.out BCP_OUTPUT/BCP_Sector_1.out BCP_OUTPUT/BCP_Security_1.out … BCP_OUTPUT/BCP_Security_145.out BCP_OUTPUT/BCP_Settlement_1.out … BCP_OUTPUT/BCP_Settlement_145.out BCP_OUTPUT/BCP_Status_Type_1.out BCP_OUTPUT/BCP_TaxRate_1.out BCP_OUTPUT/BCP_Trade_1.out … BCP_OUTPUT/BCP_Trade_145.out BCP_OUTPUT/BCP_Trade_History_1.out

			… BCP_OUTPUT/BCP_Trade_History_145.out BCP_OUTPUT/BCP_Trade_Type_1.out BCP_Watch_Item_1.out … BCP_Watch_Item_145.out BCP_OUTPUT/BCP_Watch_List_1.out … BCP_OUTPUT/BCP_Watch_List_145.out BCP_OUTPUT/BCP_Zip_Code_1.out Check_Constraints_Fixed.log Check_Constraints_Growing.log Check_Constraints_Scaling.log Convert_NI_ITEM_Data.log CreateDB.log Create_DB_Audit_Tables.log Create_DM_Audit_Table.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 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 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.log splog.log 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
	Scripts and files used to customize the database load to this particular server configuration	SupportingFiles/Clause2/4060000.Cust	Backup_Database.sql Create_Database.sql Remove_Database.sql Restore_Database.sql
	Index Creation Scripts	SupportingFiles/Clause2/DDL	BCP_1.cmd … BCP_145.cmd 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 stored procedures	SupportingFiles/Clause2/DML	BrokerVolume.sql CustomerPosition.sql DataMaintenance.sql MarketFeed.sql MarketWatch.sql SecurityDetail.sql TradeLookup.sql TradeOrder.sql TradeResult.sql TradeStatus.sql TradeUpdate.sql
	Database load helper scripts	SupportingFiles/Clause2/ Utility	Checkpoint_TPCE_Database.SQL Check_tempdb.sql Count_Customers.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 SpaceUsed_Extended.sql SpaceUsed_Extended_Detlev.sql SQL_Server_Configuration.sql Trade_Cleanup.sql Version.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 Runtime Scripts	SupportingFiles/Clause2/Audit_Scripts/ RunTime	Calculate_Std_Deviation_Trades_Per_LU.sql
	Database Space Scripts	SupportingFiles/Clause2/Audit_Scripts/ Space	Get_Table_Sizes.sql SPFiles.sql SPLog.sql SPUsed.sql
Clause3	Transaction Frames	SupportingFiles/Clause3/ StoredProcedures	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.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	BenchCraftConfig.xml
	EGenLoader Parameter	SupportingFiles/Clause5	BuildSteps.log EGenLoaderFrom1To28000.log EGenLoaderFrom28001To56000.log …. EGenLoaderFrom4032001To4060000.log

	EGenLogger Output	SupportingFiles/Clause5	TxnReportE-MI.xls
Clause6	EGenValidate	SupportingFiles/Clause6	EGenValidate.out
Clause7	ACID	SupportingFiles/Clause7	MSTPCE ACID Procedures.pdf
	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.AfterDatabaseLoad.out ConsistencyAfterBusinessRecovery.out ERRORLOG_consistency_afterrestore
		SupportingFiles/Clause7/Consistency/Scripts	Consistency.sql Consistency.vbs
	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery	20MinReportPart1.xls 20MinReportPart2.xls BenchCraftConfig.xml BusinessRecoveryAll.xlsx ConsistencyAfterBusinessRecovery.out Errorlog_firstrun ERRORLOG_recovery ERRORLOG_restore ERRORLOG_secondrun FullRunReportPart1.xls FullRunReportPart2.xls SettlementAfter.out SettlementBefore.out SpConfigure.out StepReportPart1.xls StepReportPart2.xls window_event_log_businiss.txt
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/Data Accessibility	20MinAfterRecoveryStartReport.xl 5MinBeforeDataFailureReport.xls 5MinBeforeLogFailureReport.xls 5MinBeforeTempdbFailureReport.xl BenchCraftConfig.xml DataAccessibilityAll.xlsx ERRORLOG_restore ERRORLOG_testrun FullRunReport.xls SettlementAfter.out SettlementBefore.out SpConfigure.out StepReport.xls
	Isolation	SupportingFiles/Clause7/Isolation	Isolation1_S1.out Isolation1_S2.out Isolation1_S3.out

			Isolation1_S4.out Isolation2_S1.out Isolation2_S2.out Isolation2_S3.out Isolation2_S4.out Isolation3_S1.out Isolation3_S2.out Isolation3_S3.out Isolation4_S1.out Isolation4_S2.out Isolation4_S3.out
		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
October 11, 2019

Fujitsu Limited
Ichiro Yamada
4-1-1 Kami-Kodanaka, Nakahara-Ku,
Kawasaki-City
Kanagawa-Pref., 211-8588 JAPAN

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

All pricing shown is in US Dollars ($).

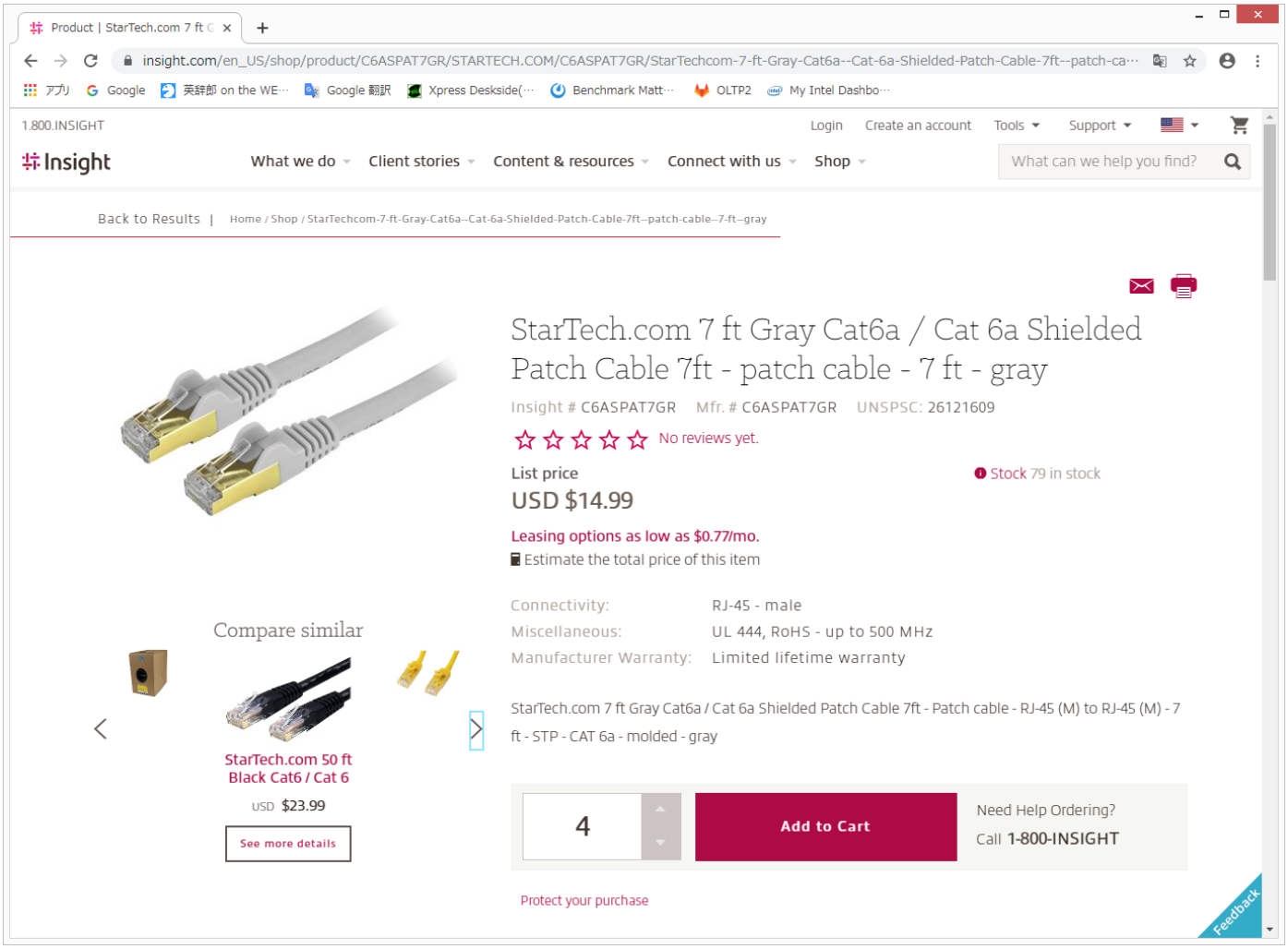
Description	Unit Price	Quantity	Price
Database Management System			
SQL Server 2017 Enterprise Edition *2 Core License* *Open Program – No Level* Unit Price reflects a 5% discount from the retail unit price of $14,256.00	$13,472.50	28	$377,230.00
Database Server Operating System			
Windows Server 2016 Standard *2 Core License* *Open Program – No Level* *Unit Price Reflects a 17% discount from the retail unit price of $110.25*	$92.00	28	$2,576.00
Tier-A Operating System(s)			
Windows Server 2016 Standard *2 Core License* *Open Program – No Level* *Unit Price Reflects a 17% discount from the retail unit price of $110.25*	$92.00	28	$2,576.00
Support			
Microsoft Problem Resolution Services *Professional Support* *(1 Incident).*	$259.00	1	$259.00

All Microsoft software components are currently orderable and available. 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: TPC-E_VhmT2pjjqZjEJUWA5DeBRw@@42743__fiy.doc


Product | StarTech.com 7 ft
insight.com/en_US/shop/product/C6ASPAT7GR/STARTECH.COM/C6ASPAT7GR/StarTechcom-7-ft-Gray-Cat6a--Cat-6a-Shielded-Patch-Cable-7ft--patch-ca···
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Create an account
Tools
Support
Insight
What we do
Client stories
Content & resources
Connect with us
Shop
What can we help you find?
Back to Results |
Home / Shop / StarTechcom-7-ft-Gray-Cat6a--Cat-6a-Shielded-Patch-Cable-7ft--patch-cable--7-ft--gray
StarTech.com 7 ft Gray Cat6a / Cat 6a Shielded Patch Cable 7ft - patch cable - 7 ft - gray
Insight # C6ASPAT7GR
Mfr. # C6ASPAT7GR
UNSPSC: 26121609
No reviews yet.
List price
USD $14.99
Stock 79 in stock
Leasing options as low as $0.77/mo.
Estimate the total price of this item
Connectivity: RJ-45 - male
Miscellaneous: UL 444, RoHS - up to 500 MHz
Manufacturer Warranty: Limited lifetime warranty
StarTech.com 7 ft Gray Cat6a / Cat 6a Shielded Patch Cable 7ft - Patch cable - RJ-45 (M) to RJ-45 (M) - 7 ft - STP - CAT 6a - molded - gray
Compare similar
StarTech.com 50 ft Black Cat6 / Cat 6
USD $23.99
See more details
4
Add to Cart
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Feedback