TPC Benchmark™ E

Full Disclosure Report for

PRIMERGY RX300 S8

Using

**Microsoft SQL Server 2012
Enterprise Edition SP1**

Using

**Microsoft Windows Server 2012
Standard Edition**

TPC-E Version 1.12.0

Submitted for Review

September 10, 2013

First Edition September 2013

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 2012 Enterprise Edition SP1.

The TPC Benchmark™ E tests were run on a PRIMERGY RX300 S8 system using the Microsoft Windows Server 2012 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 PRIMERGY RX300 S8	**Microsoft SQL Server 2012 Enterprise Edition SP1 Microsoft Windows Server 2012 Standard Edition**	**$ 334,140 USD**	**2,472.58**	**$ 135.14 USD**	**September 10, 2013**

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

FUJITSU	PRIMERGY RX300 S8	TPC-E 1.12.0 TPC Pricing 1.7.0
		Report Date September 10, 2013

TPC-E Throughput **2,472.58 tpsE**	Price/Performance **$ 135.14 USD per tpsE**	Availability Date **September 10, 2013**	Total System Cost **$ 334,140 USD**

Database Server Configuration

Operating System **Microsoft Windows Server 2012 Standard Edition**	Database Manager **Microsoft SQL Server 2012 Enterprise Edition SP1**	Processors/Cores/Threads **2/24/48**	Memory **512 GB**

SUT

Tier A
PRIMERGY RX200 S8
2x Intel Xeon E5-2640 v2 2.00 GHz
32 GB Memory
2x 250 GB 7.2k rpm SATA Drive
2x onboard LAN 1 Gb/s
1x Dual Port LAN 1 Gb/s

Tier B
PRIMERGY RX300 S8
2x Intel Xeon E5-2697 v2 2.70 GHz
512 GB Memory
2x 146 GB 15k rpm SAS Drives
6x 300 GB 15k rpm SAS Drives
2x onboard LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40
80x 200 GB SSD Drives

Initial Database Size **10,257 GB**	Redundancy Level 1 **RAID-5 data and RAID-10 log**	Storage **80 x 200 GB SSD** **6 x 300 GB 15k rpm HDD**

TPC-E 1.12.0
TPC Pricing 1.7.0
Report Date
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FUJITSU

PRIMERGY RX300 S8

Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3-yr. Maint. Price
Database Server (Tier B) Hardware			$		$	$
PRIMERGY RX300S8						
PY RX300S8	S26361-K1457-V401	1	1,440.00	1	1,440.00	
Modulare SV 450W platin hp	S26113-F575-E12	1	275.00	2	550.00	
Cable pow ercord rack, 4m, grey	T26139-Y1968-E100	1	12.00	2	24.00	
Pow er Supply Dummy	S26113-F574-E99	1	4.00	1	4.00	
Intel Xeon E5-2697 v2 12C/24T 2.70 GHz 30MB	S26361-F3791-E270	1	3,700.00	2	7,400.00	
32GB (1x32GB) 4Rx4 L DDR3-1600 LR ECC	S26361-F3782-E517	1	1,180.00	16	18,880.00	
Performance Mode Installation	S26361-F3694-E2	1	7.00	2	14.00	
DVD-RW supermulti slimline SATA	S26361-F3269-E2	1	106.00	1	106.00	
HD SAS 6G 146GB 15K HOT PL 2.5" EP	S26361-F4482-E514	1	335.00	2	670.00	
HD SAS 6G 300GB 15K HOT PL 2.5" EP	S26361-F4482-E530	1	510.00	6	3,060.00	
RAID Ctrl SAS 6G 1GB (D3116C)	S26361-F3669-E3	1	520.00	1	520.00	
RAID Ctrl SAS 6G 8Port ex 1GB LP LSI V3	S26361-F3713-L503	1	950.00	5	4,750.00	
Rack Mount Kit F1-C S7 LV	S26361-F2735-E175	1	145.00	1	145.00	
Rack Cable Arm 2U	S26361-F2735-E82	1	40.00	1	40.00	
Mounting in symmetrical Racks	S26361-F4530-E10	1	7.00	1	7.00	
Region-Kit APAC/America/EMEA/Indien	S26361-F1452-E100	1	7.00	1	7.00	
PRIMERGY RX300S8 Installation, normal business hours	PYR300-N038005-0NA	1	350.00	1		350.00
PY RX300 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing	PYR300-U004361-0NA	1	621.00	1		621.00
				Subtotal (*)	37,617.00	971.00
Storage						
PRIMECENTER RACK						
PRIMECENTER M1 Rack 724S 24U-1050x700	S26361-K827-V220	1	2,400.00	1	2,400.00	
Dummy panel, plastics, 1U + assembly	S26361-F4530-L131	1	12.00	3	36.00	
Dummy panel, plastics, 2U + assembly	S26361-F4530-L132	1	12	6	72.00	
Socket strip 3phase 3x 8 sockets	S26361-F2262-L31	1	240.00	1	240.00	
PY PRIMECENTER during normal business hours, PRIMERGY Installation, Racks, One Time billing	PYPCTR-N076005-0NA	1	265.00	1		265.00
PY PRIMECENTER Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYPCTR-U004361-0NA)	PYPCTR-U004361-0NA	1	750.00	1		750.00
ETERNUS JX40		1				
ETERNUS JX40	FTS:ETJXS11BG		3,283.00	5	16,415.00	
SSD SAS 6G 200 GB MLC HOT PL 2.5" EP PERF	S26361-F4581-L200	1	1,920.00	80	153,600.00	
SAS CABLE 1X SFF 8088-1X SFF 8088 2M	D:KBSAS1S-1S-2M	1	73.00	5	365.00	
PY JX40 Warranty Uplift, 12 Months, Enhanced Plus Level, 24x7x365 Phone Support (Sev1 - Live Transfer), 24x7x365 Onsite and Parts (Sev1 Resp. Time - 4 Hours), Incl. Holidays, Prepaid billing	PYJX40-U004121-0NA	1	639.00	5		3,195.00
PY JX40 Post Warranty, 24 Months, Enhanced Plus Level, 24x7x365 Phone Support (Sev1 - Live Transfer), 24x7x365 Onsite and Parts (Sev1 Resp. Time - 4 Hours), Incl. Holidays, Prepaid billing	PYJX40-P004241-0NA	1	1,218.00	5		6,090.00
PY JX40 during normal business hours, Primergy storage installation, One Time billing	PYJX40-N043005-0NA	1	450.00	5		2,250.00
				Subtotal(*)	173,128.00	12,550.00

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PRIMERGY RX300 S8

TPC-E 1.12.0
TPC Pricing 1.7.0

Report Date
September 10, 2013

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Database Server (Tier B) Software						
SQL Server 2012 Enterprise Edition 2 Core License	7JQ-00256	2	13,472.50	12	161,670.00	
Microsoft Windows Server 2012 Standard 2 Processor License	P73-05761	2	735.00	1	735.00	
Microsoft Problem Resolution Services	n/a	2	259.00	1		259.00
				Subtotal	162,405.00	259.00
Application Server (Tier A) Hardware						
Primergy RX200 S8		1				
PY RX200 S8, 4x2.5	S26361-K1455-V101	1	1,100.00	1	1,100.00	
Modulare SV 450W platin hp	S26113-F575-E10	1	275.00	1	275.00	
Power Supply Dummy	S26113-F574-E99	1	4.00	1	4.00	
Intel Xeon E5-2640 v2 8C/16T 2.00 GHz 20 MB	S26361-F3789-E200	1	1,220.00	2	2,440.00	
Fan upgrade kit 2nd CPU	S26361-F1386-E120	1	61.00	1	61.00	
8GB (1x8GB) 1Rx4 L DDR3-1600 R ECC	S26361-F3781-E515	1	166.00	4	664.00	
Independent Mode Installation	S26361-F3694-E10	1	7.00	2	14.00	
DVD-RW supermulti slimline SATA	S26361-F3269-E2	1	106.00	1	106.00	
HD SATA 6G 250GB 7.2K HOT PL 2.5" BC	S26361-F3708-E250	1	280.00	2	560.00	
Eth Ctrl 2x1Gbit PCIe x4 D2735-2 Cu lp	S26361-F3610-E202	1	225.00	1	225.00	
Rack Mount Kit F1-C S7 LV	S26361-F2735-E175	1	145.00	1	145.00	
Cable powercord rack, 4m, grey	T26139-Y1968-E100	1	12.00	1	12.00	
Mounting in symmetrical Racks	S26361-F4530-E10	1	7.00	1	7.00	
Region-Kit APAC/America/EMEA/Indien	S26361-F1452-E100	1	7.00	1	7.00	
PRIMERGY RX200S8 Installation, normal business hours	PYR200-N038005-0NA	1	200.00	1		200.00
PYRX200 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYR200-U004361-0NA)	PYR200-U004361-0NA	1	750.00	1		750.00
				Subtotal(*)	5,620.00	950.00
Application Server (Tier A) Software						
Microsoft Windows Server 2012 Standard 2 Processor License	P73-05761	2	735.00	1	735.00	
				Subtotal	735.00	
Miscellaneous						
DISPLAY B20T-6 LED (incl 2spares)	S26361-K1416-V140	1	200.00	3	600.00	
Infrastructure or Connectivity						
KB400 USB grey INT USA (incl 2 spares)	S26381-K550-E102	1	14.00	3	42.00	
Mouse M480 grey (incl 2 spares)	S26381-K431-E101	1	8.00	3	24.00	
LAN-CAT 5 Enhanced, l=3m	T26139-Y2425-M3	1	5.00	2	10.00	
				Subtotal(*)	676.00	0.00
				Total	380,181.00	14,730.00
Dollar Volume Discount (see Notes)		28%	1		60,771.48	
					319,409.52	

Notes:	**Three-Year Cost of Ownership USD**	$334,140
Price Source: 1=Fujitsu, 2=Microsoft Corporation		
Discount applies to all subtotal marked with(*) .	**TPC-E Throughput**	2472.58
Pricing is for these or similar quantities.Discounts for similarly sized configurations will be similar to what is quoted here, but may vary based on the specific components priced.	**$ USD/tpsE**	$135.14

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.

Numerical Quantities Summary				
Reported Throughput:	**2,472.58 tpsE**	**Configured Customers:**		**1,250,000**
Response Times (in seconds)	**Minimum**	**Average**	**90th%tile**	**Maximum**
Broker Volume	0.00	0.01	0.02	0.19
Customer Position	0.00	0.01	0.02	1.35
Market Feed	0.00	0.01	0.02	0.62
Market Watch	0.00	0.01	0.01	0.64
Security Detail	0.00	0.00	0.01	0.77
Trade Lookup	0.00	0.07	0.10	0.84
Trade Order	0.00	0.02	0.03	1.89
Trade Result	0.00	0.02	0.04	2.71
Trade Status	0.00	0.01	0.01	1.29
Trade Update	0.01	0.08	0.11	0.84
Data Maintenance	0.00	0.01	N/A	0.07
Transaction Mix		**Transaction Count**		**Mix %**
Broker Volume		8,723,315		4.900%
Customer Position		23,143,554		13.000%
Market Feed		1,780,265		1.000%
Market Watch		32,044,877		18.000%
Security Detail		24,923,837		14.000%
Trade Lookup		14,241,869		8.000%
Trade Order		17,980,738		10.100%
Trade Result		17,802,617		10.000%
Trade Status		33,824,983		19.000%
Trade Update		3,560,415		2.000%
Data Maintenance		120		N/A
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)		00:16:37		
Measurement Interval (hh:mm:ss)		02:00:00		
Business Recovery Time (hh:mm:ss)		00:23:37		
Total Number of Transactions Completed		178,026,470		

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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 anytime, especially in relation to each other.

Goal of the TPC-E Benchmark

The TPC-E benchmark simulates the OLTP workload of a brokerage firm. The focus of the benchmark is the central database that executes transactions related to the firm's customer accounts. In keeping with the goal of measuring the performance characteristics of the database system, the benchmark does not attempt to measure the complex flow of data between multiple application systems that would exist in a real environment.
The mixture and variety of transactions being executed on the benchmark system is designed to capture the characteristic components of a complex system. Different transaction types are defined to simulate the interactions of the firm with its customers as well as its business partners. Different transaction types have varying run-time requirements.
The benchmark defines:

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

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

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

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

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

Restrictions and Limitations

Despite the fact that this benchmark offers a rich environment that represents many OLTP applications, this benchmark does not reflect the entire range of OLTP requirements. In addition, the extent to which a customer can achieve the Results reported by a vendor is highly dependent on how closely TPC-E approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.

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

Benchmark Sponsors are permitted various possible implementation designs, insofar as they adhere to the model described and pictorially illustrated in this specification. A Full Disclosure Report (FDR) of the implementation details, as specified in Clause 9.1, must be made available along with the reported Results.

Clause 1: Overview

Order and Titles

The order and titles of sections in the Report and Supporting Files must correspond with the order and titles of sections from the TPC-E Standard Specification (i.e., this document). The intent is to make it as easy as possible for readers to compare and contrast material in different Reports (9.1.1.1).

The order and titles in this report correspond to those in the TPC-E specification.

Executive Summary Statement

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

The Executive summary has been included near the beginning of this FDR.

Benchmark Sponsor

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

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

Configuration Diagram

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

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

Figure 1-1: Priced Configuration

Tier A
PRIMERGY RX200 S8
2x Intel Xeon E5-2640 v2 2.00 GHz
32 GB Memory
2x 250 GB 7.2k rpm SATA Drive
2x onboard LAN 1 Gb/s
1x Dual Port LAN 1 Gb/s

Tier B
PRIMERGY RX300 S8
2x Intel Xeon E5-2697 v2 2.70 GHz
512 GB Memory
2x 146 GB 15k rpm SAS Drives
6x 300 GB 15k rpm SAS Drives
2x onboard LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40
80x 200 GB SSD Drives

Figure 1-2: Measured Configuration

Tier A
PRIMERGY RX200 S8
2x Intel Xeon E5-2640 v2 2.00 GHz
32 GB Memory
1x 250 GB 7.2k rpm SATA Drive
2x onboard LAN 1 Gb/s
1x Dual Port LAN 1 Gb/s

Tier B
PRIMERGY RX300 S8
2x Intel Xeon E5-2697 v2 2.70 GHz
512 GB Memory
2x 146 GB 15k rpm SAS Drives
6x 300 GB 15k rpm SAS Drives
2x onboard LAN 1 Gb/s
6x SAS RAID Controller

Storage
1x PRIMECENTER Rack
5x ETERNUS JX40
80x 200 GB SSD Drives
3x 1 TB 7.2k rpm SATA Drives
11x FibreCat SX40
108x 146 GB 15k rpm SAS Drives
24x 450 GB 15k rpm SAS Drives

Hardware Configuration

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

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

Tier A
The Tier A server is a Fujitsu PRIMERGY RX200 S8 with two Intel Xeon E5-2640 v2 Eight-Core Processor and 32
GB of memory. One SATA 250 GB 7.2k rpm disk drive is connected to the onboard controller. One 1 Gb/s dual port
Ethernet LAN card is plugged in the PCI-E slot. Each of the two ports is directly connected with one of the 1 Gb/s
Ethernet onboard LAN ports of Tier B using a LAN crossover cable. There are two LAN segments for these
connections. The two onboard 1 Gb/s LAN ports are used for driver connection.

Tier B

The Tier B or database server is a Fujitsu PRIMERGY RX300 S8 with two Intel Xeon E5-2697 v2 12-Core Processors and 512 GB memory. All of the eight onboard 2.5" disk bays are used with 2x SAS 146 GB 15k rpm; 6x SAS 300 GB 15k rpm disk drives and RAID controller SAS 6G 1GB (D3116C). Two drives are configured with RAID1 for OS and database. The six drives with 300 GB are configured with RAID10 for database log. Five RAID controllers SAS 6G 8Port ex 1GB are used to connect the external disk drives to the server. The controller cache of all 6 RAID controllers is configured with Write Through. The two onboard 1 Gb/s Ethernet LAN ports are connected to the Tier A system as described above.

Storage

5 Fujitsu ETERNUS JX40 are used, each with 16x 200GB SSD 2.5" RAID5. The enclosures are connected to the controllers SAS 6G 8Port ex 1GB. For details see table 2-2 Disk Configuration. The disk configuration can be done with the ServerView RAID Manager, which is shipped on ServerStart DVD together with the Server.

Software Configuration

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

The default installation of the operating system was executed on Tier A and B as well as the installation of the database SW on Tier B and the database client connectivity on Tier A. Information about changes to the software, settings and BenchCraft can be found in the SupportingFiles directory Introduction - Software.
SQL Server 2012 SP1 has been updated with cumulative update package 4. For details and how to obtain the SW see http://support.microsoft.com/kb/2833645.

Clause 2: Database Design, Scaling and Population

Database Creation

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

The database has been created for 1,250,000 customers. The SQL Server scripts and setup command files are included in the SupportingFiles\Clause2 folder. Two file groups are used for the tables and indices. The distribution is shown in table 2-1.

Partitioning

While few restrictions are placed upon horizontal or vertical partitioning of tables and rows in the TPC-E benchmark (see Clause 2.3.3), any such partitioning must be reported in the Report. (9.3.2.2)

There is no partitioning implemented in this configuration.

Replication and Duplicated Attributes

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

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

Cardinality of Tables

The cardinality (e.g. the number of rows) of each table, as it existed after database load (see Clause 2.6), must be reported in the Report (9.3.2.5).

The database was configured for 1,250,000 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	8875013	1
ADDRESS	1875004	1
BROKER	12500	1
CASH_TRANSACTION	19871954148	2
CHARGE	15	1
COMMISSION_RATE	240	1
COMPANY	625000	1
COMPANY_COMPETITOR	1875000	1
CUSTOMER	1250000	1
CUSTOMER_ACCOUNT	6250000	1
CUSTOMER_TAXRATE	2500000	1
DAILY_MARKET	1117406250	1
EXCHANGE	4	1
FINANCIAL	12500000	1
HOLDING	1105811163	2
HOLDING_HISTORY	28947653948	2
HOLDING_SUMMARY	62162646	2
INDUSTRY	102	1
LAST_TRADE	856250	1
NEWS_ITEM	1250000	1
NEWS_XREF	1250000	1
SECTOR	12	1
SECURITY	856250	1
SETTLEMENT	21600000000	2
STATUS_TYPE	5	1
TAXRATE	320	1
TRADE	21600000000	2
TRADE_HISTORY	51840050801	2
TRADE_REQUEST	0	2
TRADE_TYPE	5	1
WATCH_ITEM	125017846	1
WATCH_LIST	1250000	1
ZIP_CODE	14741	1

Distribution of Tables, Partitions and Logs

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

Table 2-2: Disk Configuration

HBA - Port	Disk	Drives	Partition	Size	Use
Crtl 0	0 – onboard	2x146GB 15K SAS, RAID1	C:\	136 GB	OS, DB
	1 – onboard	6x300GB 15K SAS, RAID10	L:\	836 GB	DB Log
Crtl 1 Port 0	2 – JX40	16x200GB SSD, RAID5	C:\jp\tpce011 C:\jp\tpce012 C:\jp\tpce013 C:\jp\tpce014	69.79 GB 906 GB 906 GB 906 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 1 Port 1	3 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help01	1498 GB	DB setup Backup
	4 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help02	1498 GB	DB setup Backup
	5 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help03	1498 GB	DB setup Backup
Crtl 2 Port 0	6 – JX40	16x200GB SSD, RAID5	C:\jp\tpce021 C:\jp\tpce022 C:\jp\tpce023 C:\jp\tpce024	69.79 GB 906 GB 906 GB 906 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 2 Port 1	7 – SX40	12x450GB, 15K SAS, RAID5	C:\jp\help04 C:\jp\help05 C:\jp\help06	1535 GB 1535 GB 1535 GB	DB setup Backup
Crtl 3 Port 0	8 – JX40	16x200GB SSD, RAID5	C:\jp\tpce031 C:\jp\tpce032 C:\jp\tpce033 C:\jp\tpce034	69.79 GB 906 GB 906 GB 906 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 3 Port 1	9 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help07	1498 GB	DB setup Backup
	10 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help08	1498 GB	DB setup Backup
	11 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help09	1498 GB	DB setup Backup
Crtl 4 Port 0	12 – JX40	16x200GB SSD, RAID5	C:\jp\tpce041 C:\jp\tpce042 C:\jp\tpce043 C:\jp\tpce044	69.79 GB 906 GB 906 GB 906 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 4 Port 1	13 – SX40	12x450GB, 15K SAS, RAID5	C:\jp\help10 C:\jp\help11 C:\jp\help12	1535 GB 1535 GB 1535 GB	DB setup Backup
Crtl 5 Port 0	14 – JX40	16x200GB SSD, RAID5	C:\jp\tpce051 C:\jp\tpce052 C:\jp\tpce053 C:\jp\tpce054	69.79 GB 906 GB 906 GB 906 GB	Filegroup1 Filegroup2 Filegroup2 Filegroup2
Crtl 5 Port 1	15 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help13	1498 GB	DB setup Backup
	16 – SX40	12x146GB, 15K SAS, RAID5	C:\jp\help14	1498 GB	DB setup Backup
	17 – SX40	24x73GB, 15K SAS, RAID5	C:\jp\help15	1560 GB	DB setup Backup

Database Interface, Data Model and Load Methodology

A statement must be provided in the Report that describes:
The Database Interface (e.g., embedded, call level) and access language (e.g., SQL, COBOL read/write) used to implement the TPC-E Transactions. If more than one interface / access language is used to implement TPC-E, each interface / access language must be described and a list of which interface /access language is used with which Transaction type must be reported.
The data model implemented by the DBMS (e.g., relational, network, hierarchical) (9.3.2.7).
The methodology used to load the database must be reported in the Report (9.3.2.8).

Microsoft SQL Server 2012 Enterprise Edition SP1 is a relational database. The interface used was Microsoft SQL Server stored procedures accessed with Remote Procedure Calls embedded in C++ code using the Microsoft ODBC interface.
The methodology used to load the database is described in Clause2 of the SupportingFiles directory.

Clause 3: Transactions

Vendor-Supplied Code

A statement that vendor-supplied code is functionally equivalent to Pseudo-code in the specification (see Clause 3.2.1.6) must be reported in the Report (9.3.3.1).

The vendor supplied code is functionally equivalent to the pseudo-code.

Database Footprint Requirements

A statement that the database footprint requirements (as described in Clause 3.3) were met must be reported in the Report (9.3.3.2).

Database footprint requirements were met as described in the specification.

Clause 4: SUT, Driver and Network

Network Configuration

The Network configurations of both the measured and Priced Configurations must be described and reported in the Report. This includes the mandatory Network between the Driver and Tier A (see Clause 4.2.2) and any optional Database Server interface networks (9.3.4.2):

Figures 1-1 and 1-2 show the configuration of the measured and priced configurations. Both are identical in case of the network configuration. Tier B system PRIMERGY RX300 S8 has an onboard Ethernet controller with two 1Gb/s ports. Tier A system PRIMERGY RX200 S8 has an onboard Ethernet controller with two 1Gb/s ports used for driver system connection. Tier A system was extended with one dual-port 1Gb/s Ethernet controller card. These two ports were directly connected with the two onboard ports of Tier B using different LAN segments.

Clause 5: EGen

EGen Version

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

The EGen version used was 1.12.0.

EGen Code

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

All the required TPC-provided code was used in the benchmark.

EGen Modifications

If the Test Sponsor modified EGen, a statement EGen has been modified must be reported in the Report. All formal waivers from the TPC documenting the allowed changes to EGen must also be reported in the Report (see Clause 5.3.7.1). If any of the changes to EGen do not have a formal waiver that must also be reported (9.3.5.3).
If the Test Sponsor extended EGenLoader (as described in Appendix A.6), the use of the extended EGenLoader and the audit of the extension code by an Auditor must be reported (9.3.5.4).

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

Clause 6: Performance Metrics and Response time

EGen Driver

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

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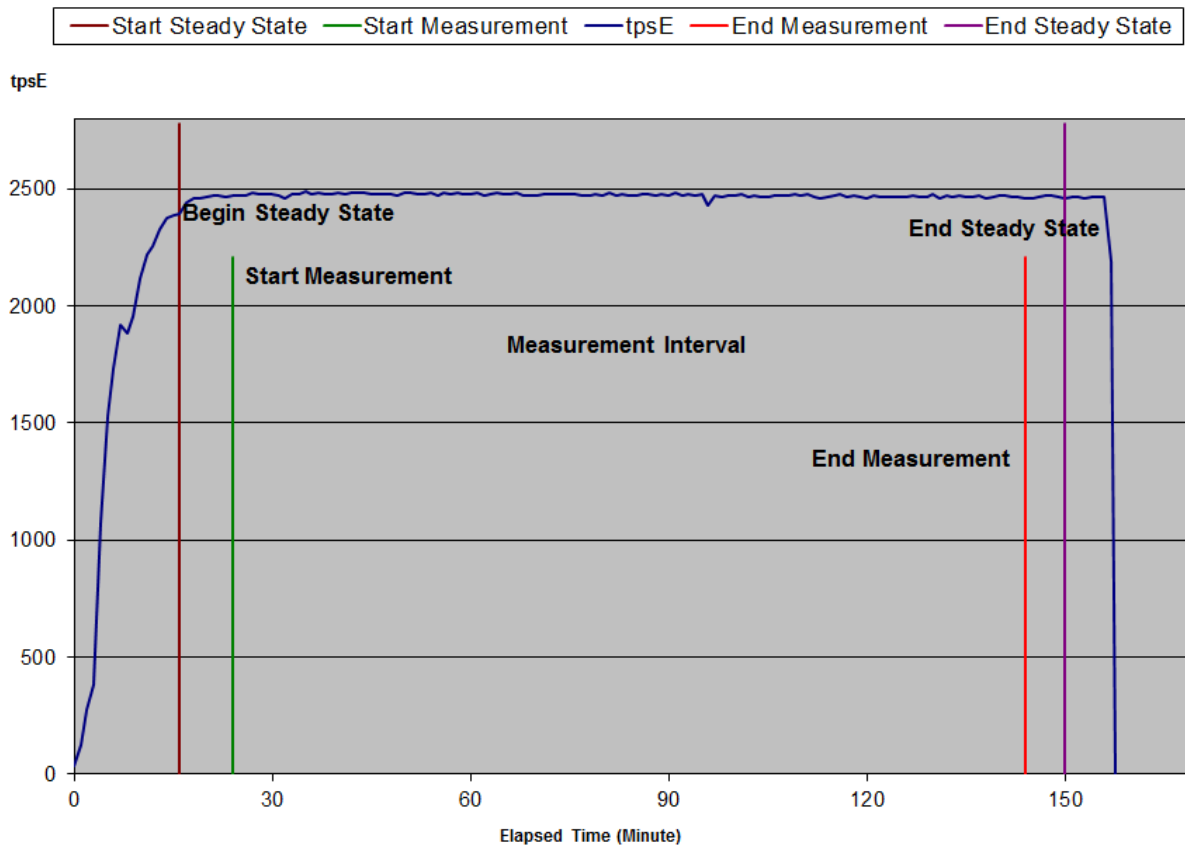
Measured Throughput

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

The measured throughput was 2,472.58 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%	49.99%	Ok
	Get History	48.00%	52.00%	50.00%	Ok
	Overall				Ok
Market Watch	By Watch List	57.00%	63.00%	60.01%	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%	29.99%	Ok
	Frame 2	28.50%	31.50%	30.00%	Ok
	Frame 3	28.50%	31.50%	30.01%	Ok
	Frame 4	9.50%	10.50%	10.00%	Ok
	Overall				Ok
Trade Update	Frame 1	31.00%	35.00%	32.98%	Ok
	Frame 2	31.00%	35.00%	33.02%	Ok
	Frame 3	32.00%	36.00%	34.00%	Ok
	Overall				Ok
Trade Order	By Non-Owner	9.50%	10.50%	10.00%	Ok
	By Company Name	38.00%	42.00%	39.99%	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%	25.02%	Ok
	Trade Qty 400	24.00%	26.00%	25.00%	Ok
	Trade Qty 800	24.00%	26.00%	24.99%	Ok
	Market Buy	29.70%	30.30%	30.00%	Ok
	Market Sell	29.70%	30.30%	30.02%	Ok
	Limit Buy	19.80%	20.20%	19.99%	Ok
	Limit Sell	9.90%	10.10%	10.00%	Ok
	Stop Loss	9.90%	10.10%	9.99%	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).
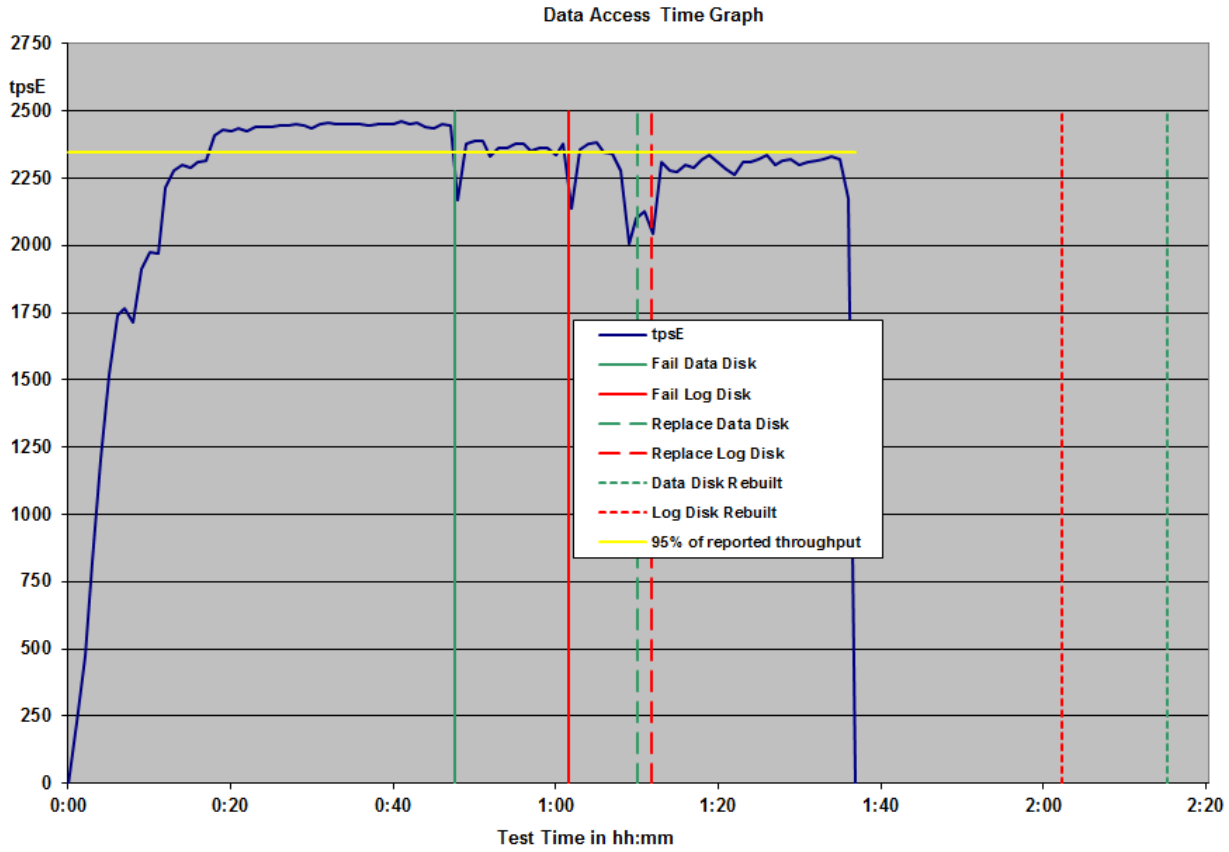*A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.5.7.2) (9.3.7.3).*

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 a database data array. Since RAID5 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.
5. Begin the necessary recovery process, by replacing the failed drives in the database data array and start the rebuild process.
6. Begin the necessary recovery process, by replacing the failed drives in the database log array and start the rebuild.
7. Continue running the Driver for at least 20.
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

Data Access Time Graph

Legend:
- tpsE
- Fail Data Disk
- Fail Log Disk
- Replace Data Disk
- Replace Log Disk
- Data Disk Rebuilt
- Log Disk Rebuilt
- 95% of reported throughput

Test Time in hh:mm

Business Recovery

The Test Sponsor must describe in the Report the test(s) used to demonstrate Business Recovery (9.3.4.7).
The Business Recovery Time must be reported on the Executive Summary Statement and in the Report. If the failures described in Clauses 7.5.2.2, 7.5.2.3 and 7.5.2.4 were not combined into one Durability test (usually powering off the Database Server during the run), then the Business Recovery Time for the failure described for instantaneous interruption is the Business Recovery Time that must be reported in the Executive Summary Statement. All the Business Recovery Times for each test requiring Business Recovery must be reported in the Report (9.3.7.6).
9.3.7.6 The Business Recovery Time Graph (see Clause 7.5.7.4) must be reported in the Report for all Business Recovery tests (9.3.7.7).

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

1. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
2. Start submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes.
3. Induce the failures by power off Tier B.
4. On the driver side the number of MEE connections is captured and after transaction failures is noted by the drivers, terminate the run and collect the data for Pre-Failure Run.
5. Re-power and restart Tier B.
6. When restarting the database on Tier B, it automatically starts the recovery and records timestamps. The Database Recovery Time was 00:03:20 (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 00:20:17 (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 00:23:37 (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
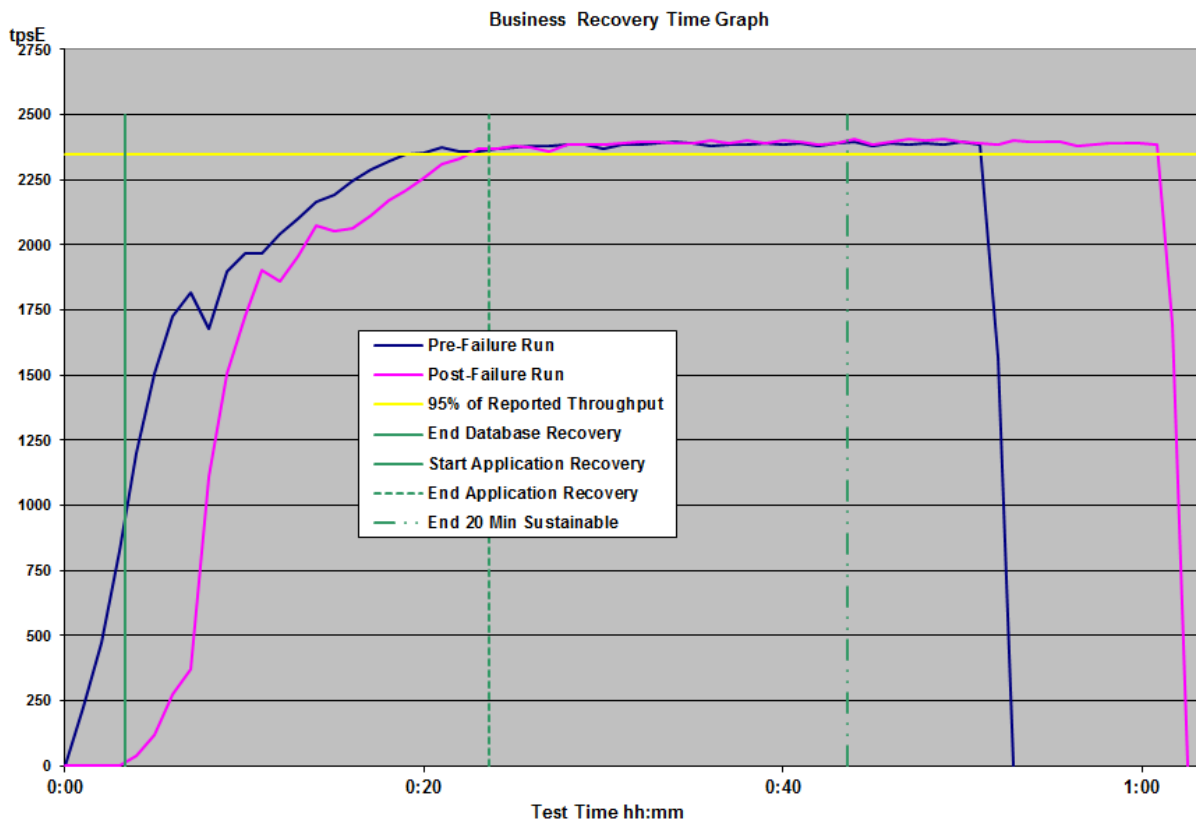
Clause 8: Pricing Related Items

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

Table	Initial Rows	Data (KB)	Index size (KB)	Extra 5% (KB)	initinal size Total + 5% (KB)	grow size After run (KB)	Growth (KB)	1 Day Growth (KB)	Req. Add. (KB)
Customers Used	1,250,000								
Performance	2472.58 TpsE		settlements after 8 hours (Busines Day)			71,210,304			
ACCOUNT_PERMISSION	8,875,013	488,696	3,136	24,592	516,424	491,888	56	178	24,592
ADDRESS	1,875,004	108,168	824	5,450	114,442	109,080	88	279	5,450
BROKER	12,500	912	1,008	96	2,016	1,920	0	0	96
CASH_TRANSACTION	19,873,667,236	2,055,744,192	4,339,088	103,004,164	2,163,087,444	2,063,975,256	3,891,976	12,334,496	12,334,496
CHARGE	15	8	8	1	17	16	0	0	1
COMMISSION_RATE	240	16	16	2	34	32	0	0	2
COMPANY	625,000	133,032	40,616	8,682	182,330	173,648	0	0	8,682
COMPANY_COMPETITOR	1,875,000	50,360	46,192	4,828	101,380	96,552	0	0	4,828
CUSTOMER	1,250,000	204,848	61,528	13,319	279,695	266,408	32	102	13,319
CUSTOMER_ACCOUNT	6,250,000	566,360	139,624	35,299	741,283	705,984	0	0	35,299
CUSTOMER_TAXRATE	2,500,000	52,176	824	2,650	55,650	53,112	112	355	2,650
DAILY_MARKET	1,117,406,250	52,260,808	152,424	2,620,662	55,033,894	52,414,296	1,064	3,373	2,620,662
EXCHANGE	4	8	8	1	17	16	0	0	1
FINANCIAL	12,500,000	1,408,664	4,552	70,661	1,483,877	1,413,456	240	761	70,661
HOLDING	1,105,857,657	73,890,936	50,400,200	6,214,557	130,505,693	125,619,584	1,328,448	4,210,133	4,210,133
HOLDING_HISTORY	28,950,164,868	1,052,726,000	703,373,736	87,804,987	1,843,904,723	1,760,674,800	4,575,064	14,499,346	14,499,346
HOLDING_SUMMARY	62,162,807	2,715,416	10,608	136,301	2,862,325	2,726,024	0	0	0
INDUSTRY	102	8	24	2	34	32	0	0	2
LAST_TRADE	856,250	53,312	824	2,707	56,843	54,136	0	0	2,707
NEWS_ITEM	1,250,000	135,522,824	2,064	6,776,244	142,301,132	135,524,912	24	77	6,776,244
NEWS_XREF	1,250,000	31,152	824	1,599	33,575	31,976	0	0	1,599
SECTOR	12	8	24	2	34	32	0	0	2
SECURITY	856,250	118,160	33,488	7,582	159,230	151,648	0	0	7,582
SETTLEMENT	21,601,862,273	1,030,161,432	2,173,096	51,616,726	1,083,951,254	1,034,510,904	2,176,376	6,897,396	6,897,396
STATUS_TYPE	5	8	8	1	17	16	0	0	1
TAXRATE	320	24	16	2	42	56	16	51	51
TRADE	21,602,005,412	2,578,050,768	1,442,671,808	201,036,129	4,221,758,705	4,024,393,872	3,671,296	11,635,114	11,635,114
TRADE_HISTORY	51,844,863,729	1,559,438,648	4,068,616	78,175,363	1,641,682,627	1,567,388,520	3,881,256	12,300,522	12,300,522
TRADE_REQUEST	0	0	0	0	0	358,176	358,176	1,135,136	1,135,136
TRADE_TYPE	5	8	1,032	52	1,092	1,040	0	0	52
WATCH_ITEM	125,017,846	3,494,112	13,344	175,373	3,682,829	3,507,672	216	685	175,373
WATCH_LIST	1,250,000	31,144	29,016	3,008	63,168	60,160	0	0	3,008
ZIP_CODE	14,741	488	48	27	563	536	0	0	27

Growing Tables			**Initial Database Size**			Settlements	22,469,407		
			10,502,755 (MB)			**Grown Database Size**			
			10,257 (GB)			10,522,174 (MB)			

	number	partition size (MB)	file size (MB)	alloc total (MB)	loaded (MB)	required (MB)		
filegroup1	5	71,465	316,750	357,325	190,485	200,009		space OK
filegroup2	15	927,334	13,824,000	13,910,016	10,312,270	10,373,805		space OK

		Number of disks	80				
		Disk Capacity (MB)	190,240				
		RAID5 Overhead	6%				
Initial Growing Space (MB)	10,312,270	Total Space (MB)	14,268,000				
Final Growing Space (MB)	10,331,687	Number of disks	-	Initial Log Size (MB)	28,808	Log units	1
Delta (MB)	19,417	Disk Capacity (MB)	953,344	Final Log Size (MB)	176,121	Disks per unit	6
Data Space per Trade (MB	0.000864	RAID1 Overhead	50%	Log Growth (MB)	147,313	Disk Capacity (MB)	285,568
1 Day Data Growth (MB)	61,535	Total Space (MB)	-	Log Space per Trade	0.006556	RAID10 Overhead	50.0%
60 Day Space (MB)	14,194,873	Total Space (MB)	14,268,000	1 Day Log Space (MB	466,866	Log Space (MB)	856,704

Attestation Letter

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

InfoSizing

The Right Metric For Sizing IT

TPC Transaction Processing
Performance Council

Certified Auditors

Detlev Seidel
Fujitsu Technology Solutions
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33106 Paderborn, Germany

September 5, 2013

I verified the TPC Benchmark^{TM} E v1.12.0 performance of the following configuration:

Platform:	PRIMERGY RX300 S8
Operating System:	Microsoft Windows Server 2012 Standard Edition
Database Manager:	Microsoft SQL Server 2012 Enterprise Edition SP1

The results were:

Performance Metric	**2,472.58 tpsE**
Trade-Result 90th %-tile	0.04 Seconds

Tier B (Server)   **PRIMERGY RX300 S8**

CPUs	2 x Intel Xeon E5-2697 v2 2.70 GHz		
Memory	512 GB (30 MB L3)		
Disks	**Qty** **Size**		**Type**
	2	146 GB	15K rpm SAS HDD
	80	200 GB	SAS SSD
	6	300 GB	15K rpm SAS HDD

Tier A (Client)   **PRIMERGY RX200 S8**

CPUs	2 x Intel Xeon E5-2640 v2 2.00 GHz
Memory	32 GB (20MB L3)
Disks	2 x 250 GB 7.2K rpm SATA 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 v1.12.0
- The transaction were correctly implemented
- The database was properly scaled and populated for 1,250,000 customers
- The mandatory network between the driver and the SUT was configured

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- 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 00:23:37 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.doc flatfilelocations.txt makehelpdirff.cmd Readme.txt tempdb15.sql
	Parameter OS Tunables Database Setup	SupportingFiles/Introduction/Software/	CountOperations.reg MemoryManagement.reg MSTPCE Database Setup Reference.doc SQL_IP.reg SQL_LargePages.req SQL_Nodes.reg SQL_Server_Configuration.ver TierA_SQL2012_client_connection_all.reg TierA_W32Time.reg
	Startup Scripts Tier A	SupportingFiles/Introduction/Software/	start_all_RX300S8.cmd
	Startup Scripts Tier B	SupportingFiles/Introduction/Software/	StartSQL2012.cmd
Clause 2	Create Database	SupportingFiles/Clause2	Backup_Database.sql Check_tempdb.sql Checkpoint_TPCE_Database.SQL Count_Customers.sql Create_Database.sql Create_DM_Audit_Table.sql Create_TID_Ranges_Table.sql Create_Timer_Table.sql Create_TL_TU_Warnings_Table.sql Create_TPCE_VERSIONS_Table.sql Database_Options_1.sql Database_Options_2.sql Drop_and_Create_TPCE_INFO.sql End_Load_Timer.sql Get_Next_T_ID.sql Install_Load_Timer_Proc.sql Load_TPCE_Info.sql Output_TPCE_VERSIONS_Table.SQL Remove_Database.sql Restore_Database.sql SQL_Server_Configuration.sql tempdb15.sql TPCE_Setup.cmd Trade_Cleanup.cmd Trade_Cleanup.sql Version.sql
	Create Database output	SupportingFiles/Clause2/DB_setup	1250000Customers_Load_Timer.log Backup_Database.log BrokerVolume.log Build_Steps.log

			BulkInsert_1.out
			… BulkInsert_45.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 EGenLoaderFrom1To28000.log EGenLoaderFrom28001To56000.log …. EGenLoaderFrom1222001To1250000.log ERRORLOG FK_Constraints.log Get_Next_T_ID.log Insert_Duplicates_Tests.log Load_Timer.log Load_Timer_Proc.log Load_TPCE_Info.log MarketFeed.log MarketWatch.log Referential_Integrity_Tests.log RemoveDB.log SecurityDetail.log spfiles.ver splog.ver spused.ver SQL_Server_Configuration.log Tables_Fixed.log Tables_Growing.log Tables_Scaling.log TPCE_VERSIONS.log TradeLookup.log TradeOrder.log TradeResult.log TradeStatus.log TradeUpdate.log Version.log
	Index Creation Scripts	SupportingFiles/Clause2/DDL	BulkInsert_<1..45>.sql Convert_NI_ITEM_Data.SQL Create_Check_Constraints_Fixed.sql Create_Check_Constraints_Growing.sql Create_Check_Constraints_Scaling.sql Create_FK_Constraints.sql Create_Indexes_Fixed_Tables.sql Create_Indexes_Growing_Tables.sql Create_Indexes_Scaling_Tables.sql Create_Tables_Fixed.sql Create_Tables_Growing.sql Create_Tables_Scaling.sql Drop_FK_Constraints.sql

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

			TradeResultDB_SP.cpp TradeResultDB_SP.h TradeStatusDB_SP.cpp TradeStatusDB_SP.h TradeUpdateDB_SP.cpp TradeUpdateDB_SP.h TransactionsSP.vcproj TransactionsSP.vcxproj TxnHarnessDBBase.cpp TxnHarnessDBBase.h TxnHarnessDBConn.cpp TxnHarnessDBConn.h
	TxnHarness	SupportingFiles/Clause3/TxnHarnes	TxnHarness.vcproj TxnHarness.vcxproj TxnHarness_stdafx.cpp TxnHarness_stdafx.h TxnHarnessSendToMarket.cpp TxnHarnessSendToMarket.h
Clause4			
Clause5	EGen Driver Configuration	SupportingFiles/Clause5	RX300S8_1250KCus_16x20_spiderc_RTE01-slow.xml
	EGenLoader Parameter	SupportingFiles/Clause5	BuildSteps.log EGenLoaderFrom1To28000.log EGenLoaderFrom28001To56000.log …. EGenLoaderFrom1222001To1250000.log
	EGenLogger Output	SupportingFiles/Clause5	TxnReportE-MI.xls
Clause6	EGenValidate	SupportingFiles/Clause6	EGenValidate.txt
Clause7	ACID	SupportingFiles/Clause7	MSTPCE ACID Procedures.doc
	ACID Procedures	SupportingFiles/Clause7/AcidProcs	AcidProc.cmd AcidProc.out Remove_AcidProcs.cmd
	ACID Scripts	SupportingFiles/Clause7/AcidProcs/Scripts	AcidProc.vbs CustomerPosition_Iso3.sql CustomerPosition_Iso4.sql Drop_SPROC.sql Remove_AcidProcs.vbs TradeOrder_C.sql TradeOrder_Iso1_1.sql TradeOrder_Iso1_2.sql TradeOrder_Iso2.sql TradeOrder_Iso3.sql TradeOrder_Iso4.sql TradeOrder_RB.sql TradeResult_Iso1_1.sql TradeResult_Iso1_2.sql TradeResult_Iso2_1.sql TradeResult_Iso2_2.sql TradeResult_Iso3.sql TradeResult_Iso4.sql
	Atomicity	SupportingFiles/Clause7/Atomicity	Atomicity.cmd Atomicity_C.out Atomicity_RB.out
		SupportingFiles/Clause7/Atomicity/Scripts	atom.vbs Atomicity_C.sql Atomicity_RB.sql
	Consistency	SupportingFiles/Clause7/Consistency	Consistency.cmd Consistency.out
		SupportingFiles/Clause7/Consistency/Scripts	Consistency.sql Consistency.vbs
	Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery	BR_BenchCraft_Config.xml BR_Consistency.out BR_Count_Settlement1.ver BR_Count_Settlement2.ver BR_ERRORLOG1.txt BR_ERRORLOG2a.txt

			BR_ERRORLOG2b.txt BR_SystemEvents_TierB.txt BusinessRecov_Part1_step60.xlt BusinessRecov_Part1_TxnReportE_20.xls BusinessRecov_Part1_TxnReportE_all.xls BusinessRecov_Part2_step60.xlt BusinessRecov_Part2_TxnReportE_20.xls BusinessRecov_Part2_TxnReportE_all.xls BusinessRecov_TimeGraph.xls
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/Data Accessibility	DA_BenchCraft_Config.xml DA_Count_Settlement1.ver DA_Count_Settlement2.ver DA_ERRORLOG.txt DataAccess_TimeGraph.xls DataAccess_TxnReportE_5min1.xls DataAccess_TxnReportE_5min2.xls DataAccess_TxnReportE_20min.xls DataAccess_TxnReportE_all.xls SystemEvents_Application.txt
	Isolation	SupportingFiles/Clause7/Isolation	Isolation1_S1.rpt Isolation1_S2.rpt Isolation1_S3.rpt Isolation1_S4.rpt Isolation2_S1.rpt Isolation2_S2.rpt Isolation2_S3.rpt Isolation2_S4.rpt Isolation3_S1.rpt Isolation3_S2.rpt Isolation3_S3.rpt Isolation4_S1.rpt Isolation4_S2.rpt Isolation4_S3.rpt
		SupportingFiles/Clause7/Isolation/Scripts	Isolation1_S1.sql Isolation1_S2.sql Isolation1_S3.sql Isolation1_S4.sql Isolation2_S1.sql Isolation2_S2.sql Isolation2_S3.sql Isolation2_S4.sql Isolation3_S1.sql Isolation3_S2.sql Isolation3_S3.sql Isolation4_S1.sql Isolation4_S2.sql Isolation4_S3.sql
Clause8	60-Day Space Calculations	SupportingFiles/Clause8	tpce_space.xls

Appendix: Third Party Price Quotations

Microsoft Corporation
One Microsoft Way
Redmond, WA   98052-6399

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

Microsoft

August 21, 2013

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

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

All pricing shown is in US Dollars ($).

Part Number	Description	Unit Price	Quantity	Price
Database Management System				
7JQ-00256	**SQL Server 2012 Enterprise Edition** *2 Core License* *Open Program - Level C*	$13,472.50	12	$161,670.00
Database Server Operating System				
P73-05761	**Windows Server 2012 Standard** *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
Tier-A Operating System(s)				
P73-05761	**Windows Server 2012 Standard** *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
Support				
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident).*	$259.00	1	$259.00

SQL Server 2012 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_qhtplylGYLKTVUKf95957fiiiLtgsdwyhilg.