

**TPC Benchmark<sup>TM</sup> E**  
**Full Disclosure Report**  
**for**  
**Huawei Tecal RH5885 V2**  
**using**  
**Microsoft® SQL Server 2012**  
**Enterprise Edition**  
**And**  
**Microsoft® Windows® Server 2008**  
**R2**  
**Enterprise Edition with SP1**

TPC-E Version 1.12.0

First Edition

Submit for Review

Dec 14, 2012

**Huawei Technologies CO.,Ltd.**

## **First Edition Dec 2012**

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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.

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## Abstract


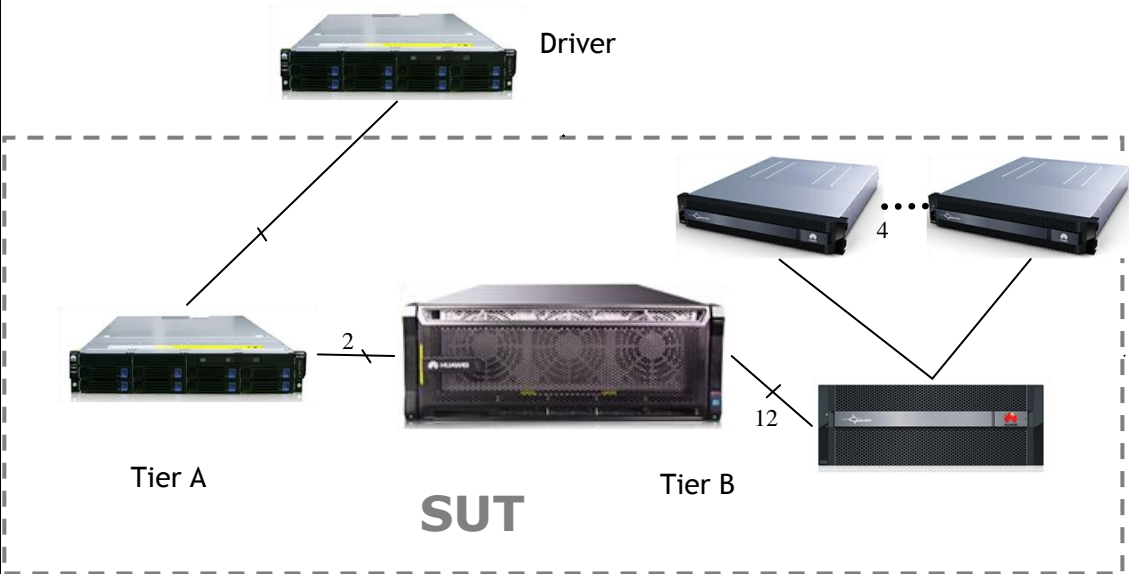
This report documents the TPC Benchmark™ E result achieved by Huawei using Microsoft SQL Server 2012 Enterprise Edition, following the requirement of TPC Benchmark™ E Standard Specification, Revision 1.12.0.

The TPC Benchmark™ E tests were run on a Huawei Tecal RH5885 V2 system using the Microsoft Windows Server 2008 R2 Enterprise Edition with SP1 operating system.

The benchmark results are summarized in the following table:

Hardware	Software	Total System Cost	tpsE	\$USD/tpsE	Availability Date
Huawei Tecal RH5885 V2	Microsoft Windows Server 2008 R2 with SP1 And Microsoft SQL Server 2012	\$1,076,417	3053.84	\$352.48	Oct 30, 2012

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

	<h1>Huawei Tecal RH5885 V2</h1>		<b>TPC-E 1.12.0 TPC Pricing 1.7.0</b>
			Report date Dec 14, 2012
TPC-E Throughput <b>3053.84 tpsE</b>	Price/Performance <b>\$352.48</b> USD per tpsE	Availability Date <b>Oct 30, 2012</b>	Total System Cost <b>\$1,076,417USD</b>
<b>Database Server Configuration</b>			
Operating System <b>Microsoft Windows Server 2008 R2 Enterprise Edition with SP1</b>	Database Manager <b>Microsoft SQL server 2012 Enterprise Edition</b>	Processors/Cores/Threads <b>4/40/80</b>	Memory <b>1024GB</b>
			
Huawei Tecal RH2285 - 2 x Intel Xeon Processor x5670 2.93GHz (2 proc/12cores/24threads) - 16GB Memory - Onboard Dual-Port Gigabit Ethernet - PCI-E Dual-Port Gigabit Ethernet	Huawei Tecal RH5885 V2 - 4 x Intel Xeon Processor E7-4870 2.40 GHz (4 proc/40cores/80threads) - 1 TB Memory(64 x 16 GB) - 2 x 300G 10K RPM (RAID 1) - 6 x 300G 10K RPM (RAID 10) - Onboard Quad-Port Gigabit Ethernet - 1 x LSI MegaRAID SAS 9260-8i - 8 x 8Gb Dual-port FC HBA	Huawei OceanStor Dorado5100 - 4 Enclosures 24 x 200GB SSD 96 total SSD Drivers Huawei OceanStor S5500T - 6 x 2TB 7.2K RPM SATA (60 days space)	
Initial Database Size <b>12,735 GB</b>	Redundancy Level: 1 <b>RAID-10 Log</b> <b>RAID-5 Data</b>	Storage <b>96 x 200 GB</b> <b>8 x 300 GB</b> <b>6 x 2000 GB</b>	



# Huawei Tecal RH5885 V2

**TPC-E 1.12.0  
TPC Pricing  
1.7.0**

**Report date  
Dec 14, 2012**

Description	Part Number	Price Source	Unit Price	Quantity	Extended Price	3-Yr. Maint. Price
<b>Server Hardware</b>						
Huawei Tecal RH5885 V2 Rack Server-4*GE-DVDROM-No RAID	02310MSM		1	5,119	1	5,119
EPW3000-12A-X-BC2MP3KM-3000W AC Power Module	02310KEU		1	690	2	1,380
RAID Card for RH5885V2-RAID0/1/5/10-1G Cache	02310MTX		1	659	1	659
X86 series-LGA1567-2400MHz-0.9V-64bit-13000mW-Westmere	41020286		1	8089	4	32,356
Xeon E7-4870-10Core						
Hard Disk-SAS 300G-10000rpm-2.5"	06210133		1	289	8	2,312
Memory board(support 8 DIMMs)	03030QGA		1	329	8	2,632
MEMORY,DDR3 RDIIMM-16G-240 PIN-1.5ns-1333000KHz-1.35V-ECC&Registered&Address Parity-2 Rank(1G*4bit)-Height 30mm	06200107		1	409	64	26,176
Qlogic-DualPort FC HBA Card,PCI-E, 8Gbps,Fiber Channel						
Multimode LC Optic Interface,English Manual	06030220		1	976	8	7,808
Basic-Maintenance-Tecal RH5885 V2 Rack Server 3 years -5*9	88134CNK		1	11,372	1	11,372
Maintenance Service						
Tecal Server-First Onsite installation service- International	88120NMN		1	6,065	1	6,065
Premium-Maintenance-Tecal RH5885 V2 Rack Server 3 years -7*24	88133MVX		1	2,274	1	2,274
Maintenance Service						
				<b>Subtotal</b>	<b>78,442</b>	<b>19,711</b>
<b>Server storage</b>						
OceanStor Dorado5100 High Performance Solid State Storage						
System Controller Enclosure(AC,1000000 IOPS,8GBps						
Bandwidth,8*8G FC Front-End Port,4*4*6G SAS Back-End Port,with	0235G752		1	19,378	1	19,378
HS HSSD Controller System Software,SPE61C0200)						
2*24Gbps SAS-wide I/O modules(Total 2 ports)	0302G247		1	1,034	8	8,272
4*8Gbps Fibre Channel I/O modules(Total 4 ports)	0302G248		1	1,219	4	4,876
High Performance Solid State Storage System Disk Enclosure-						
4.8TB(2U,AC,24*200GB SLC,with HS SAS in Band Management	0235G74V		1	107,417	4	429,669
Software,DAE12425U2)						
Patchcord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m	14130321		1	11	12	132
HS Integrated Storage Manager-Device Management License for	3107G04D		1	5,466	1	5,466
Dorado						
OceanStor Dorado5100 High Performance Solid State Storage						
System Controller Enclosure(AC,1000K IOPS,8GBps Bandwidth,8*8G						
FC Front-End Port,4*24G SAS Back-End Port,with HW Solid-state	88134ULJ		1	9,009	1	9,009
Storage System Software)-Warranty Upgrade To Hi-Care Onsite						
Premier 24x7x4H Engineer Onsite Service-3 Year(s)						
High Performance Solid State Storage System Disk Enclosure-						
4.8TB(2U,AC,24*200GB SLC,with HS SAS in Band Management	88134ULJ		1	49,930	4	199,720
Software,DAE12425U2)-Warranty Upgrade To Hi-Care Onsite						
Premier 24x7x4H Engineer Onsite Service-3 Year(s)						
SPE31C0212-31 Controller Enclosure(2U,3.5",Dual						
Controller,AC,8GB Cache,2*4*8G FC Front-End Port,2*2*24G SAS						
Back-End Port(Wide Port),UPS Cache Protected Module,HS Storage	0235G6MU		1	6,119	1	6,119
Array Control System Software)						
2000GB 7.2K RPM SAS-SATA Disk Unit(3.5")	0235G6HP		1	537	6	3,222
Patchcord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m	14130321		1	11	1	11
OceanStor HS UltraPath Software License	3107G01B		1	1,938	1	1,938
HS Integrated Storage Manager-Device Management License for	3107G03E		1	1,616	1	1,616
OceanStor Block S5500T						
SPE31C0212-31 Controller Enclosure(2U,3.5",Dual						
Controller,AC,8GB Cache,2*4*8G FC Front-End Port,2*2*24G SAS						
Back-End Port(Wide Port),UPS Cache Protected Module,HS Storage	88134ULJ		1	3,593	1	3,593
Array Control System Software)-Warranty Upgrade To Hi-Care						
Onsite Premier 24x7x4H Engineer Onsite Service-3 Year(s)						
2000GB 7.2K RPM SAS-SATA Disk Unit(3.5")-Warranty Upgrade To	88134ULJ		1	250	6	1,500
Hi-Care Onsite Premier 24x7x4H Engineer Onsite Service-3 Year(s)						
				<b>Subtotal</b>	<b>480,699</b>	<b>213,822</b>



# Huawei Tecal RH5885 V2

**TPC-E 1.12.0  
TPC Pricing  
1.7.0**

**Report date  
Dec 14, 2012**

Server Software			
SQL Server 2012 Enterprise Edition	7JQ-00256	2	13,473
Windows Server 2008 R2 Enterprise Edition	P72-04217	2	2,280
Microsoft Problem Resolution Services	N/A	2	259
			<b>Subtotal</b>
			271,730
<b>Client Hardware</b>			
Tecal RH2285(Chassis for 8HDD,2*GE)	02317715	1	859
750W golden AC power supply module	98080310	1	265
X86 series,LGA1366,2930MHz,0.9V,64bit,95000mW,Westmere	41020199	1	2679
Xeon X5670,6kernel,ECP Dedicated	06200111	1	159
Memory Module,DDR3,8GB,240pin,1333000KHz,1.35V,ECC,2Rank	06210158	1	299
HardDisk,1000GB,SATA III 6.0Gb/s,7200rpm or Above,3.5",64M,Hot-Swappable,Built-in,Extended	06020085	1	59
DVD-RW,CD 24X/DVD	03020PLF	1	189
8X,SATA,12.7*128*126.1mm,embedded,SATA,5V POWER	06310023	1	128
SR100 RAID Card(RAID0,1,1E)	98080308	1	46
NIC,Dual Port Gigabit Ethernet Server Adapter,RJ45 Copper,Dual Port,PCI-E 2.0 X4-8086-10C9-2,Driver CD	02310FKE	1	301
Rail set			
Tecal RH2285(Chassis for 8HDD,2*GE)-Warranty Upgrade To Hi-Care Onsite Standard 24x7x4H Engineer Onsite Service-1 Year(s)			903
			<b>Subtotal</b>
			8,085
<b>Client Software</b>			
Windows Server 2008 R2 Enterprise Edition	P72-04217	2	2,280
			<b>Subtotal</b>
			2,280
<b>Infrastructure</b>			
ViewSonic VA1938WA-LED Black 19" (18.5" Vis) 5ms Widescreen LCD Monitor(2 spares)	N82E16824116523	3	120
Microsoft Wireless Desktop 2000 M7J-00001 Black USB RF Wireless Ergonomic Keyboard & Mouse(2 spares)	N82E16823109235	3	38
Coboc 3 ft. Cat 6 550MHz UTP Network Cable (2 spares)	N82E16812117400	3	2
			<b>Subtotal</b>
			486
			<b>Total :</b>
			841,722
			234,695
			1,076,417
Pricing: 1-Huawei;2-Microsoft; 3-newegg.com;		3-Year Cost of Ownership (USD): \$1,076,417	
		TPC-E Throughput: 3,053.84	
		\$(USD)/tpsE: \$352.48	
Benchmark results and test methodology audited by Doug Johnson for InfoSizing, Inc. ( <a href="http://www.sizing.com">www.sizing.com</a> )			
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 specifications. If you find that stated prices are not available according to these terms, please inform the TPC at <a href="mailto:pricing@tpc.org">pricing@tpc.org</a> . Thank you.			



# Huawei Tecal RH5885 V2

**TPC-E 1.12.0**  
**TPC Pricing 1.7.0**

Report date  
Dec 14, 2012

Availability Date  
Oct 30, 2012

Numerical Quantities Summary				
<b>Reported Throughput: 3053.84 tpsE</b>		<b>Configured Customers: 1,550,000</b>		
Response Time (in seconds)	Minimum	Average	90% Percentile	Maximum
Broker Volume	0.00	0.03	0.05	0.35
Customer Position	0.00	0.02	0.03	0.36
Market Feed	0.00	0.02	0.04	0.19
Market Watch	0.00	0.02	0.03	0.34
Security Detail	0.00	0.01	0.02	0.34
Trade Lookup	0.00	0.10	0.15	0.49
Trade Order	0.00	0.05	0.07	0.39
Trade Result	0.00	0.06	0.08	5.96
Trade Status	0.00	0.01	0.02	0.35
Trade Update	0.01	0.12	0.16	0.45
Data Maintenance	0.01	0.03	N/A	0.18
Transaction Mix		Transaction Count		Mix%
Broker Volume		10,773,579		4.900%
Customer Position		28,582,613		13.000%
Market Feed		2,198,780		1.000%
Market Watch		39,576,407		18.000%
Security Detail		30,781,663		14.000%
Trade Lookup		17,589,196		8.000%
Trade Order		22,206,628		10.100%
Trade Result		21,987,699		10.000%
Trade Status		41,774,954		19.000%
Trade Update		4,397,330		2.000%
Data Maintenance		120		N/A
Test Duration and Timings				
Ramp-up Time(hh:mm:ss)				0:21:00
Measurement Interval(hh:mm:ss)				2:00:00
Business Recovery Time(hh:mm:ss)				3:31:06
Total Number of Transactions Completed in Measurement Interval				219,868,849

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## Clause 0: Preamble

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

### 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).*

Huawei Technologies Co., Ltd. is the sponsor of this TPC Benchmark™ E result.

### Configuration Diagrams

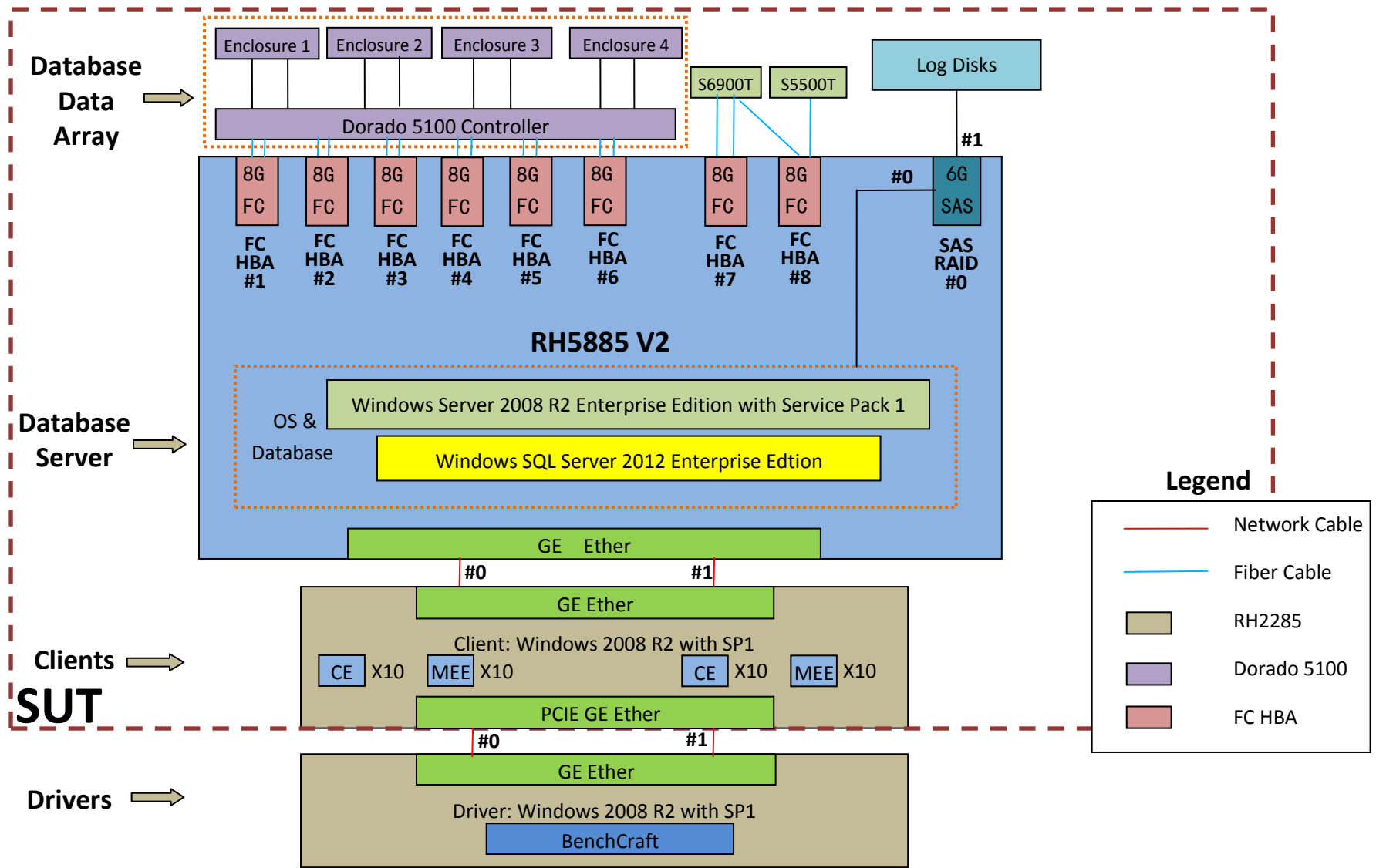
*Diagrams of both the Measured and Priced Configurations must be reported, accompanied by a description of the differences.*

*Any information and/or measurement results used to prove the validity of a Component substitution must be included in the FDR. Original and substituted Components must be clearly identified. Proof of comparable performance for substitution without a full benchmark run must be cited in the FDR.*

The priced configuration is above in the executive summary. Figure2-1 show the logic view of the measure configuration.

#### Figure 2-1. Measured Configuration

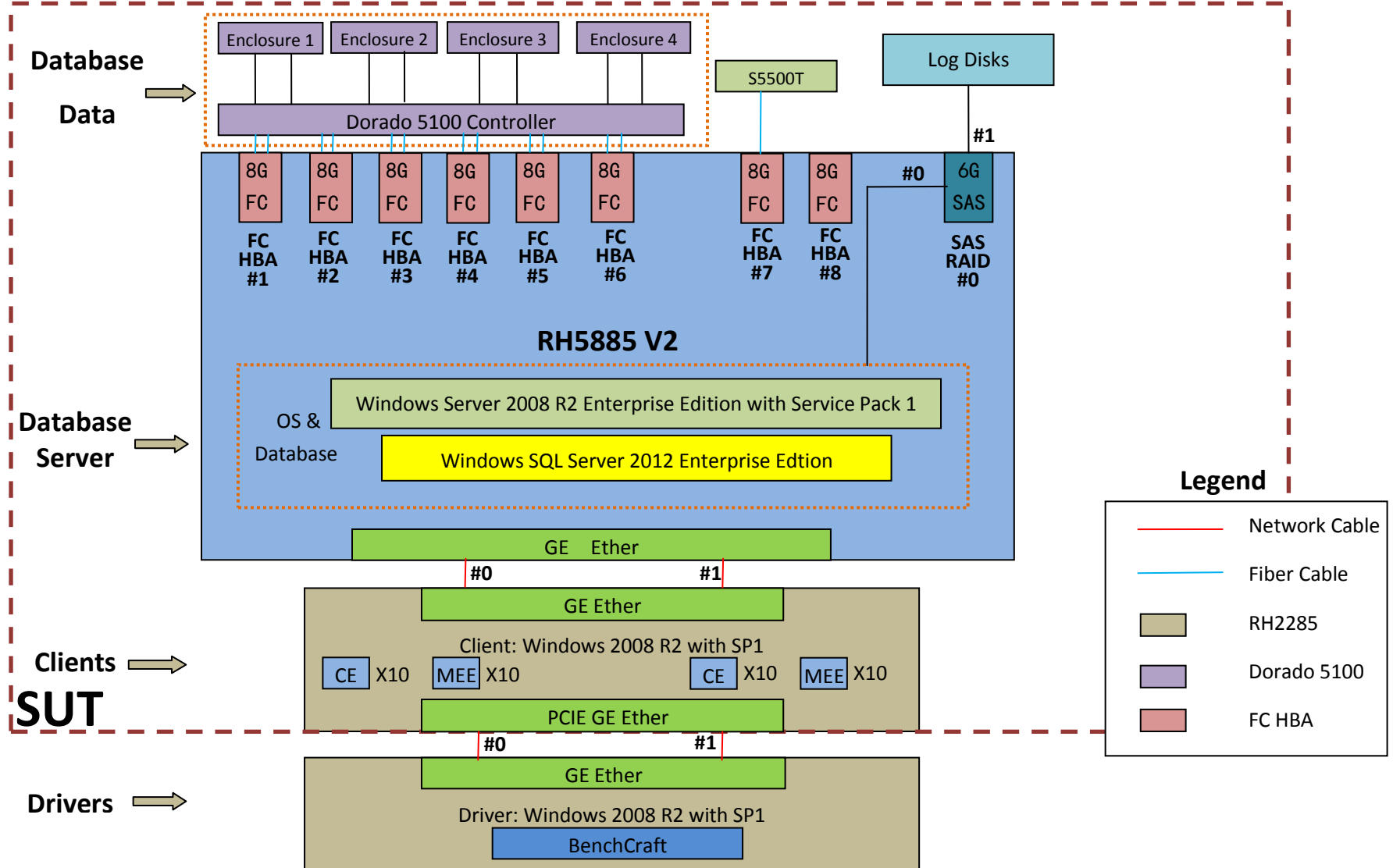
## RH5885 V2 TPC-E Measured Configuration



The only difference between the priced configuration and the measured configuration is we use Huawei OceanStor S6900T to store the flat files and database backup in the measured configuration. The priced configuration diagram is as below:

Figure 2-2. Priced Configuration

## RH5885 V2 TPC-E Priced Configuration



## Hardware and Software Configuration Steps

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

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

*Any and all configuration scripts or step by step GUI instructions are reported in the Supporting Files (see Clauses 9.4.1.1 and 9.4.1.2). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of computer systems and the TPC-E specification could recreate the hardware and software environments.*

Detailed instructions for installing and configuring the SUT hardware and software are included in the supporting files:

- Information specific to the Tier A client can be found in:  
SupportingFiles\Introduction\TierA\TierA\_RH2285\_Setup.pdf
- Information specific to the Tier B database server and storage can be found in:  
SupportingFiles\Introduction\TierB\TierB\_RH5885V2\_Setup.pdf

## **Clause 2- Database Design, Scaling, and Population**

### **Database Creation and Table Definitions**

*A description of the steps taken to create the database for the Reported Throughput must be reported in the Report. Any and all scripts or step by step GUI instructions are reported in the Supporting Files (see Clause 9.4.2). The description, scripts and GUI instructions must be sufficient such that a reader knowledgeable of database software environments and the TPC-E specification could recreate the database.*

The database was created and populated using the Microsoft TPC-E Benchmark kit. Instructions for doing so are included in the supporting files. See SupportingFiles\Clause2\MSTPCE Database Setup Reference.pdf.

Changes and customizations were made to some of the kit files. First, the filegroups the database was loaded onto were changed in number from three filegroups to two. Second, several scripts were modified to customize the load to the specific hardware configuration of this SUT.

The default kit files create the database on three filegroups: fixed\_fg, scaling\_fg, and growing\_fg. That was changed so that only two filegroups were used, fixed\_fg and growing\_fg. All of the items that would have been loaded onto scaling\_fg were loaded instead onto fixed\_fg.

The modified files are included as part of SupportingFiles\Clause2:

- Utility\Create\_TID\_Ranges\_Table.sql
- DDL\ Create\_Indexes\_Scaling\_Tables.sql
- DDL\ Create\_Tables\_Scaling.sql

The files that were customized for this specific SUT hardware are included in the folder SupportingFiles\Clause2\1550000.Cust\Database:

- Tempdb.sql creates a larger temporary database for SQL Server
- Shrinktempdb.sql shrinks it back down
- Backup\_Database.sql backs up the tpce database to the specified device names
- Restore\_Database.sql restores the tpce database from the specified device names
- Create\_Database.sql maps the database filegroups and log to physical storage
- Flatfile.txt tells the database loader where to store the database flatfiles during the load
- Remove\_Database.sql drops the current tpce database

### **Database Physical Organization**

*The physical organization of tables and User-Defined Objects, within the database, must be reported in the Report.*

The following tables and related indexes were on the growing\_fg filegroup:

- CASH\_TRANSACTION
- SETTLEMENT
- TRADE
- TRADE\_HISTORY
- TRADE\_REQUEST
- HOLDING
- HOLDING\_HISTORY
- HOLDING\_SUMMARY

The remaining tables and their related indexes were all on the fixed\_fg filegroup.

### **Horizontal/Vertical 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.*

Partitioning was not used for this benchmark.

## Replication

*Replication of tables, if used, must be reported in the Report.*

Replication was not used for this benchmark.

## Table Attributes

*Additional and/or duplicated columns in any table must be reported in the Report along with a statement on the impact on performance (see Clause 2.3.5).*

No additional attributes were used for this benchmark.

## Cardinality of Tables

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

The database was built with 1,550,000 customers. The cardinality is shown in Table 2-1.

**Table 2-1. Initial Cardinality of Tables**

Table Name	Rows
ACCOUNT_PERMISSION	11,004,982
ADDRESS	2,325,004
BROKER	15,500
CASH_TRANSACTION	24,641,310,527
CHARGE	15
COMMISSION_RATE	240
COMPANY	775,000
COMPANY_COMPETITOR	2,325,000
CUSTOMER	1,550,000
CUSTOMER_ACCOUNT	7,750,000
CUSTOMER_TAXRATE	3,100,000
DAILY_MARKET	1,385,583,750
EXCHANGE	4
FINANCIAL	15,500,000
HOLDING	1,371,511,840
HOLDING_HISTORY	35,895,015,283
HOLDING_SUMMARY	77,083,179
INDUSTRY	102
LAST_TRADE	1,061,750
NEWS_ITEM	1,550,000
NEWS_XREF	1,550,000
SECTOR	12
SECURITY	1,061,750
SETTLEMENT	26,784,000,000
STATUS_TYPE	5
TAXRATE	320
TRADE	26,784,000,000
TRADE_HISTORY	64,281,723,117



TRADE_REQUEST	0
TRADE_TYPE	5
WATCH_ITEM	155,055,177
WATCH_LIST	1,550,000
ZIP_CODE	14,741

## Distribution of Tables and Logs

*The distribution of tables, partitions and logs across all media must be explicitly depicted for the Measured and Priced Configurations.*

There are three types storage layout in Huawei Tecal RH5885 V2 TPC-E test environment.

### Part I: OS, MS SQL Server and Log

There was one internal LSI MegaRAID 9260-8i SAS/SATA RAID controller in the RH5885, which was connected to eight 300GB 2.5" 10K SAS drivers. Two of the eight drivers were configured as a RAID-1 array and formatted as NTFS to load the Windows Server 2008 R2 with SP1 and Microsoft SQL Server 2012. The other six drivers were configured as a RAID-10 array to store the database log.

### Part II: database data

There were eight PCI-E slots in the RH5885 Server. Six of eight slots were placed a QLogic QLE 2562 8Gb Dual-port FC HBA in each. The database data was stored on a Huawei OceanStor Dorado5100 disk array, which was connected to six FC HBAs via twelve FC cables. There were four disk enclosures in Dorado5100, and each enclosure held twenty four 2.5" 200GB SAS SSDs. In total, four enclosures and 96 SSDs were in used. All the 96 drives were configured to six RAID-5 arrays with 16 drives in each RAID group. Each data RAID array was broken into two LUNs and each LUN was broken to two partitions: one for fixed\_fg (RAW) and one for growing\_fg (RAW).

### PART III: 60-Days space, tempDB, Backup and Flatfiles

Additionally, there were still two PCI-E slots in RH5885.

In the measured configuration, both of these two PCI-E slots were placed a QLogic QLE 2562 8GB Dual-port HBA, which were connected to a Huawei OceanStor S6900T disk array via three FC cables. There were four enclosures in the S6900T, and each enclosure held twenty four 600GB 2.5" 10K SAS drives. In total, four enclosures and 96 HDDs were in used. All the 96 drives were configured to five RAID-5 arrays. One RAID-5 array held 16 HDDs and formatted as NTFS to store the tempDB log. The other four RAID-5 arrays held 20 HDDs in each array. These four arrays were formatted as NTFS to generate and load the TPC-E Benchmark database, and used during database backup and restore operations.

A Huawei OceanStor S5500T disk array was connected to the RH5885 Server via one FC cable. The S5500T held six 2TB 3.5" SATA drives, and was configured to one RAID-5 group to satisfy the 60-Day space requirement.

In the priced configuration, only one of these two PCI-E slots was placed a QLogic QLE 2562 8GB Dual-port HBA, which was connected to a Huawei OceanSpace S5500T disk array via one FC cable. The S5500T held six 2TB 3.5" SATA drives, and was configured to one RAID-5 group to satisfy the 60-Day space requirement.

Table 2-2 depicts the database configuration of the measured and priced systems to meet the 8-hour steady state requirement (Drives without mark means the measured and priced configuration are the same ).

**Table 2-2. Data Distribution for the Measured and Priced Configuration**

Disk	Controller	Drivers	Partition	Size	Use
------	------------	---------	-----------	------	-----

#		Enclosure RAID Level	(File System)		
0	Internal LSI MegaRAID 9260-8i	2 X 300GB SAS HDD Internal RAID-1	C:(NTFS)	279GB	OS
1	Internal LSI MegaRAID 9260-8i	6 X 300GB SAS HDD Internal RAID-10	E:(RAW) F:(NTFS)	640GB 195GB	LOG MDF
2	QLogic QLE 2562 #1	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx1(RAW) C:\data\gw1(RAW)	26.7GB 1268.8GB	Fixed_fg Growing_fg
3	QLogic QLE 2562 #1	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx2(RAW) C:\data\gw2(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
4	QLogic QLE 2562 #2	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx3(RAW) C:\data\gw3(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
5	QLogic QLE 2562 #2	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx4(RAW) C:\data\gw4(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
6	QLogic QLE 2562 #3	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx5(RAW) C:\data\gw5(RAW)	26.7GB 1268.8GB	Fixed_fg Growing_fg
7	QLogic QLE 2562 #3	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx6(RAW) C:\data\gw6(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
8	QLogic QLE 2562 #4	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx7(RAW) C:\data\gw7(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
9	QLogic QLE 2562 #4	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx8(RAW) C:\data\gw8(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
10	QLogic QLE 2562 #5	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx9(RAW) C:\data\gw9(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
11	QLogic QLE 2562 #5	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx10(RAW) C:\data\gw10(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
12	QLogic QLE 2562 #6	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx11(RAW) C:\data\gw11(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
13	QLogic QLE 2562 #6	16 X 200GB SAS SDD Dorado5100 RAID-5	C:\data\fx12(RAW) C:\data\gw12(RAW)	26.7GB 1366.3GB	Fixed_fg Growing_fg
14	QLogic QLE 2562 #7	16 X 600GB SAS HDD OceanStor S6900T (Measured)	G:(NTFS)	8025GB	tempDB
15	QLogic QLE 2562 #7	20 X 600GB SAS HDD OceanStor S6900T (Measured) RAID-5	C:\data\bk1(NTFS)	10602GB	Backup, flatfiles & tempDB
16	QLogic QLE 2562 #7	20 X 600GB SAS HDD OceanStor S6900T (Measured)	C:\data\bk2(NTFS)	10602GB	Backup, flatfiles & tempDB

		RAID-5			
17	QLogic QLE 2562 #8	20 X 600GB SAS HDD OceanStor S6900T (Measured) RAID-5	C:\data\bk3(NTFS)	10602GB	Backup, flatfiles & tempDB
18	QLogic QLE 2562 #8	20 X 600GB SAS HDD OceanStor S6900T (Measured) RAID-5	C:\data\bk4(NTFS)	10602GB	Backup, flatfiles & tempDB
19	QLogic QLE 2562 #8	6 X 2TB SATA HDD OceanStor S5500T RAID-5	Z:(NTFS)	9311.9GB	60-day Space

## Database Interface and Model Implemented

*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).*

Microsoft SQL Server 2012 Enterprise Edition is a relational database. The interface used was Microsoft SQL Server stored procedures accessed with Remote Procedure Calls embedded in C++ code using the Microsoft ODBC interface.

## Database Load Methodology

*The methodology used to load the database must be reported in the Report.*

The database was loaded using the flat files option on the EGenLoader command line. This will generate flat files first, then bulk insert the data into the tables. A further description is provided in SupportingFiles\Clause2\MSTPCE Database Setup Reference.pdf.

## **Clause 3 – Transaction Related Items**

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### **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.*

The stored procedure code for the transactions was functionally equivalent to the pseudo-code. The stored procedures can be seen in SupportingFiles\Clause3\StoredProcedures.

The code to interface the stored procedures can be found in:

- SupportingFiles\Clause3\BaseServer
- SupportingFiles\Clause3\TransactionsSP
- SupportingFiles\Clause3\TxnHarness

### **Database Footprint of Transactions**

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

The database footprint requirements were met.

## **Clause 4 – SUT, Driver, and Network**

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### **Network Configuration**

*The Network configurations of both the Measured and Priced Configurations must be described and reported. 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).*

The network configurations of the measured and priced configurations were the same. Refer to Figure 2-1 for a diagram of the network connections.

The Tier A client and Tier B database server were directly connected via two Gb Ethernet cables. These cables were connected to onboard Gb Ethernet ports in the client and onboard Gb Ethernet ports in the server. These two network connections handled all of the network traffic between Tier A and Tier B while a measurement was underway.

The Tier A client and the driver were directly connected by another two Gb Ethernet cables. These two cables were connected to the PCI-E Gb Ethernet ports in the client and onboard Ethernet ports in the driver. These two network connections handled all of the network traffic between Tier A and driver while a measurement was underway.

## Clause 5 – EGen

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### EGen Version

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

EGen v1.12.0 was used in the benchmark.

### EGen Code and Modifications

*A statement that all required TPC-provided EGen code was used in the benchmark must be reported. 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 (see Clause 5.3.7.1). If any of the changes to EGen do not have a formal waiver, that must also be reported. If the Test Sponsor extended EGenLoader, the use of the extended EGenLoader and the audit of the extension code by an Auditor must be reported (see Clause 5.7.4).*

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

EGen was not modified for use in this benchmark.

EGenLoader was not extended for this benchmark.

### EGen Files

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

See the supporting files directory SupportingFiles\Clause3\prj for the files related to EGenLoader and EGenValidate.

See the supporting files directory SupportingFiles\Clause3\SUT\_CE\_Server for the files related to the SUT\_CE\_Server.

See the supporting files directory SupportingFiles\Clause3\SUT\_MEE\_Server for the files related to the SUT\_MEE\_Server.

## Clause 6 – Performance Metrics and Response Time

### EGen Instances

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

There were 20 EGenDriverCEs with a total of 795 EGenDriverCE instances used in the benchmark.

There were 20 EGenDriverMEEs with a dynamic number of instances used in the benchmark.

### Measured Throughput

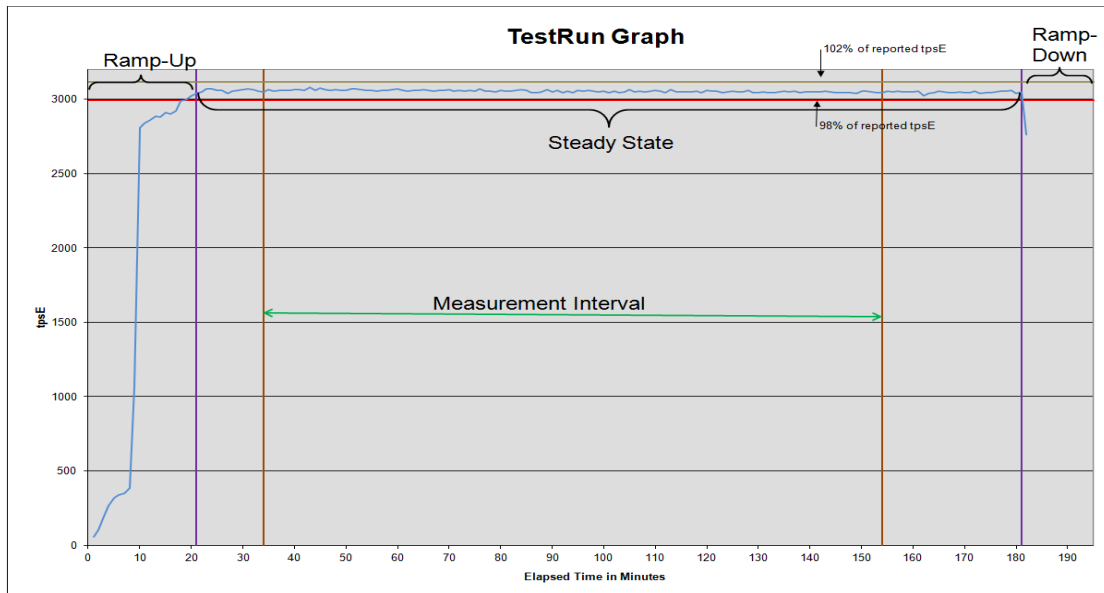
The Measured Throughput must be reported (see Clause 6.7.1.2).

The Measured Throughput was 3,053.84 tpsE.

### Throughput vs. Elapsed Time for Trade-Result Transaction

A Test Run Graph of throughput versus elapsed wall clock time must be reported for the Trade-Result Transaction (see Clause 6.7.2).

Figure 6-1. Test Run Graph



### Steady State Methodology

The method used to determine that the SUT had reached a Steady State prior to commencing the Measurement Interval must be reported.

During the run, observation of the tpsE as the benchmark ran was used to determine Steady State. After the run, Steady State was confirmed by:

1. Looking at the Test Run Graph and verifying that tpsE was steady prior to commencing the Measurement Interval.
2. Calculating the average tpsE over 60-minute windows during Steady State, with the start of each window 10 minutes apart. Then it was 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. Calculating the average tpsE over 10-minute windows during Steady State, with the start of each window 1 minute apart. Then it was confirmed that the minimum 10-minute average

tpsE was not less than 80% of the Reported Throughput, and 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 (e.g., checkpointing, writing Undo/Redo Log records).

Checkpoints had a duration of 430 seconds and were scheduled to run every 447 seconds.

Data-Maintenance was run every 60 seconds.

## Transaction Statistics

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

Table 6-1 contains the transaction statistics.

**Table 6-1. Transaction Statistics**

Input Parameter	Value	Actual Percentage	Require Range
<b>Customer-Position</b>			
By Tax ID	1	49.99%	48% to 52%
Get History	1	49.98%	48% to 52%
<b>Market-Watch</b>			
Securities chosen by	Watch List	60.01%	57% to 63%
	Account ID	34.99%	33% to 37%
	Industry	5.00%	4.5% to 5.5%
<b>Security-Detail</b>			
Access LOB	1	1.00%	0.9% to 1.1%
<b>Trade-Lookup</b>			
Frame to execute	1	30.00%	28.5% to 31.5%
	2	30.00%	28.5% to 31.5%
	3	29.98%	28.5% to 31.5%
	4	10.02%	9.5% to 10.5%
<b>Trade-Order</b>			
Transactions requested by a third party	1	10.00%	9.5% to 10.5%
By Company Name	1	39.99%	38% to 42%
Buy On Margin	1	8.00%	7.5% to 8.5%
Rollback	1	0.99%	0.94% to 1.04%
LIFO	1	35.02%	33% to 37%
Trade Quantity	100	25.00%	24% to 26%
	200	24.99%	24% to 26%
	400	25.00%	24% to 26%
	800	25.02%	24% to 26%
Trade Type	Market Buy	30.00%	29.7% to 30.3%
	Market Sell	30.01%	29.7% to 30.3%
	Limit Buy	20.00%	19.8% to 20.2%
	Limit Sell	9.99%	9.9% to 10.1%
	Stop Loss	10.00%	9.9% to 10.1%
<b>Trade-Update</b>			
Frame to execute	1	33.03%	31% to 35%
	2	32.97%	31% to 35%
	3	34.00%	32% to 36%



## 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. 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.

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.

### 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.

All ACID tests were conducted according to specification. 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 false. 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_back` flag set to true. 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. A TPC-E database when first populated by EGenLoader must meet these consistency conditions. The three consistency conditions must be tested after initial database population and after any Business Recovery tests.

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  $(T\_ST\_ID = \text{--- CMPT'})$ .

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  $(T\_ST\_ID = \text{--- CMPT'})$ .

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 to issue queries to the database after the database was loaded and after the Business Recovery Test. The results of the queries demonstrated that the database was consistent for all three tests.

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 directory SupportingFiles\Clause7\Consistency.

## Isolation Requirements

*The isolation property of a Transaction is the level to which it is isolated from the actions of other concurrently executing Transactions. 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.*

Isolation tests 1 through 4 were successfully done following the procedure documented in the file SupportingFiles\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. 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 a Single Point of Failure.*

### Durability Test for Data Accessibility

*The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.6.7.1) and describe the Data Accessibility test(s) used to demonstrate compliance.*

*A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.6.7.2).*

This benchmark result used Redundancy Level 1. The test for Redundancy Level 1 is the test for permanent irrecoverable failure of any single Durable Medium.

To prove Redundancy Level 1, the following steps were successfully performed:

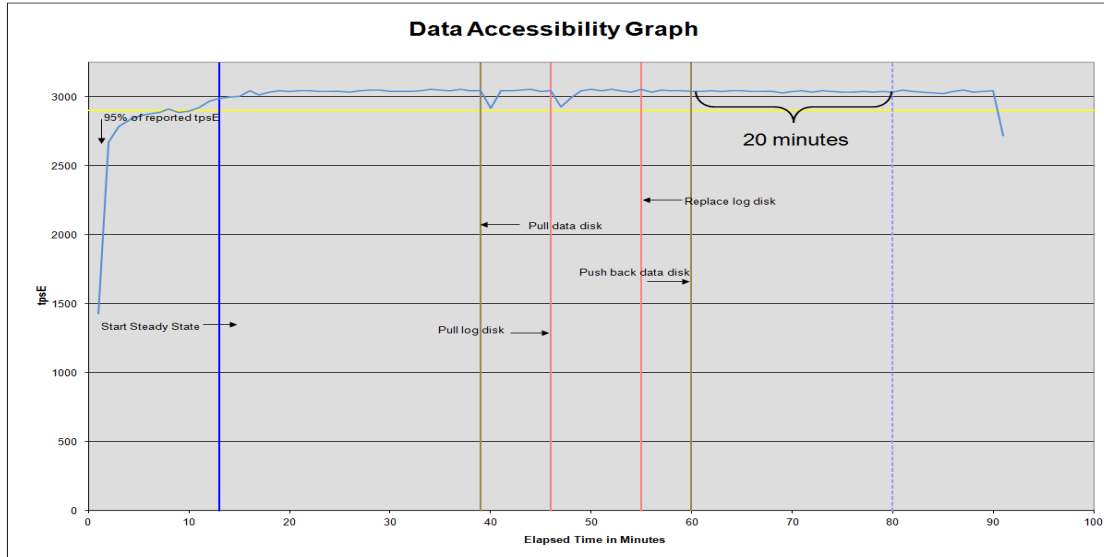
1. Determined the current number of completed trades in the database, count1.
2. Started a run, using the profile from the measured run, with checkpoints, and met the Durability Throughput Requirements for at least 5 minutes.
3. Induced the first failure, which in this case was failing a drive in a database data array by physically removing it from its enclosure. Since the database data arrays are RAID protected, transaction processing continued.
4. Waited until the Durability Throughput Requirements were met again for at least 5 minutes.
5. Induced the second failure, which in this case was failing a drive in the database log array by physically removing it from its enclosure. Since the database log array is RAID protected, transaction processing continued.
6. After a few minutes passed, a new drive was inserted into the log enclosure to replace the failed log drive. The log array rebuilding process was started.
7. After a few minutes passed, a new drive was inserted into the data enclosure to replace the failed data drive. The data array rebuilding process was started.
8. Continued running the benchmark for at least 20 minutes.
9. Terminated the run gracefully.
10. Retrieved the new number of completed trades in the database by running *select count(\*) as count2 from SETTLEMENT.*
11. Verified that (count2 – count1), which is the number of actual completed Trade-Result

Transactions done during the run, equaled the number of successful Trade-Result transactions reported by the Driver.

12. Allowed the recovery process to complete.

Figure 7-1 is a graph of the measured throughput versus elapsed time for the data accessibility run. 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.

**Durability Test for Business Recovery**

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

*The Business Recovery Time must be reported on the Executive Summary Statement and in the Report. If the failures described in Clauses 7.6.2.2, 7.6.2.3 and 7.6.2.4 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.*

*The Business Recovery Time Graph (see Clause 7.6.7.4) must be reported in the Report for all Business Recovery tests.*

The tests for “Loss of processing,” “Loss of Vulnerable Storage Component,” and “Loss of all external power to the SUT” were combined.

The following steps were successfully performed to test Business Recovery:

1. Determined the current number of completed trades in the database, count1.
2. Started a run, using the profile from the measured run, with checkpoints, and met the Durability Throughput Requirements for at least 20 minutes.
3. Pulled the power cords from the database server.
4. Stopped submitting Transactions.
5. Plugged in and restarted the database server.
6. Started SQL Server on the database server. It automatically began recovery of the tpcE database. The timestamp in the SQL Server ERRORLOG of the first message related to

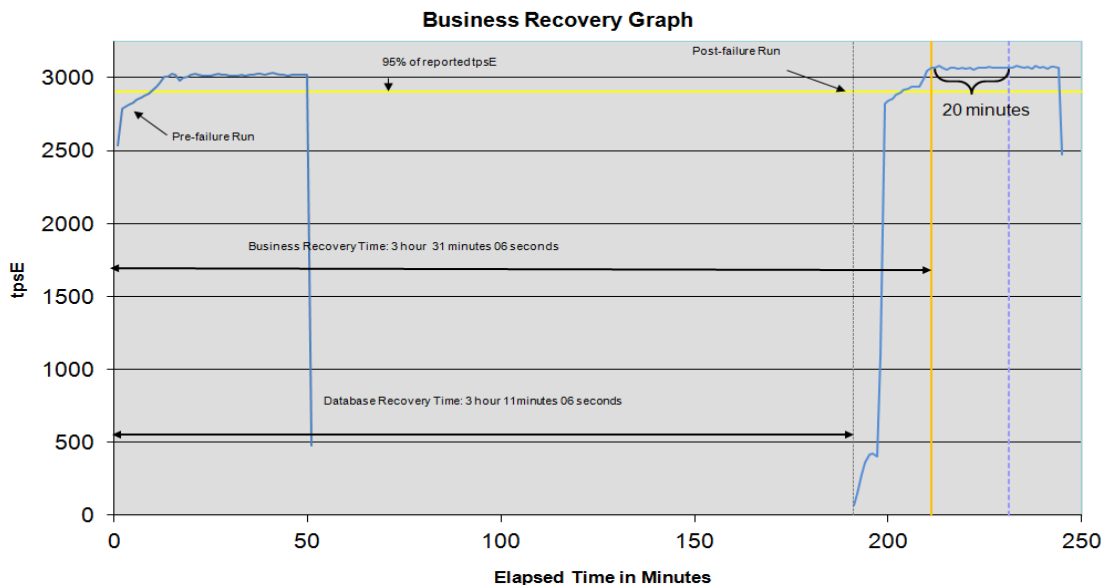
database tpcE is considered the start of Database Recovery.

7. Waited for SQL Server to finish recovering the database. The timestamp in the SQL Server ERRORLOG of the message indicating that the recovery of database tpcE is complete is considered the end of Database Recovery.
8. Since there was a time gap between the end of Database Recovery and the start of Application Recovery, and the Drivers and Transactions needed to be started again (not just continued), the Trade-Cleanup Transaction was executed during this time gap.
9. Started a run, using the profile from the measured run, with checkpoints. The time when the first transaction is submitted to the database is considered the start of Application Recovery.
10. Let the run proceed until a 20 minute window existed such that the first minute of the window and the entire window both scored at least 95% of the Reported Throughput. The time of the beginning of that 20-minute window is considered the end of Application Recovery.
11. Terminated the run gracefully.
12. Verified that no errors were reported during steps 8 through 12.
13. Retrieved the new number of completed trades in the database by running `select count(*) as count2 from SETTLEMENT`.
14. Verified that  $(\text{count2} - \text{count1})$ , which is the number of actual completed Trade-Result Transactions done during the two runs, was greater than or equal to the combined number of successful Trade-Result Transactions reported by the Driver for both runs. In the case of an inequality, verified that the difference was less than or equal to the maximum number of transactions that could be simultaneously in-flight from the Driver to the SUT.
15. Verified database consistency.

Figure 7-2 is a graph of the measured throughput versus elapsed time for Business Recovery.

The Database Recovery Time was 03:11:06. The Application Recovery Time was 00:20:00. The Business Recovery Time, which is the sum of the Database Recovery Time and the Application Recovery Time, was 03:31:06.

**Figure 7-2. Business Recovery Time Graph**



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

## Clause 8 – Pricing

### 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.

The 60-day space calculations shown in Table 8-1 are included in SupportingFiles\Clause8\tpece\_space.xls.

**Table 8-1. Disk Space Requirements**

TPC-E Disk Space Requirements											
Customers	1,550,000	Performance		3053.84 TpsE		Reported		3053.84 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	15,500	1,136	1,384	126	2,646	15,500	2,520	-	-	126	
CASH_TRANSACTION	24,654,946,141	2,555,795,360	5,392,880	128,059,412	2,689,247,652	24,684,127,097	2,566,813,320	5,625,080	15,596,811	15,596,811	
CHARGE	15	8	8	1	17	15	16	-	-	1	
COMMISSION_RATE	240	16	16	2	34	240	32	-	-	2	
SETTLEMENT	26,798,822,717	1,278,651,296	2,699,448	64,067,537	1,345,418,281	26,830,542,607	1,284,483,160	3,132,416	8,685,335	8,685,335	
TRADE	26,799,234,688	3,198,859,376	1,791,052,712	249,495,604	5,239,407,692	26,831,137,111	4,995,064,360	5,152,272	14,285,844	14,285,844	
TRADE_HISTORY	64,318,284,483	1,935,957,416	5,055,488	97,050,645	2,038,063,549	64,394,483,981	1,946,629,792	5,616,888	15,574,097	15,574,097	
TRADE_REQUEST	-	-	-	-	-	-	182,533	445,656	445,656	1,235,683	1,235,683
TRADE_TYPE	5	8	1,032	52	1,092	5	1,040	-	-	52	
ACCOUNT_PERMISSION	11,004,982	606,104	4,472	30,529	641,105	11,004,982	610,632	56	156	30,529	
CUSTOMER	1,550,000	254,136	76,816	16,548	347,500	1,550,000	330,968	16	45	16,548	
CUSTOMER_ACCOUNT	7,750,000	702,392	173,616	43,800	919,808	7,750,000	876,008	-	-	43,800	
CUSTOMER_TAXRATE	3,100,000	64,792	1,384	3,309	69,485	3,100,000	66,296	120	333	3,309	
HOLDING	1,371,884,683	92,465,008	62,580,384	7,752,270	162,797,662	1,372,692,526	156,954,864	1,909,472	5,294,445	5,294,445	
HOLDING_HISTORY	35,915,005,476	1,306,453,920	873,296,152	108,987,504	2,288,737,576	35,957,777,262	2,187,016,800	7,266,728	20,148,653	20,148,653	
HOLDING_SUMMARY	77,082,553	3,371,720	13,608	169,266	3,554,594	77,083,175	3,385,328	-	-	-	
WATCH_ITEM	155,055,177	4,340,648	17,032	217,884	4,575,564	155,055,177	4,357,944	264	732	217,884	
WATCH_LIST	1,550,000	38,704	36,808	3,776	79,288	1,550,000	75,512	-	-	3,776	
COMPANY	775,000	165,184	51,848	10,852	227,884	775,000	217,040	8	23	10,852	
COMPANY_COMPETITOR	2,325,000	62,512	58,072	6,029	126,613	2,325,000	120,584	-	-	6,029	
DAILY_MARKET	1,385,583,750	64,866,568	189,640	3,252,810	68,309,018	1,385,583,750	65,057,408	1,200	3,328	3,252,810	
EXCHANGE	4	8	8	1	17	4	16	-	-	1	
FINANCIAL	15,500,000	1,746,888	6,096	87,649	1,840,633	15,500,000	1,753,248	264	732	87,649	
INDUSTRY	102	8	24	2	34	102	32	-	-	2	
LAST_TRADE	1,061,750	66,232	1,392	3,381	71,005	1,061,750	67,624	-	-	3,381	
NEWS_ITEM	1,550,000	168,048,536	3,048	8,402,579	176,454,163	1,550,000	168,051,616	32	89	8,402,579	
NEWS_XREF	1,550,000	38,672	1,384	2,003	42,059	1,550,000	40,056	-	-	2,003	
SECTOR	12	8	24	2	34	12	32	-	-	2	
SECURITY	1,061,750	146,856	42,360	9,461	198,677	1,061,750	189,232	16	45	9,461	
STATUS_TYPE	5	8	8	1	17	5	16	-	-	1	
ADDRESS	2,325,004	134,184	1,392	6,779	142,355	2,325,004	135,616	40	111	6,779	
TAXRATE	320	40	16	3	59	320	56	-	-	3	
ZIP_CODE	14,741	488	96	29	613	14,741	584	-	-	29	
<b>TOTALS (KB)</b>		<b>10,612,838,232</b>	<b>2,740,758,648</b>	<b>667,679,844</b>	<b>14,021,276,724</b>		<b>13,382,747,408</b>	<b>29,150,528</b>	<b>80,826,462</b>	<b>92,918,474</b>	
Initial Database Size (MB)		13,040,622	12,735 GB								
Database Filegroups	LUN Count	Partition Size (MB)	MB Allocated	MB Loaded	MB Required						
growing_fg	10	1,399,100	16,589,100	12,804,341	12,883,267					OK	
fixed_fg	12	27,306	327,672	236,281	248,095					OK	
Settlements	31,719,890										
Data Space Required (MB)	Data Space Configured (MB)	Log Space Required (MB)	Log Space Configured (MB)								
Initial Growing Space	12,804,341	Initial Log Size	29,727								
Final Growing Space	12,832,806	Data LUNS	10	2	1		Before Run Log Size	135,592	Log LUNS	1	
Delta	28,465	Disks per LUN	8	8	6		After Run Log Size	342,791	Log Disks	6	
Data Space per Trade	0.000897397	Disk Capacity	189,440	176,128	1,906,688		Log Growth	207,199	Disk Capacity	285,568	
1 Day Data Growth	78,927	RAID Overhead	94%	94%	83%		Log Growth/Trade	0.006532159	RAID Overhead	50%	
60 Day Space	17,776,219	Total Space					1 Day Log Space	604,234	Log Space	856,704	
											OK

### Availability Date

The committed Availability Date of Components used in the price calculations must be reported with a precision of one day. All hardware, software and support used in the calculations must be Orderable by Any Customer on the Availability Date. For each of the Components 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 Component 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

The total solution as priced will be generally available Oct 30, 2012.

## **Supporting Files Index**

*An index for all files required by Clause 9.4 Supporting Files must be provided.*

An index of the files contained in the supporting files is here:  
SupportingFiles\SupportingFilesIndex.pdf

## **Auditor's Attestation Letter**

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

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

Xuhua Ma  
 Huawei Technologies Co., Ltd  
 A1 Block, Binjiang Intelligence Port  
 NO.301, Binxing Road  
 Hangzhou city, Zhejiang province 310052  
 P.R.China

December 8, 2012

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

Platform: Huawei Tecal RH5885 V2  
 Operating System: Microsoft Windows Server 2008 R2 with SP1  
 Database Manager: Microsoft SQL Server 2012 Enterprise Edition

The results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
<b>Tier B, Server: Huawei Tecal RH5885 V2</b>				
4 x Intel Xeon E7-4870 (2.40GHz)	1024 GB (4 x 30 MB L3)	96 x 200GB SSD SAS 8 x 300 GB 10K SAS 6 x 2TB 7.2K SATA	0.08 Seconds	3,053.84
<b>Tier A, One Client: Huawei Tecal RH2285</b>				
2 x Intel Xeon x5670 (2.93 GHz)	16 GB (2 x 12 MB L3)	2 x 1000 GB 7.2K SATA	n/a	n/a

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 transactions were correctly implemented.

- The database was properly scaled and populated for 1,550,000 customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.
- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.
- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 03:31:06 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



## Appendix A – Price Quotes

Microsoft Corporation  
One Microsoft Way  
Redmond, WA 98052-6399

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

Microsoft

October 15, 2012

Huawei Technologies Co., Ltd Maxuhua  
A1 Block, Binjiang Intelligence Port,  
No.301m Binxing Road,  
Hangzhou, Zhejiang Province, China  
310052

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

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

Part Number	Description	Unit Price	Quantity	Price
<b>Database Management System</b>				
7JQ-00256	<b>SQL Server 2012 Enterprise Edition</b> <i>2 Core License Open Program - Level C</i>	\$13,472.50	20	\$269,450.00
<b>Database Server Operating System</b>				
P72-04217	<b>Windows Server 2008 R2 Enterprise Edition</b> <i>Server License with 25 CALs Open Program - Level C Unit Price reflects a 43% discount from the retail unit price of \$3,999.</i>	\$2,280.00	1	\$2,280.00
<b>Tier-A Operating System(s)</b>				
P72-04217	<b>Windows Server 2008 R2 Enterprise Edition</b> <i>Server License with 25 CALs Open Program - Level C Unit Price reflects a 43% discount from the retail unit price of \$3,999.</i>	\$2,280.00	1	\$2,280.00
<b>Support</b>				
N/A	<b>Microsoft Problem Resolution Services</b> <i>Professional Support (1 Incident).</i>	\$259.00	1	\$259.00

SQL Server 2012 Enterprise Edition and Windows Server 2008 R2 Enterprise 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\_qhtplyIGYLKTVUKf85757fihiMjhiJhpkQkl.

Shop All StoresKeywords, Model # or Item #
Marketplace

Home > My Shopping Cart

MY SHOPPING CART
My Wish Lists | Print Cart | Email Cart

Qty.	Product Description	Savings	Total Price
3	ViewSonic VA1938WA-LED Black 19" (18.5" Vis) 5ms Widescreen LCD Monitor <small>Item #: N82E16824116523 Return Policy: Monitor Standard Return Policy</small>	-\$30.00 Instant	<del>(\$269.97)</del> \$269.97 <small>(\$89.99 each)</small>
Protect Your Investment (expand for options)			
3	Microsoft Wireless Desktop 2000 M7J-00001 Black USB RF Wireless Ergonomic Keyboard & Mouse <small>Item #: N82E16823109235 Return Policy: Standard Return Policy</small>	-\$14.00 Instant	<del>(\$71.97)</del> \$71.97 <small>(\$23.99 each)</small>
Protect Your Investment (expand for options)			
6	Coboc 3 ft. Cat 6 550MHz UTP Network Cable (Black) <small>Item #: N82E16812117400 Return Policy: Computer Cables and Accessories Extended Return Policy</small>	-\$0.05 Sale	<del>(\$5.88)</del> \$5.88 <small>(\$0.98 each)</small>
<b>Subtotal:</b>			<b>\$347.82</b>

**Calculate Shipping**

Zip Code   Method

**Shipping: \$0.00**

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**Redeem Newegg Gift Cards / Google Offer Code**

Card Number:  Security Code:

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**Apply Promo Codes**

You must [login](#) first to enter Promo Codes.

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No Payments + No Interest if paid in full in 6 Months on order over \$250.  
Subject to credit approval. See Terms

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**Grand Total:\*** \$347.82

\* Above total does not include shipping or taxes. Please input zip code to calculate your grand total.

**Having problems with your cart?** Check FAQ for help or try [emptying your cart to start over](#).

▶ [view important shipping information](#).

-OR-