Hewlett-Packard Company

TPC Benchmark™ H
Full Disclosure Report
for
HP ProLiant DL980 G7
using
Microsoft SQL Server 2008 R2 Enterprise Edition
and
Windows Server 2008 R2 Enterprise Edition

First Edition
June 2010

Hewlett-Packard Company (HP), the Sponsor of this benchmark test, 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. The Sponsor assumes 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, the Sponsor provides no warranty of the pricing information in this document.

Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, the TPC Benchmark H 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 was obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. No warranty of system performance or price/performance is expressed or implied in this report.

Printed in the United States, June, 2010

Abstract

Overview

This report documents the methodology and results of the TPC Benchmark™ H test conducted on the HP ProLiant DL980 G7 using Microsoft SQL Server 2008 R2 Enterprise Edition for x64 in conformance with the requirements of the TPC Benchmark™ H Standard Specification, Revision 2.11.0. The operating system used for the benchmark was Microsoft Windows Server 2008 R2 Enterprise Edition for x64.

The TPC Benchmark™ H was developed by the Transaction Processing Performance Council (TPC). The TPC was founded to define transaction processing benchmarks and to disseminate objective, verifiable performance data to the industry.

TPC Benchmark H Full Disclosure Report and other information can be downloaded from the Transaction Processing Performance Council web site at www.tpc.org.

Standard and Executive Summary Statements

Pages iv - ix contain the Executive Summary and Numerical Quantities Summary of the benchmark results for the HP ProLiant DL980 G7.

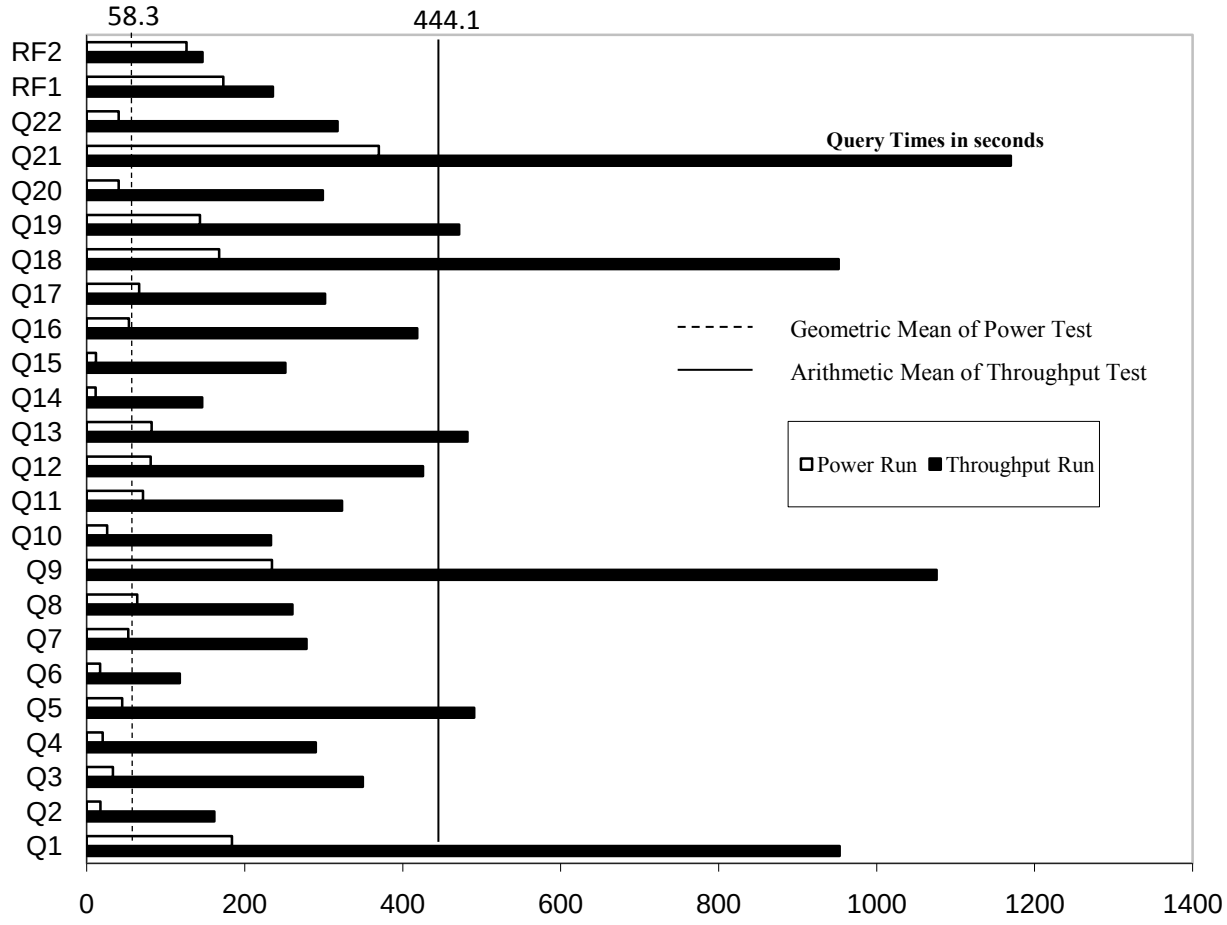
Auditor

The benchmark configuration, environment and methodology used to produce and validate the test results, and the pricing model used to calculate the cost per QppH and QthH were audited by Francois Raab of InfoSizing to verify compliance with the relevant TPC specifications.

The auditor's letter of attestation is attached in Section 9.1 "Auditors' Report."

	HP ProLiant DL980 G7	TPC-H Rev. 2.11.0 TPC Pricing Rev. 1.5.0 Report Date: June 21, 2010
Total System Cost	Composite Query per Hour Rating	Price/Performance
$435,169 USD	**162,601.7** QphH @ 3000G	**$2.68 USD** $ / QphH @3000G

Database Size	Database Manager	Operating System	Other Software	Availability Date
3000GB	**SQL Server 2008 R2 Enterprise Edition**	**Windows Server 2008 R2 Enterprise Edition**	**None**	**October 13, 2010**



Database Load Time = 8h35m17s	Storage Redundancy Level	
Load included backup: Y	Base Tables and Auxiliary Data Structures	0
Total Data Storage / Database Size = 15.18	DBMS Temporary Space	0
Memory/Database Size = 17.1%	OS and DBMS Software	1

System Components	System Total	Per Node
Nodes:	1	n.a.
Intel(R) Xeon(R) CPU X7560 @ 2.27GHz:	8	8
Cores/Threads:	64/128	64/128
Memory:	512GB	512GB
OS Disk Drives(internal):	4	4
Network Interfaces (on-board GigE):	2	2
Storage Controllers LSI SAS 9200 / P411 / HP 82E 8Gb Dual FC:	10 / 3 / 1	10 / 3 / 1
MSA2324fc	1	n.a.
Storage Shelves D2700:	26	n.a.
Storage Subsystem Disk Drives:	660	n.a.
Total Storage:	45,528.59 GB	n.a.

HP ProLiant DL980 G7

TPC-H Rev. 2.11.0
TPC Pricing Rev. 1.5.0

Report Date: June 21, 2010

Description	Price Key	Part Number	Unit Price	Qty.	Extended Price	3 Yr Maint Price
Server Hardware						
HP DL980 CTO Chassis	1	AM426A#0D1	$13,199	1	$13,199	
HP DL980 8p FIO Kit	1	597871-L21#FIO	$30,359	1	$30,359	
HP DL980 8p Kit	1	597871-B21#0D1	$30,359	1	$30,359	
CPU Installation Assembly	1	AM442A#0D1	$3,999	1	$3,999	
HP 4GB 1Rx4 PC3-10600R-9 Kit	1	593339-B21#0D1	$230	128	$29,440	
Memory Board	1	588141-B21#0D1	$130	8	$1,040	
SATA DVDRW Optical Kit	1	481043-B21#0D1	$130	1	$130	
HP PCI Express Kit	1	588137-B21#0D1	$349	1	$349	
HP DL980 LP PCIe I/O Expansion Module	1	AM434A#0D1	$399	1	$399	
HP P410i 512MB Flash Backed Write Cache	1	534916-B21#0D1	$429	1	$429	
HP 72GB 6G SAS 15K 2.5in DP ENT HDD	1	512545-B21#0D1	$349	2	$698	
HP 146GB 6G SAS 15K 2.5in DP ENT HDD	1	512547-B21#0D1	$499	2	$998	
HP 3year 4h 24x7 ProLiant DL980 HW Support	1	UV298E	$3,205	1		$3,205
HP 17" Flat Panel Monitor	1	GV537A8	$130	1	$130	
HP PS/2 Keyboard And Mouse Bundle	1	RC464AA	$39	1	$39	
			Subtotal		**$111,568**	**$3,205**
Storage						
HP 5642 Unassembled Rack	1	358254-B21	$865	2	$1,730	
HP 24A High Voltage US/JP Modular PDU	1	252663-D72	$299	2	$598	
HP Smart Array Controller P411	1	462832-B21	$649	3	$1,947	
HP Smart Array Controller P411 (10% Spares)	1	462832-B21	$649	2	$1,298	
LSI 9200-8e SAS HBA	3	LSI00188	$328	10	$3,280	
LSI 9200-8e SAS HBA (10% Spares)	3	LSI00188	$328	2	$656	
HP ext Mini SAS 4m Cable	1	432238-B21	$142	26	$3,692	
HP StorageWorks D2700 Disk Enclosure	1	AJ941A	$3,399	26	$88,374	
HP StorageWorks D2700 Disk Enclosure (10% Spares)	1	AJ941A	$3,399	3	$10,197	
HP 72GB 15k 2.5" Dual Port 6G SAS Drive	1	512545-B21	$349	644	$224,756	
HP 72GB 15k 2.5" Dual Port 6G SAS Drive (10% Spares)	1	512545-B21	$349	65	$22,685	
HP 82E 8Gb Dual-port PCI-e FC HBA	1	AJ763A	$2,250	1	$2,250	
HP 82E 8Gb Dual-port PCI-e FC HBA (10% Spares)	1	AJ763A	$2,250	2	$4,500	
HP 2m Multi-mode OM2 LC/LC FC Cable	1	221692-B21	$75	2	$150	
HP MSA2324fc Dual Controller Array	1	AJ797A	$8,900	1	$8,900	
HP 72GB 15k 2.5" Dual Port 6G SAS Drive 3yr Warranty HD	1	512545-B21	$349	16	$5,584	
HP 3y 4h 24x7 MSA2000 Array HW Support	1	UJ675E	$1,513	1		$1,513
			Subtotal		**$380,597**	**$1,513**
Server Software						
Windows Server 2008 R2 Enterprise Edition	2	P72-04217	$2,310	1	$2,310	
SQL Server 2008 R2 Enterprise Edition Server License w/ 25 CALs	2	810-08553	$8,318	1	$8,318	$259
SQL Server 2008 R2 Client Access License	2	359-05354	$114	55	$6,270	
			Subtotal		**$16,898**	**$259**
		Total Extended Price			**$509,063**	**$4,977**

	Total Discounts	**$78,117**	**$755**
Price Key: 1 - HP , 2 - Microsoft, 3 - MicroLand Audited by Francois Raab of InfoSizing, Inc. (www.sizing.com)	**Grand Total**	**$430,964**	**$4,222**
All discounts are based on US list prices and for similar quantities and configurations. A 16% discount was based on the overall specific components pricing from vendor 1 in this single quotation. Discounts for similarly sized configurations will be similar to those quoted here, but may vary based on the components in the configuration.	**3 year cost of ownership USD:**		**$435,169**
	QphH @ 3000GB:		**162,601.7**
	$ USD/QphH @ 3000GB		**$2.68**

Sales contact: HP Sales Development, 19111 Pruneridge Ave., Cupertino, CA 95014 (408) 447 2320 or H-P direct: 800-203-6748

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

Numerical Quantities

Measurement Results

Database Scale Factor	3000
Total Data Storage / Database Size	15.18
Start of Database Load	2010-06-13 10:29:42
End of Database Load	2010-06-13 19:04:59
Database Load Time	8h35m17s
Query Streams for Throughput Test	8
TPC-H Power	185,297.7
TPC-H Throughput	142,685.6
TPC-H Composite Query-per-Hour (QphH@3000GB)	162,601.7
Total System Price over 3 Years	$435,169 USD
TPC-H Price/Performance Metric ($ USD / QphH@3000GB)	$ 2.68 USD / QphH@3000GB

Measurement Interval

Measurement Interval in Throughput Test	13,322 seconds

Duration of Stream Execution

Power Stream	Seed	RF1 Start Time RF1 End Time	Query Start Time Query End Time	RF2 Start Time RF2 End Time	Duration
	613190459	06/14/10 8:45:18	06/14/10 8:48:11	06/14/10 9:18:44	0:35:33
		06/14/10 8:48:11	06/14/10 9:18:44	06/14/10 9:20:50	

Throughput Stream	Seed	Query Start Time Query End Time	Duration	RF1 Start Time RF1 End Time	RF2 Start Time RF2 End Time
1	613190460	06/14/10 9:20:51	2:55:40	06/14/10 12:11:49	06/14/10 12:14:36
		06/14/10 12:03:01		06/14/10 12:14:36	06/14/10 12:16:32
2	613190461	06/14/10 9:20:51	3:01:36	06/14/10 12:16:32	06/14/10 12:20:10
		06/14/10 12:11:00		06/14/10 12:20:10	06/14/10 12:22:28
3	613190462	06/14/10 9:20:51	3:08:07	06/14/10 12:22:28	06/14/10 12:26:25
		06/14/10 11:46:46		06/14/10 12:26:25	06/14/10 12:28:58
4	613190463	06/14/10 9:20:51	3:14:45	06/14/10 12:28:58	06/14/10 12:33:02
		06/14/10 12:07:02		06/14/10 12:33:02	06/14/10 12:35:36
5	613190464	06/14/10 9:20:51	3:21:32	06/14/10 12:35:37	06/14/10 12:39:55
		06/14/10 11:59:20		06/14/10 12:39:55	06/14/10 12:42:24
6	613190465	06/14/10 9:20:51	3:28:20	06/14/10 12:42:24	06/14/10 12:46:38
		06/14/10 12:02:46		06/14/10 12:46:38	06/14/10 12:49:11
7	613190466	06/14/10 9:20:52	3:35:13	06/14/10 12:49:12	06/14/10 12:53:32
		06/14/10 12:07:46		06/14/10 12:53:32	06/14/10 12:56:04
8	613190467	06/14/10 9:20:52	3:42:01	06/14/10 12:56:05	06/14/10 13:00:15
		06/14/10 12:11:48		06/14/10 13:00:15	06/14/10 13:02:53

TPC-H Timing Intervals (in seconds):

Query	Stream 0	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5
Q1	183.8	708.6	1,019.8	728.3	993.6	1,004.8
Q2	17.5	41.6	67.2	106.3	52.3	230.5
Q3	33.3	198.2	264.0	218.4	127.8	254.5
Q4	20.1	938.9	118.2	200.8	120.8	195.7
Q5	45.1	335.9	351.0	823.2	511.3	458.5
Q6	17.1	230.3	67.8	81.2	57.5	117.3
Q7	52.6	264.3	512.3	239.7	200.0	271.2
Q8	63.9	149.8	276.5	529.1	320.1	211.9
Q9	234.5	1,262.8	928.7	847.1	848.2	831.2
Q10	25.9	103.1	331.5	287.3	161.7	262.9
Q11	71.4	751.7	207.8	507.9	181.9	203.6
Q12	81.0	380.1	574.4	305.3	550.5	354.1
Q13	82.0	440.6	255.7	432.0	458.7	823.9
Q14	11.3	51.0	590.9	70.1	186.4	113.4
Q15	11.5	138.8	117.8	96.2	361.9	130.4
Q16	53.5	611.1	273.7	376.6	419.9	229.8
Q17	66.4	196.6	588.9	303.2	181.5	183.3
Q18	167.7	838.0	1,082.0	1,019.0	862.4	1,199.4
Q19	143.5	323.3	521.7	468.8	534.6	589.0
Q20	40.6	281.2	425.6	124.4	150.7	443.0
Q21	370.0	1,202.2	1,443.1	757.9	1,763.7	1,151.1
Q22	40.3	281.6	190.6	231.8	925.0	249.1
UF1	173.0	166.6	217.5	236.7	243.3	258.4
UF2	126.3	115.7	137.7	152.7	154.4	148.4

TPC-H Timing Intervals (in seconds):

Query	Stream 6	Stream 7	Stream 8	Min Qi	Max Qi	Avg. Qi
Q1	933.0	730.1	1,507.6	708.6	1,507.6	953.2
Q2	307.9	164.6	323.5	41.6	323.5	161.7
Q3	1,074.0	454.1	206.7	127.8	1,074.0	349.7
Q4	337.6	163.3	244.3	118.2	938.9	290.0
Q5	447.9	226.6	770.7	226.6	823.2	490.6
Q6	62.7	61.5	264.4	57.5	264.4	117.8
Q7	191.9	243.6	301.4	191.9	512.3	278.1
Q8	149.1	300.6	147.3	147.3	529.1	260.6
Q9	1,373.1	1,198.9	1,318.4	831.2	1,373.1	1,076.1
Q10	121.1	136.3	463.6	103.1	463.6	233.4
Q11	205.0	432.6	96.5	96.5	751.7	323.4
Q12	328.8	301.8	610.5	301.8	610.5	425.7
Q13	569.9	359.5	517.3	255.7	823.9	482.2
Q14	61.1	48.5	47.6	47.6	590.9	146.1
Q15	75.7	916.3	175.6	75.7	916.3	251.6
Q16	422.0	312.6	700.1	229.8	700.1	418.2
Q17	296.2	361.7	302.5	181.5	588.9	301.7
Q18	1,009.5	1,089.0	517.2	517.2	1,199.4	952.1
Q19	345.6	467.0	523.2	323.3	589.0	471.7
Q20	233.4	628.3	103.2	103.2	628.3	298.7
Q21	978.5	1,153.7	907.9	757.9	1,763.7	1,169.8
Q22	190.5	264.1	207.3	190.5	925.0	317.5
UF1	253.7	259.9	250.1	166.6	259.9	235.8
UF2	153.0	152.2	157.7	115.7	157.7	146.5

0 General Items

0.1 Test Sponsor

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

This benchmark was sponsored by Hewlett-Packard Company. The benchmark was developed and engineered by Hewlett-Packard Company. Testing took place at Microsoft facilities in Redmond, Washington.

0.2 Parameter Settings

Settings must be provided for all customer-tunable parameters and options which have been changed from the defaults found in actual products, including by not limited to:

- *Database Tuning Options*
- *Optimizer/Query execution options*
- *Query processing tool/language configuration parameters*
- *Recovery/commit options*
- *Consistency/locking options*
- *Operating system and configuration parameters*
- *Configuration parameters and options for any other software component incorporated into the pricing structure*
- *Compiler optimization options*

This requirement can be satisfied by providing a full list of all parameters and options, as long as all those which have been modified from their default values have been clearly identified and these parameters and options are only set once.

The supporting files archive contains a list of all database parameters and operating system parameters.

0.3 Configuration Items

Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences. This includes, but is not limited to:

- *Number and type of processors*
- *Size of allocated memory, and any specific mapping/partitioning of memory unique to the test.*
- *Number and type of disk units (and controllers, if applicable).*
- *Number of channels or bus connections to disk units, including their protocol type.*
- *Number of LAN (e.g. Ethernet) Connections, including routers, workstations, terminals, etc., that were physically used in the test or are incorporated into the pricing structure.*
- *Type and the run-time execution location of software components (e.g., DBMS, query processing tools /languages, middle-ware components, software drivers, etc.).*

The System Under Test (SUT), an HP ProLiant DL980 G7, depicted in Figure 0.1, consisted of :

8	Intel(R) Xeon(R) CPU X7560 @ 2.27GHz
512	GB RAM
1	HP 82E 8Gb Dual FC Controller
1	MSA2324fc Enclosure
3	P411 Smart Array Controllers
10	LSI SAS 9200 Controllers
26	HP StorageWorks D2700 Enclosures
660	72GB SAS Disks
2	72GB SAS Disks (internal)
2	146GB SAS Disks (internal)

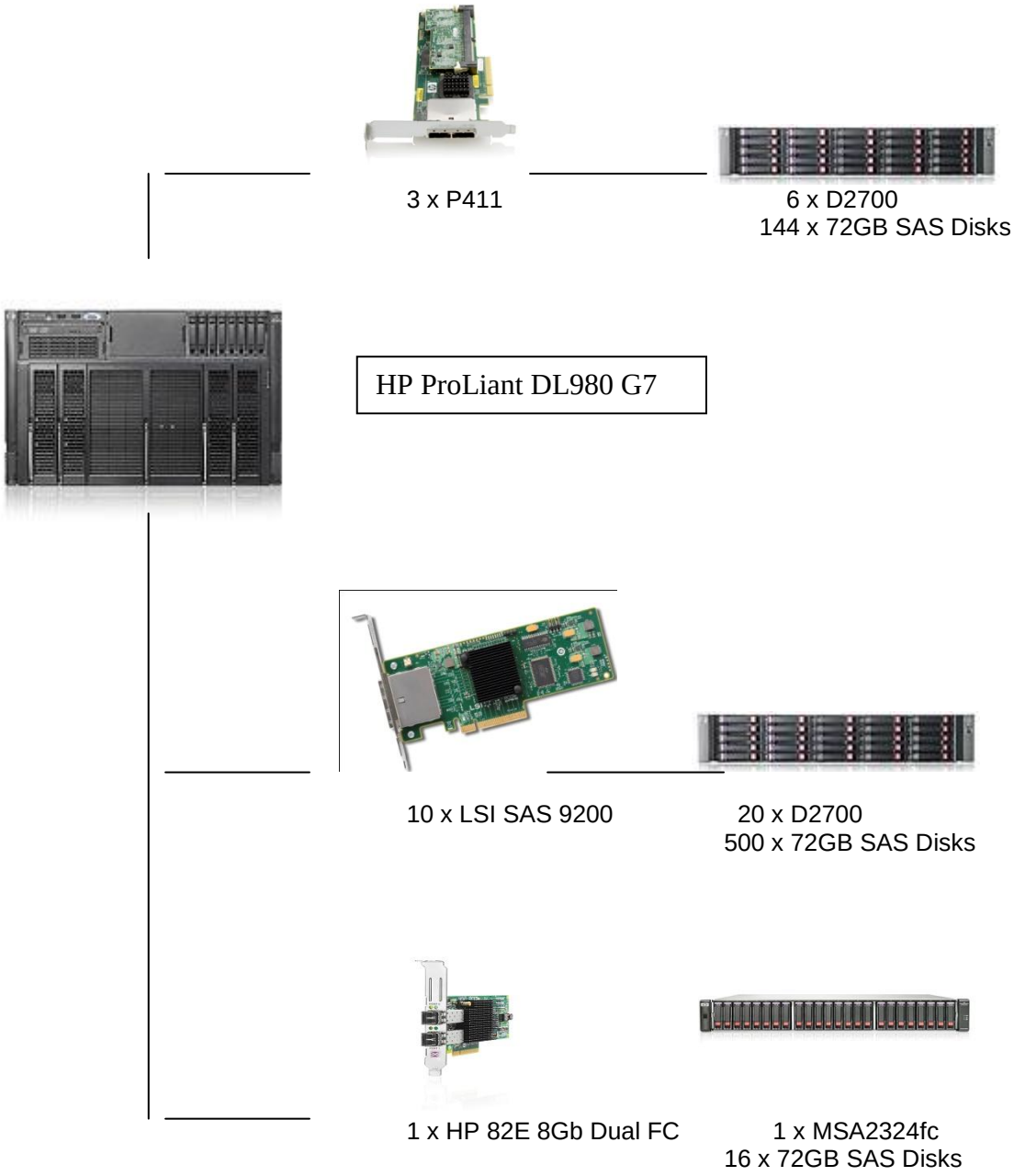


Figure 0.1 Benchmark and priced configuration for HP ProLiant DL980 G7

1.0 Clause 1: Logical Database Design

1.1 Table Definitions

Listings must be provided for all table definition statements and all other statements used to set up the test and qualification databases.

The Supporting Files Archive contains the table definitions and the program used to load the database.

1.2 Physical Organization of Database

The physical organization of tables and indices, within the test and qualification databases, must be disclosed. If the column ordering of any table is different from that specified in Clause 1.4, it must be noted.

The Supporting Files Archive contains the DDL for the index definitions.

1.3 Horizontal Partitioning

Horizontal partitioning of tables and rows in the test and qualification databases (see Clause 1.5.4) must be disclosed.

Horizontal partitioning was not used

1.4 Replication

Any replication of physical objects must be disclosed and must conform to the requirements of Clause 1.5.6.

No replication was used.

2.0 Clause 2: Queries and Refresh Functions - Related Items

2.1 Query Language

The query language used to implement the queries must be identified.

T-SQL was the query language used.

2.2 Random Number Generation

The method of verification for the random number generation must be described unless the supplied DBGEN and QGEN were used.

DBGEN version 2.11.0 and QGEN version 2.11.0 were used to generate all database populations.

2.3 Substitution Parameters Generation

The method used to generate values for substitution parameters must be disclosed. If QGEN is not used for this purpose, then the source code of any non-commercial tool used must be disclosed. If QGEN is used, the version number, release number, modification number and patch level of QGEN must be disclosed.

The TPC source based QGEN version 2.11.0 was used to generate the substitution parameters

2.4 Query Text and Output Data from Database

The executable query text used for query validation must be disclosed along with the corresponding output data generated during the execution of the query text against the qualification database. If minor modifications (see Clause 2.2.3) have been applied to any functional query definitions or approved variants in order to obtain executable query text, these modifications must be disclosed and justified. The justification for a particular minor query modification can apply collectively to all queries for which it has been used. The output data for the power and throughput tests must be made available electronically upon request..

The Supporting Files Archive contains the query text and query output. The following modifications were used:

- The “dateadd” function is used to perform date arithmetic in Q1, Q4, Q5, Q6, Q10, Q12, Q14 , Q15 and Q20.
- The “datepart” function is used to extract part of a date (“YY”) in Q7, Q8 and Q9.
- The “top” function is used to restrict the number of output rows in Q2, Q3, Q10, Q18 and Q21
- The “count_big” function is used in place of “count” in Q1

2.5 Query Substitution Parameters and Seeds Used

All the query substitution parameters used during the performance test must be disclosed in tabular format, along with the seeds used to generate these parameters.

The Supporting Files Archive contains the seed and query substitution parameters used.

2.6 Isolation Level

The isolation level used to run the queries must be disclosed. If the isolation level does not map closely to one of the isolation levels defined in Clause 3.4, additional descriptive detail must be provided.

The queries and transactions were run with isolation level Read Committed.

2.7 Refresh Functions

The details of how the refresh functions were implemented must be disclosed

The Supporting Files Archive contains the source code for the refresh functions.

3.0 Clause 3: Database System Properties

3.1 Atomicity Requirements

The results of the ACID tests must be disclosed along with a description of how the ACID requirements were met. This includes disclosing the code written to implement the ACID Transaction and Query.

All ACID tests were conducted according to specification. The steps performed are outlined below.

3.1.1 Atomicity of the Completed Transactions

Perform the ACID Transaction for a randomly selected set of input data and verify that the appropriate rows have been changed in the ORDER, LINEITEM, and HISTORY tables.

The following steps were performed to verify the Atomicity of completed transactions:

1. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. The ACID Transaction was performed using the order key from step 1.
3. The ACID Transaction committed.
4. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for the same order key. It was verified that the appropriate rows had been changed.

3.1.2 Atomicity of Aborted Transactions

Perform the ACID transaction for a randomly selected set of input data, submitting a ROLLBACK of the transaction for the COMMIT of the transaction. Verify that the appropriate rows have not been changed in the ORDER, LINEITEM, and HISTORY tables.

The following steps were performed to verify the Atomicity of the aborted ACID transaction:

1. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. The ACID Transaction was performed using the order key from step 1. The transaction was stopped prior to the commit.
3. The ACID Transaction was ROLLED BACK. .
4. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for the same order key used in steps 1 and 2. It was verified that the appropriate rows had not been changed.

3.2 Consistency Requirements

Consistency is the property of the application that requires any execution of transactions to take the database from one consistent state to another. A consistent state for the TPC-H database is defined to exist when:

*O_TOTALPRICE = SUM(trunc(trunc((L_EXTENDEDPRICE – L_DISCOUNT) * (1 + L_TAX)))*

for each ORDER and LINEITEM defined by (O_ORDERKEY = L_ORDERKEY)

3.2.1 Consistency Tests

Verify that ORDER and LINEITEM tables are initially consistent as defined in Clause 3.3.2.1, based upon a random sample of at least 10 distinct values of O_ORDERKEY.

The following steps were performed to verify consistency:

1. The consistency of the ORDER and LINEITEM tables was verified based on a sample of O_ORDERKEYs.
2. One hundred ACID Transactions were submitted from each of nine execution streams.
3. The consistency of the ORDER and LINEITEM tables was re-verified.

3.3 Isolation Requirements

Operations of concurrent transactions must yield results which are indistinguishable from the results which would be obtained by forcing each transaction to be serially executed to completion in some order.

3.3.1 Isolation Test 1 - Read-Write Conflict with Commit

Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is committed)

The following steps were performed to satisfy the test of isolation for a read-only and a read-write committed transaction:

1. An ACID Transaction was started for a randomly selected O_KEY, L_KEY and DELTA. The ACID Transaction was suspended prior to Commit.
2. An ACID query was started for the same O_KEY used in step 1. The ACID query blocked and did not see any uncommitted changes made by the ACID Transaction.
3. The ACID Transaction was resumed and committed. The ACID query completed. It returned the data as committed by the ACID Transaction.

3.3.2 Isolation Test 2 - Read-Write Conflict with Rollback

Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is rolled back.

The following steps were performed to satisfy the test of isolation for read-only and a rolled back read-write transaction:

1. An ACID transaction was started for a randomly selected O_KEY, L_KEY and DELTA. The ACID Transaction was suspended prior to Rollback.
2. An ACID query was started for the same O_KEY used in step 1. The ACID query did not see any uncommitted changes made by the ACID Transaction.
3. The ACID Transaction was ROLLED BACK.
4. The ACID query completed.

3.3.3 Isolation Test 3 - Write-Write Conflict with Commit

Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is committed.

The following steps were performed to verify isolation of two update transactions:

1. An ACID Transaction T1 was started for a randomly selected O_KEY, L_KEY and DELTA. The ACID transaction T1 was suspended prior to Commit.
2. Another ACID Transaction T2 was started using the same O_KEY and L_KEY and a randomly selected DELTA.
3. T2 waited.
4. The ACID transaction T1 was allowed to Commit and T2 completed.
5. It was verified that: T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE +(DELTA1*(T1.L_EXTENDEDPRICE/T1.L_QUANTITY))

3.3.4 Isolation Test 4 - Write-Write Conflict with Rollback

Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is rolled back.

The following steps were performed to verify the isolation of two update transactions after the first one is rolled back:

1. An ACID Transaction T1 was started for a randomly selected O_KEY, L_KEY and DELTA. The ACID Transaction T1 was suspended prior to Rollback.
2. Another ACID Transaction T2 was started using the same O_KEY and L_KEY used in step 1 and a randomly selected DELTA.
3. T2 waited.
4. T1 was allowed to ROLLBACK and T2 completed.

5. It was verified that T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE.

3.3.5 Isolation Test 5 – Concurrent Read and Write Transactions on Different Tables

Demonstrate the ability of read and write transactions affecting different database tables to make progress concurrently.

The following steps were performed:

1. An ACID Transaction T1 for a randomly selected O_KEY, L_KEY and DELTA. The ACID Transaction T1 was suspended prior to Commit.
2. Another ACID Transaction T2 was started using random values for PS_PARTKEY and PS_SUPPKEY.
3. T2 completed.
4. T1 completed and the appropriate rows in the ORDER, LINEITEM and HISTORY tables were changed.

3.3.6 Isolation Test 6 – Update Transactions During Continuous Read-Only Query Stream

Demonstrate the continuous submission of arbitrary (read-only) queries against one or more tables of the database does not indefinitely delay update transactions affecting those tables from making progress.

The following steps were performed:

1. An ACID Transaction T1 was started, executing Q1 against the qualification database. The substitution parameter was chosen from the interval [0..2159] so that the query ran for a sufficient amount of time.
2. Before T1 completed, an ACID Transaction T2 was started using randomly selected values of O_KEY, L_KEY and DELTA.
3. T2 completed before T1 completed.
4. It was verified that the appropriate rows in the ORDER, LINEITEM and HISTORY tables were changed.

3.4 Durability Requirements

The tested system must guarantee durability: the ability to preserve the effects of committed transactions and insure database consistency after recovery from any one of the failures listed in Clause 3.5.2.

3.4.1 Permanent Unrecoverable Failure of Any Durable Medium and Loss of System Power

Guarantee the database and committed updates are preserved across a permanent irrecoverable failure of any single durable medium containing TPC-H database tables or recovery log tables

The test database log was stored on two RAID-10 arrays consisting of 8 physical disks each. The RAID-10 LUNs were configured as a striped volume at OS level. The tables for the test database were stored on 500 volumes on 500 single disks. A backup of the test database was taken. The backup was spread across 36 logical volumes on RAID-5 arrays.

The tests were conducted on the qualification database. The qualification database was loaded in the same fashion as the test database but used fewer disks. The steps performed are shown below:

1. The complete database was backed up.
2. Nine streams of ACID transactions were started. Each stream executed a minimum of 100 transactions.
3. While the test was running, one of the disks from the database/log array was removed.
4. It was determined that the test kept on running.
5. A Database disk was removed and a checkpoint was issued to force a failure
6. The nine streams of ACID transactions failed and recorded their number of committed transactions in success files
7. The Database log was backed up and the Database was dropped.
8. The pulled disks were replaced with new ones. While the Log disk was undergoing the RAID rebuild process the DB disk was prepared for use.
9. The database was restored and a command was issued causing the database to run through the recovery
10. The counts in the history table and success files were compared and verified, and the consistency of the ORDERS and LINEITEM tables was verified.

3.4.2 System Crash

Guarantee the database and committed updates are preserved across an instantaneous interruption (system crash/system hang) in processing which requires the system to reboot to recover.

1. Nine streams of ACID transactions were started. Each stream executed a minimum of 100 transactions.
2. While the streams of ACID transactions were running the System and the Log Array were powered off.
3. When power was restored the system booted and the Database engine was restarted.
4. The database went through a recovery period.
5. The counts in the history table and success files were compared and verified, and the consistency of the ORDERS and LINEITEM tables was verified.

In addition to the Power Failure to Server and Log Array a failure of one of the two Log Array controllers was also simulated.

1. Nine streams of ACID transactions were started. Each stream executed a minimum of 100 transactions.
2. While the streams of ACID transactions were running one controller of the Log Array was pulled.
3. The nine streams of ACID transactions failed and recorded their number of committed transactions in success files.
4. The database was stopped and the array controller replaced.
5. The database was started up again and went through a recovery period.
6. The counts in the history table and success files were compared and verified, and the consistency of the ORDERS and LINEITEM tables was verified.

3.4.3 Memory Failure

Guarantee the database and committed updates are preserved across failure of all or part of memory (loss of contents).

See section 3.4.2

4.0 Clause 4: Scaling and Database Population

4.1 Initial Cardinality of Tables

The cardinality (i.e., the number of rows) of each table of the test database, as it existed at the completion of the database load (see clause 4.2.5) must be disclosed.

Table 4.1 lists the TPC-H Benchmark defined tables and the row count for each table as they existed upon completion of the build.

TABLE	# of Rows
Lineitem	18,000,048,306
Orders	4,500,000,000
Partsupp	2,400,000,000
Part	600,000,000
Customer	450,000,000
Supplier	30,000,000
Nation	25
Region	5

Table 4.1 Initial Number of Rows

4.2 Distribution of Tables and Logs Across Media

The distribution of tables and logs across all media must be explicitly described for the tested and priced systems.

Microsoft SQL Server was configured on an HP ProLiant DL980 G7 with the following configuration:

3 P411 Smart Array Controllers
10 LSI SAS 9200 Controllers
26 HP StorageWorks MSA 70 Enclosures
1 HP 82E 8Gb Dual FC Controller
1 MSA2324fc
662 72GB SAS Disks
2 146 GB SAS Disks

660 disks were used to hold table data, indexes, database log, the temporary database (TempDB) and the backup.

The raw partitions for the database and the NTFS partition for the backup and flat files were mounted to a folder on the G: drive

G:\mnt\li
G:\mnt\gen
G:\mnt\temp
G:\mnt\ntfs

A description of distribution of database file groups and log can be found in the Table below.

Slot Controller/Channel	# of Disks	Array Fault Tolerance	Size in GB	Partition Format	Content
Slot 0	2	RAID 1	146	NTFS	OS, SQL
P410i (onboard)	2	RAID 1	72	NTFS	Tools, Mount Points
Slot 1 A/B	16	RAID 10	546	NTFS	Log, TempDB Log
Dual Port FC					
Slot 2 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 3 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 5 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 6 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 9 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 11 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 12 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 13 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 15 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 16 A/B	50	RAID 0	9.8	RAW	TPCH3000G LI
LSI 9200			2.9	RAW	TPCH3000G GEN
			5.9	RAW	TPCH3000G TempDB
Slot 4 A/B	48	RAID 5	12 x 205	NTFS	Backup/Flat Files
P411					
Slot 7 A/B	48	RAID 5	12 x 205	NTFS	Backup/Flat Files
P411					
Slot 8 A/B	48	RAID 5	12 x 205	NTFS	Backup/Flat Files
P411					

4.3 Mapping of Database Partitions/Replications

The mapping of database partitions/replications must be explicitly described.

Database partitioning/replication was not used.

4.4 Implementation of RAID

Implementations may use some form of RAID to ensure high availability. If used for data, auxiliary storage (e.g. indexes) or temporary space, the level of RAID used must be disclosed for each device.

RAID 0 was used for database file groups and TempDB. RAID 10 for the database recovery logs and RAID5 for the Backup drives.

4.5 DBGEN Modifications

The version number, release number, modification number, and patch level of DBGEN must be disclosed. Any modifications to the DBGEN (see Clause 4.2.1) source code must be disclosed. In the event that a program other than DBGEN was used to populate the database, it must be disclosed in its entirety.

DBGEN version 2.11.0 was used, no modifications were made.

4.6 Database Load time

The database load time for the test database (see clause 4.3) must be disclosed.

The database load time was 8h35m17s

4.7 Data Storage Ratio

The data storage ratio must be disclosed. It is computed by dividing the total data storage of the priced configuration (expressed in GB) by the size chosen for the test database as defined in 4.1.3.1. The ratio must be reported to the nearest 1/100th, rounded up.

Disk Type	# of Disks	Total (GB)
146 GB 10K rpm SAS	2	273.4
72 GB 15K rpm SAS	662	45,255.18
Total		45,528.59

Size of test database: 3000G Data Storage Ratio: 15.18

4.8 Database Load Mechanism Details and Illustration

The details of the database load must be disclosed, including a block diagram illustrating the overall process. Disclosure of the load procedure includes all steps, scripts, input and configuration files required to completely reproduce the test and qualification databases.

Flat files for each of the tables were created using DBGEN. The tables were loaded as depicted in Figure 5-8.

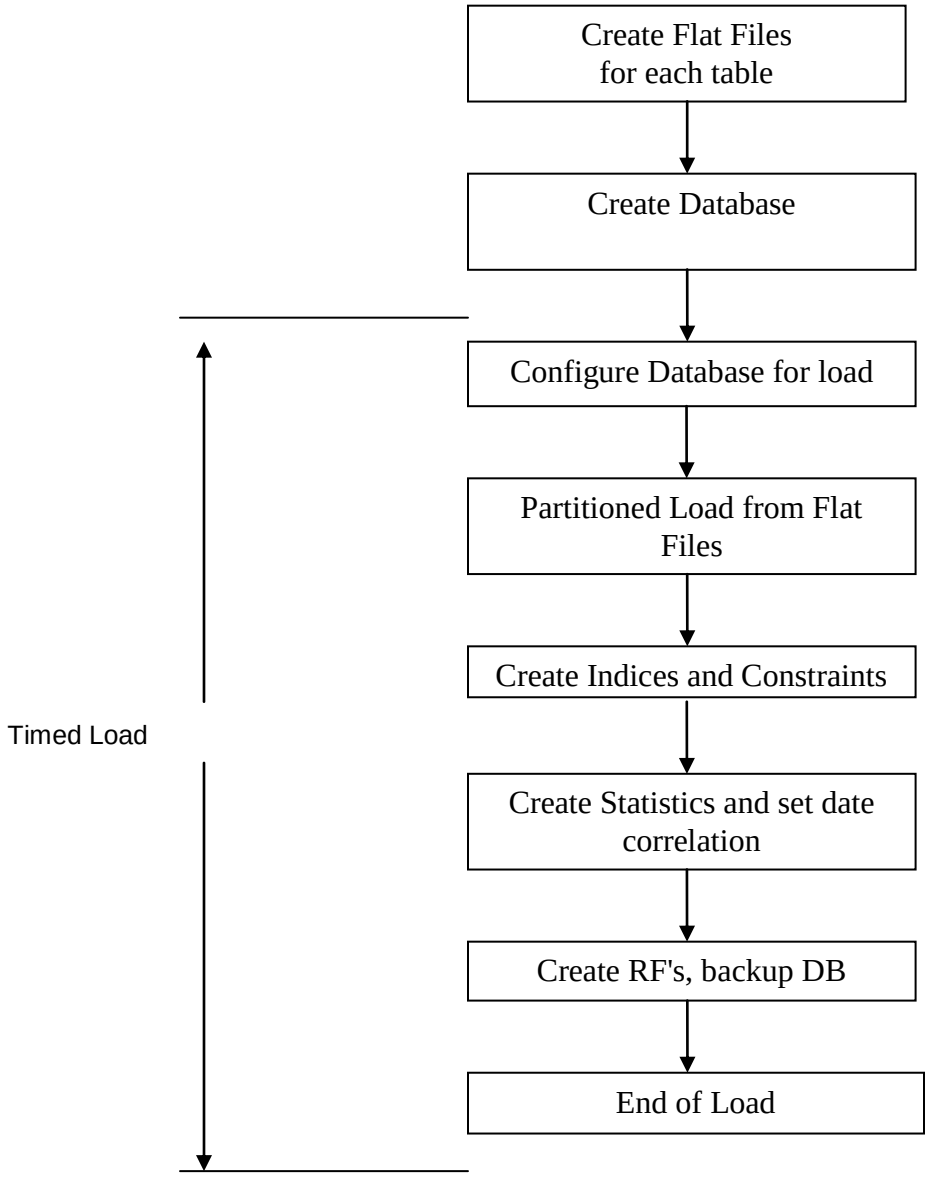


Figure 5.8: Block Diagram of Database Load Process

4.9 Qualification Database Configuration

The details of the database load must be disclosed, including a block diagram illustrating the overall process. Disclosure of the load procedure includes all steps, scripts, input and configuration files required to completely reproduce the test and qualification databases.

The qualification database used identical scripts to create and load the data with changes to adjust for the database scale factor.

4.10 Memory to Database Size Percentage

The memory to database size percentage, as defined in clause 8.3.5.10, must be disclosed.

The memory to database size percentage is 17.1%

5.0 Clause 5: Performance Metrics and Execution Rules Related Items

5.1 Steps after the Load Test

Any system activity on the SUT that takes place between the conclusion of the load test and the beginning of the performance test must be fully disclosed including listings of scripts or command logs.

Auditor requested queries were run against the database to verify the correctness of the load. The system was rebooted and SQL Server was restarted.

5.2 Steps in the Power Test

The details of the steps followed to implement the power test (e.g., system boot, database restart, etc.) must be disclosed.

The following steps were used to implement the power test:

1. RF1 Refresh Transaction
2. Stream 0 Execution
3. RF2 Refresh Transaction.

5.3 Timing Intervals for Each Query and Refresh Function

The timing intervals (see Clause 5.3.6) for each query of the measured set and for both refresh functions must be reported for the power test.

The timing intervals for each query and both refresh functions are given in the Numerical Quantities Summary earlier in this document on page vii.

5.4 Number of Streams for The Throughput Test

The number of execution streams used for the throughput test must be disclosed.

8 streams were used for the Throughput Test.

5.5 Start and End Date/Times for Each Query Stream

The start time and finish time for each query execution stream must be reported for the throughput test.

The Numerical Quantities Summary on page vii contains the start and stop times for the query execution streams run on the system reported.

5.6 Total Elapsed Time for the Measurement Interval

The total elapsed time of the measurement interval(see Clause 5.3.5) must be reported for the throughput test.

The Numerical Quantities Summary on page vii contains the timing intervals for the throughput test run on the system reported.

5.7 Refresh Function Start Date/Time and Finish Date/Time

Start and finish time for each update function in the update stream must be reported for the throughput test.

The Numerical Quantities Summary on page vii contains the start and finish times for the refresh functions of each stream.

5.8 Timing Intervals for Each Query and Each Refresh Function for Each Stream

The timing intervals (see Clause 5.3.6) for each query of each stream and for each update function must be reported for the throughput test.

The timing intervals for each query and each update function are given in the Numerical Quantities Summary earlier in this document on page vii.

5.9 Performance Metrics

The computed performance metrics, related numerical quantities and the price performance metric must be reported.

The Numerical Quantities Summary contains the performance metrics, related numerical quantities, and the price/performance metric for the system reported.

5.10 The Performance Metric and Numerical Quantities from Both Runs

The performance metric (QphH@Size) and the numerical quantities (TPC-H Power@Size and TPC-H Throughput@ Size) from both of the runs must be disclosed

Run ID	QppH@3000G	QthH@3000G	QphH@3000G
Run 1	185,334.5	144,211.9	163,485.3
Run 2	185,297.7	142,685.6	162,601.7

5.11 System Activity Between Tests

Any activity on the SUT that takes place between the conclusion of Run1 and the beginning of Run2 must be disclosed.

The system was sitting idle for several hours between runs. The first run finished around 3AM, benchmark activities were resumed around 8:30AM. The Database log confirmed that no database activity took place during that time. Before the start of Run2 the Database log was truncated.

5.12 Documentation to satisfy Clause 5.2.7

All documentation necessary to satisfy Clause 5.2.7 must be made available upon request

The supporting files archive contains the documentation

5.13 Query Validation Output

The output of the Query Output Validation Test must reported in the supporting files archive

The supporting files archive contains the documentation

6.0 Clause 6: SUT and Driver Implementation Related Items

6.1 Driver

A detailed description of how the driver performs its functions must be supplied, including any related source code or scripts. This description should allow an independent reconstruction of the driver.

The TPC-H benchmark was implemented using a Microsoft tool called StepMaster. StepMaster is a general purpose test tool which can drive ODBC and shell commands. Within StepMaster, the user designs a workspace corresponding to the sequence of operations (or steps) to be executed. When the workspace is executed, StepMaster records information about the run into a database as well as a log file for later analysis.

StepMaster provides a mechanism for creating parallel streams of execution. This is used in the throughput tests to drive the query and refresh streams. Each step is timed using a millisecond resolution timer. A timestamp T1 is taken before beginning the operation and a timestamp T2 is taken after completing the operation. These times are recorded in a database as well as a log file for later analysis.

Two types of ODBC connections are supported. A dynamic connection is used to execute a single operation and is closed when the operation finishes. A static connection is held open until the run completes and may be used to execute more than one step. A connection (either static or dynamic) can only have one outstanding operation at any time.

In TPC-H, static connections are used for the query streams in the power and throughput tests. StepMaster reads an Access database to determine the sequence of steps to execute. These commands are represented as the Implementation Specific Layer. StepMaster records its execution history, including all timings, in the Access database. Additionally, StepMaster writes a textual log file of execution for each run.

The stream refresh functions were executed using multiple batch scripts. The initial script is invoked by StepMaster, subsequent scripts are called from within the scripts.
The source for StepMaster and the RF Scripts is disclosed in the supported file archive.

6.2 Implementation Specific Layer (ISL)

If an implementation-specific layer is used, then a detailed description of how it performs its functions must be supplied, including any related source code or scripts. This description should allow an independent reconstruction of the implementation-specific layer.

The following steps are performed, to accomplish the Power and Throughput Runs:

1. Power Run

- Execute 192 concurrent RF1 threads, each of which will apply a segment of a refresh set generated by DBGen. Each thread submits multiple transactions, where a transaction spans a set of orders and their associated line items. Hold a semaphore open for RF2 which is released at the end of the query execution

- Execute the Stream 0 queries in the order according to TPC Benchmark H Specification, Appendix A. Release RF2 semaphore

- Execute 192 concurrent RF2 threads, each of which will apply a segment of a refresh set generated by DBGen. Each thread submits multiple transactions, where a transaction spans a set of orders and their associated line items.

2. Throughput Run

- Execute 8 concurrent query streams. Each stream executes queries in the order according to TPC Benchmark H Specification, Appendix A, for the appropriate Stream ID (01-08). Upon completion of each stream, a semaphore is signaled to indicate completion.
- Execute 8 consecutive RF1/RF2 transactions, against ascending Refresh sets produced by DBGen. The first RF1 waits on a semaphore prior to beginning its insert operations.

Each step during the query execution is timed by StepMaster. The timing information, together with an activity log, are stored for later analysis. The inputs and results of steps are stored in text files for later analysis. The RF timings are kept in a Masterlog file.

6.3 Profile-Directed Optimization

If profile-directed optimization as described in Clause 5.2.9 is used, such use must be disclosed.

Profile-directed optimization was not used.

7.0 Clause 7: Pricing Related Items

7.1 Hardware and Software Used

A detailed list of hardware and software used in the priced system must be reported. Each item must have a vendor part number, description, and release/revision level, and indicate General Availability status or committed delivery date. If package pricing is used, contents of the package must be disclosed. Pricing source(s) and effective date(s) of price(s) must also be reported.

The pricing summary sheet is given on page *v* in the Executive Summary at the front of this report. The source for all prices is indicated.

The HP ProLiant DL980 G7 will be available 10-13-2010. All storage components are available at publication date.

The pricing and availability of the Microsoft software used is given in a quote from Microsoft, which is included in this report in Appendix A.

7.2 Three-Year Cost of System Configuration

The total 3-year price of the entire configuration must be reported, including: hardware, software, and maintenance charges. Separate component pricing is required.

The pricing summary sheet on page v in the front of this report contains all details.

7.3 Availability Dates

The committed delivery date for general availability (availability date) of products used in the priced calculations must be reported. When the priced system includes products with different availability dates, the single availability date reported on the first page of the executive summary must be the date by which all components are committed to being available. The full disclosure report must report availability dates individually for at least each of the categories for which a pricing subtotal must be provided (see Clause 7.3.1.4). All availability dates, whether for individual components or for the SUT as a whole, must be disclosed to a precision of 1 day, but the precise format is left to the test sponsor.

Category	Available
Server Hardware	10-13-2010
Storage	Now (date of publication)
Server Software	Now (date of publication)
SQL Server	Now (date of publication)

8.0 Clause 8: Support Files Index Table

8.1 Supporting Files Index Table

An index for all files included in the supporting files archive as required by Clauses 8.3.2 must be provided in the report.

Clause	Description	Pathname
Clause 1	OS and DB Settings	SupportFilesArchive\Settings
	DB Creation Scripts	SupportFilesArchive\DatabaseCreation
Clause 2	Qualification queries and output	SupportFilesArchive\1G_Output
	Query substitution parameters	SupportFilesArchive\Parms
	Refresh Functions	SupportFilesArchive\RFs
Clause 3	ACID scripts and output	SupportFilesArchive\ACID
Clause 4	DB Load scripts	SupportFilesArchive\DataBaseLoad
	Qualification DB scripts	SupportFilesArchive\1G
Clause 5	Driver source	SupportFilesArchive\Driver
	Query and Refresh Output	SupportFilesArchive\Run_Output

9.0 Clause 9: Audit Related Items

9.1 Auditors' Report

The auditor's agency name, address, phone number, and Attestation letter with a brief audit summary report indicating compliance must be included in the full disclosure report. A statement should be included specifying who to contact in order to obtain further information regarding the audit process.

This implementation of the TPC Benchmark H was audited by Francois Raab of InfoSizing, a certified TPC-H auditor. Further information regarding the audit process may be obtained from:

Francois Raab
InfoSizing (www.sizing.com)
125 West Monroe Street
Colorado Springs, CO 80907
(719) 473-7555
(719) 473-7554

TPC Benchmark H Full Disclosure Report and other information can be downloaded from the Transaction Processing Performance Council web site at www.tpc.org.

INFO SIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Benchmark Sponsor: Mike Fitzner
Senior Performance Engineer
Hewlett-Packard Company
c/o Microsoft Corporation
1 Microsoft Way
Redmond, WA 98052

June 17, 2010

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

Platform: **HP ProLiant DL980 G7**

Database Manager: **Microsoft SQL Server 2008 R2 Enterprise Edition**

Operating System: **Microsoft Windows Server 2008 R2 Enterprise Edition**

The results were:

CPU (Speed)	Memory	Disks	QphH@3000GB
HP ProLiant DL980 G7			
8 x Intel Xeon X7560 (2.27GHz, 8-core)	24MB L3 512GB Main	662 x 72GB 15Krpm 2 x 146GB 10Krpm	**162,601.7**

In my opinion, this performance result was produced in compliance with the TPC's requirements for the benchmark.

The following verification items were given special attention:

- The database records were defined with the proper layout and size
- The database population was generated using DBGEN
- The database was properly scaled to 3,000GB and populated accordingly
- The compliance of the database auxiliary data structures was verified

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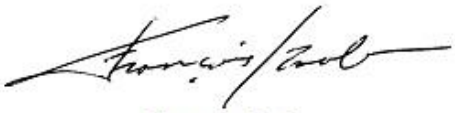
- The database load time was correctly measured and reported
- The required ACID properties were verified and met
- The query input variables were generated by QGEN
- The query text was produced using minor modifications and no query variant
- The execution of the queries against the SF1 database produced compliant answers
- A compliant implementation specific layer was used to drive the tests
- The throughput tests involved 8 query streams
- The ratio between the longest and the shortest query was such that no query timings were adjusted
- The execution times for queries and refresh functions were correctly measured and reported
- The repeatability of the measured results was verified
- The system pricing was verified for major components and maintenance
- The major pages from the FDR were verified for accuracy

Additional Audit Notes:

None.

Respectfully Yours,



François Raab
President

125 West Monroe Street • Colorado Springs, CO 80907 • 719-473-7555 • www.sizing.com

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

June 10, 2010

Hewlett-Packard
Mike Fitzner
One Microsoft Way
Redmond, WA 98052

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

All pricing shown is in US Dollars ($).

Part Number	Description	Unit Price	Quantity	Price
810-08553	**SQL Server 2008 R2 Enterprise Edition** *Server License with 25 CALs* *Discount Schedule: Open Program - Level C* *Unit Price reflects a 40% discount from the retail unit price of $13,969.*	$8,318	1	$8,318
359-05354	**SQL Server 2008 R2 Client Access License** *Discount Schedule: Open Program - Level C* *Unit Price reflects a 30% discount from the retail unit price of $163.*	$114	55	$6,270
P72-04217	**Windows Server 2008 R2 Enterprise Edition** *Server License with 25 CALs* *Discount Schedule: Open Program - Level C* *Unit Price reflects a 42% discount from the retail unit price of $3,999.*	$2,310	1	$2,310
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident).*	$259	1	$259

All products are currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found at 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 per call.

This quote is valid for the next 90 days.

Reference ID: TPCH_g7lPpiq6ZAtJNM+DREbYWNBMKVhXul+I_V1.0.0.

MICROLAND ELECTRONICS

QUOTE-0004

Microland Electronics

DATE: JUNE 10, 2010

1883 Ringwood Ave San Jose, CA 95131
Tel 408.850.9102 Fax 408.441.1767
raymondh@microlandusa.com

TO Josh Gunderson
Shipping Address:
Hewlett-Packard Company
xxxxxxx
xxxxxxx
xxxxxxx
Customer ID: HEWLETTP

SALESPERSON	JOB	SHIPPING METHOD	SHIPPING TERMS	DELIVERY DATE	PAYMENT TERMS	DUE DATE
Raymond Huang	Account Manager	Upon request	Prepaid & bill	Upon request	C.C.	

QTY	ITEM #	DESCRIPTION	UNIT PRICE		LINE TOTAL
12	LSI00188	LSI 9200_8e (All LSI controller cards come with 3 year warranty) *Actual shipping cost, (CA/CO/TX/IN) sales tax, 3% C.C fee will be added to total amount	$328.00		$3,936.00
				SUBTOTAL	$3,936.00
				(CA /CO /TX / IN) SALES TAX	
				C.C FEE	
				SHIPPING	
				TOTAL	$3,936.00

Quotation prepared by: Raymond Huang _____

This is a quotation on the goods named, subject to the conditions noted below: (Describe any conditions pertaining to these prices and any additional terms of the agreement. You may want to include contingencies that will affect the quotation.)

To accept this quotation, sign here and return: _____

THANK YOU FOR YOUR BUSINESS!