TPC Benchmark™ H

Full Disclosure Report

Second Edition

02–April–2021

Using

Altibase v7.1

on

KTNF KR580S1

First Edition: February 2021

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Abstract

This report documents the methodology and results of the TPC Benchmark™ H (TPC-H) test conducted by TTA on Altibase v7.1 on KTNF KR580S1

Altibase v7.1 on KR580S1

Company Name	System Name	Database Software	Opeating System
Telecommunications Technology Association	KTNF KR580S1	Altibase v7.1	RedHat Enterprise Linux 7.9 (Maipo)

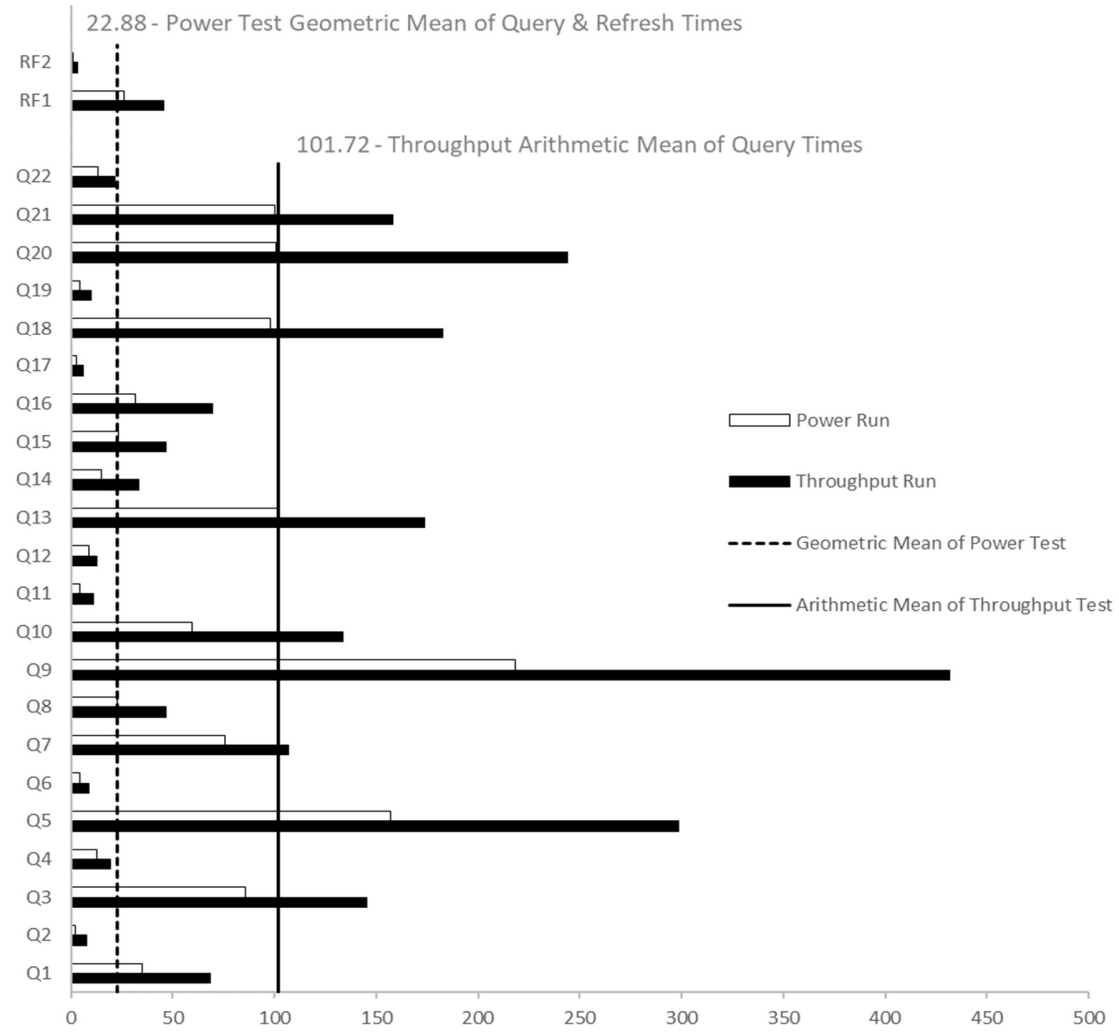
TPC Benchmark™ H Metrics

Total System Cost	Composite Metric	Price/Performance	Availability Date
68,831,160₩ (KRW)	43,903.9 QphH@100GB	1,567,768.69₩/kQphH@100GB	Available Now

	Altibase v7.1 on KTNF KR580S1	**TPC-H Rev. 3.0.0** **TPC-Pricing Rev. 2.7.0** **Report Date:** April 2, 2021

Total System Cost	Composite Query per Hour Metric	Price / Performance
68,831,160₩	**43,903.9 QphH@100GB**	**1,567,768.69₩/kQphH@100GB**

Database Size	Database Manager	Operating System	Other Software	Availability Date
100GB	Altibase v7.1	RHEL 7.9	None	Available Now



Database Load Time = **00d 01h 13m 16s**	Storage Redundancy Level	
Load included backup: **N**	Base Tables and REDO Logs	**RAID 1**
Total Data Storage/Database Size = **154.23 GiB**	DBMS Temporary Space	**No RAID (in-memory)**
Memory/Database Size = **512%**	OS and DBMS Software	**RAID 1**

System Configuration:	KTNF KR580S1
Processors/Model	2 x Intel(R) Xeon(R) Gold 6140 @ 2.30GHz
Cores/Threads:	36/72
Memory:	512 GB
OS and DBMS Disk Drives:	2 x 600 GB SAS HDD 10,000RPM (RAID1)
Base Tables Disk Drives :	2 x 3,840 GB SATA 6Gbps SSD (RAID1)
REDO Logs Disk Drives	2 x 3,840 GB SATA 6Gbps SSD (RAID1)
Total Storage	15,422.70 GiB

	Altibase v7.1 on KTNF KR580S1	TPC-H Rev. 3.0.0 TPC-Pricing Rev. 2.7.0
		Report Date: April 2, 2021

Description	Part Number	Key	Unit Price	Qty	Price	3-Yr. Maint. Price
Hardware						
Server - KTNF KR580S1		1	23,820,000₩	1	23,820,000₩	
DB Server-KR580S1 Barebone	HDD0043A	1	(included)			
Intel Xeon Scalable Gold 6140 Processor (18Core 2.3GHz/24.75MB)	HAK0116A	1	(included)	2		
64GB DDR4 2400 ECC RDIMM Memory	HCL0015A	1	(included)	8		
3.84TB 2.5" hot-swap SATA SSD	HCZ0045A	1	(included)	2		
3.84TB 2.5" hot-swap SATA SSD	HCZ0045A	1	(included)	2		
600GB 2.5" hot-swap SAS HDD 10Krpm	HBH0010A	1	(included)	2		
Broadcom MEGARAID SAS 9361-8i	HCH0037A	1	(included)	1		
RAID Card (1GB Cache)	HBV0080A	1	(included)	2		
Intel Dual Port 10G SFP+ Network Adapter	HBV0080A	1	(included)	2		
SFP+ Transceiver	HCW0009A	1	(included)	4		
Trackball Mini Keyboard	HDM0001A	1	(included)	1		
KTNF 27-inch Monitor	HDM0002A	1	(included)	1		
Hardware Sub Total					**23,820,000₩**	**4,500,000₩**
Software						
Red Hat Enterprise Linux Server Standard 3yrs	RH00004F3	2	4,089,000₩	1	4,089,000₩	
RHEL Server Standard Maintenance - 3yrs 24x7x4hrs	RP-CPS(OS)	2	6,000,000₩	1		6,000,000₩
Altibase v7.1		3	83,520,000₩	1	83,520,000₩	
Altibase v7.1 Technical Supports - 1yr 24x7x4hrs		3	24,220,800₩	3		72,662,400₩
Software Sub Total					**87,609,000₩**	**78,662,400₩**
Discounts*						
SW Discount - RHEL					-1,689,000₩	
SW Support Discount - RHEL						-3,000,000₩
SW Discount - Altibase					-59,299,200₩	
SW Support Discount - Altibase						-61,772,040₩

Discounts Sub Total	**-60,988,200₩**	**-64,772,040₩**
Total	**50,440,800₩**	**18,390,360₩**

* All discounts are based on Korea list prices and for similar quantities and configurations. Discounts for similarly sized configurations will be similar to those quoted here, but may vary based on the components in the configuration.

Pricing Key 1) KTNF Co., Ltd. 2) Rockplace Inc. 3) Altibase Corp.	**3 Yr. cost of ownership KRW(₩):**	**68,831,160**
	QphH@100GB:	**43,903.9**
All of the prices are based on South Korea's currency, KRW (₩, Korean Won) and excluded VAT.	**₩/kQphH@100GB:**	**1,567,768.69**

Benchmark implementation and results independantly audited by Doug Johnson of InfoSizing (www.sizing.com)

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections of the TPC benchmark pricing specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.

Numerical Quantities

Measurement Results:

Database Scale Factor = 100GB

Total Data Storage / Database Size = 154.23

Start of database load time = 2021-02-03 8:46:47 AM

End of database load time = 2021-02-03 10:00:03 AM

Database Load Time = 00d 01h 13m 16s

Query Streams for Throughput Test = 36

TPC-H Power = 15,733.9

TPC-H Throughput = 122,509.5

TPC-H Composite Query-per-Hour Rating (QphH@100GB) = 43,903.9

Total System Price Over 3 Years (₩, KRW) = 68,831,160₩

TPC-H Price/Performance Metric (₩/kQphH@100GB) = 1,567,768.69

Measurement Intervals:

Measurement Interval in Throughput Test (Ts) = 2,327.33 seconds

Duration of Stream Execution:

Power Run	Seed	Query Start Time Query End Time	Total Time (hh:mm:ss)	RF1 Start Time RF1 End Time	RF2 Start Time RF2 End Time
	203100003	2021-02-03 10:17:25 2021-02-03 10:37:06	00:19:41	2021-02-03 10:16:59 2021-02-03 10:17:25	2021-02-03 10:37:06 2021-02-03 10:37:07

Throughput Stream	Seed	Query Start Time Query End Time	Total Time (hh:mm:ss)	RF1 Start Time RF1 End Time	RF2 Start Time RF2 End Time
1	203100004	2021-02-03 10:37:08 2021-02-03 11:13:30	00:36:22	2021-02-03 10:37:08 2021-02-03 10:39:40	2021-02-03 10:39:40 2021-02-03 10:39:44
2	203100005	2021-02-03 10:37:08 2021-02-03 11:15:07	00:37:59	2021-02-03 10:39:44 2021-02-03 10:40:25	2021-02-03 10:40:25 2021-02-03 10:40:28

Throughput Stream	Seed	Query Start Time Query End Time	Total Time (hh:mm:ss)	RF1 Start Time RF1 End Time	RF2 Start Time RF2 End Time
3	203100006	2021-02-03 10:37:08 2021-02-03 11:14:43	00:37:35	2021-02-03 10:40:28 2021-02-03 10:41:02	2021-02-03 10:41:02 2021-02-03 10:41:05
4	203100007	2021-02-03 10:37:08 2021-02-03 11:15:05	00:37:57	2021-02-03 10:41:05 2021-02-03 10:41:43	2021-02-03 10:41:43 2021-02-03 10:41:47
5	203100008	2021-02-03 10:37:08 2021-02-03 11:14:26	00:37:18	2021-02-03 10:41:47 2021-02-03 10:42:53	2021-02-03 10:42:53 2021-02-03 10:42:57
6	203100009	2021-02-03 10:37:08 2021-02-03 11:15:56	00:38:48	2021-02-03 10:42:57 2021-02-03 10:43:30	2021-02-03 10:43:30 2021-02-03 10:43:32
7	203100010	2021-02-03 10:37:08 2021-02-03 11:13:55	00:36:47	2021-02-03 10:43:32 2021-02-03 10:44:05	2021-02-03 10:44:05 2021-02-03 10:44:08
8	203100011	2021-02-03 10:37:08 2021-02-03 11:11:59	00:34:51	2021-02-03 10:44:08 2021-02-03 10:44:41	2021-02-03 10:44:41 2021-02-03 10:44:44
9	203100012	2021-02-03 10:37:08 2021-02-03 11:14:46	00:37:38	2021-02-03 10:44:44 2021-02-03 10:45:15	2021-02-03 10:45:15 2021-02-03 10:45:18
10	203100013	2021-02-03 10:37:08 2021-02-03 11:14:29	00:37:21	2021-02-03 10:45:18 2021-02-03 10:45:54	2021-02-03 10:45:54 2021-02-03 10:45:57
11	203100014	2021-02-03 10:37:08 2021-02-03 11:13:56	00:36:48	2021-02-03 10:45:57 2021-02-03 10:46:41	2021-02-03 10:46:41 2021-02-03 10:46:44
12	203100015	2021-02-03 10:37:08 2021-02-03 11:14:31	00:37:23	2021-02-03 10:46:44 2021-02-03 10:47:24	2021-02-03 10:47:24 2021-02-03 10:47:29
13	203100016	2021-02-03 10:37:08 2021-02-03 11:13:24	00:36:16	2021-02-03 10:47:29 2021-02-03 10:48:04	2021-02-03 10:48:04 2021-02-03 10:48:08
14	203100017	2021-02-03 10:37:08 2021-02-03 11:14:14	00:37:06	2021-02-03 10:48:08 2021-02-03 10:48:50	2021-02-03 10:48:50 2021-02-03 10:48:55
15	203100018	2021-02-03 10:37:08 2021-02-03 11:15:27	00:38:19	2021-02-03 10:48:55 2021-02-03 10:50:19	2021-02-03 10:50:19 2021-02-03 10:50:22
16	203100019	2021-02-03 10:37:08 2021-02-03 11:13:10	00:36:02	2021-02-03 10:50:22 2021-02-03 10:50:56	2021-02-03 10:50:56 2021-02-03 10:51:00
17	203100020	2021-02-03 10:37:08 2021-02-03 11:14:38	00:37:30	2021-02-03 10:51:00 2021-02-03 10:51:36	2021-02-03 10:51:36 2021-02-03 10:51:40
18	203100021	2021-02-03 10:37:08 2021-02-03 11:14:13	00:37:05	2021-02-03 10:51:40 2021-02-03 10:52:44	2021-02-03 10:52:44 2021-02-03 10:52:48
19	203100022	2021-02-03 10:37:08 2021-02-03 11:12:58	00:35:50	2021-02-03 10:52:48 2021-02-03 10:53:39	2021-02-03 10:53:39 2021-02-03 10:53:43
20	203100023	2021-02-03 10:37:08 2021-02-03 11:14:05	00:36:57	2021-02-03 10:53:43 2021-02-03 10:54:36	2021-02-03 10:54:36 2021-02-03 10:54:40
21	203100024	2021-02-03 10:37:08 2021-02-03 11:14:31	00:37:23	2021-02-03 10:54:40 2021-02-03 10:55:14	2021-02-03 10:55:14 2021-02-03 10:55:18
22	203100025	2021-02-03 10:37:08 2021-02-03 11:14:54	00:37:46	2021-02-03 10:55:18 2021-02-03 10:55:51	2021-02-03 10:55:51 2021-02-03 10:55:54

Throughput Stream	Seed	Query Start Time	Total Time	RF1 Start Time	RF2 Start Time
		Query End Time	(hh:mm:ss)	RF1 End Time	RF2 End Time
23	203100026	2021-02-03 10:37:08	00:38:00	2021-02-03 10:55:54	2021-02-03 10:56:27
		2021-02-03 11:15:08		2021-02-03 10:56:27	2021-02-03 10:56:30
24	203100027	2021-02-03 10:37:08	00:37:31	2021-02-03 10:56:30	2021-02-03 10:57:25
		2021-02-03 11:14:39		2021-02-03 10:57:25	2021-02-03 10:57:29
25	203100028	2021-02-03 10:37:08	00:38:42	2021-02-03 10:57:29	2021-02-03 10:58:22
		2021-02-03 11:15:50		2021-02-03 10:58:22	2021-02-03 10:58:27
26	203100029	2021-02-03 10:37:08	00:37:52	2021-02-03 10:58:27	2021-02-03 10:59:05
		2021-02-03 11:15:00		2021-02-03 10:59:05	2021-02-03 10:59:08
27	203100030	2021-02-03 10:37:08	00:37:51	2021-02-03 10:59:08	2021-02-03 10:59:42
		2021-02-03 11:14:59		2021-02-03 10:59:42	2021-02-03 10:59:45
28	203100031	2021-02-03 10:37:08	00:37:56	2021-02-03 10:59:45	2021-02-03 11:00:21
		2021-02-03 11:15:04		2021-02-03 11:00:21	2021-02-03 11:00:23
29	203100032	2021-02-03 10:37:08	00:38:03	2021-02-03 11:00:23	2021-02-03 11:00:58
		2021-02-03 11:15:11		2021-02-03 11:00:58	2021-02-03 11:01:08
30	203100033	2021-02-03 10:37:08	00:35:04	2021-02-03 11:01:08	2021-02-03 11:02:09
		2021-02-03 11:12:12		2021-02-03 11:02:09	2021-02-03 11:02:13
31	203100034	2021-02-03 10:37:08	00:37:27	2021-02-03 11:02:13	2021-02-03 11:02:49
		2021-02-03 11:14:35		2021-02-03 11:02:49	2021-02-03 11:02:52
32	203100035	2021-02-03 10:37:08	00:37:18	2021-02-03 11:02:52	2021-02-03 11:03:39
		2021-02-03 11:14:26		2021-02-03 11:03:39	2021-02-03 11:03:42
33	203100036	2021-02-03 10:37:08	00:37:06	2021-02-03 11:03:42	2021-02-03 11:04:15
		2021-02-03 11:14:14		2021-02-03 11:04:15	2021-02-03 11:04:17
34	203100037	2021-02-03 10:37:08	00:37:56	2021-02-03 11:04:17	2021-02-03 11:05:18
		2021-02-03 11:15:04		2021-02-03 11:05:18	2021-02-03 11:05:21
35	203100038	2021-02-03 10:37:08	00:37:14	2021-02-03 11:05:21	2021-02-03 11:05:55
		2021-02-03 11:14:22		2021-02-03 11:05:55	2021-02-03 11:05:58
36	203100039	2021-02-03 10:37:08	00:38:10	2021-02-03 11:05:58	2021-02-03 11:06:32
		2021-02-03 11:15:18		2021-02-03 11:06:32	2021-02-03 11:06:35

Query Execution Times (Query1~Query12):

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
0	35.15	2.46	85.78	12.93	157.28	4.64	75.65	22.88	218.25	59.39	4.68	8.80
1	69.54	4.20	142.04	21.34	320.46	9.31	115.36	36.95	407.34	146.74	7.30	12.82
2	68.47	7.04	137.04	19.00	312.88	11.13	110.32	52.11	403.57	90.07	36.54	11.66
3	59.49	4.35	152.35	19.19	271.59	8.32	104.86	114.21	426.14	132.30	7.42	13.60
4	60.08	4.15	140.53	19.00	379.56	8.37	110.22	38.54	467.83	127.33	7.98	12.96
5	69.14	3.37	155.53	17.03	272.67	8.53	96.48	39.43	464.37	141.99	8.44	11.69
6	68.41	4.16	145.05	22.47	294.67	9.02	106.34	37.47	480.01	214.90	9.52	12.24
7	69.33	4.12	137.33	21.30	293.34	8.85	107.82	51.80	436.01	100.96	7.76	13.82
8	84.19	4.28	130.27	19.77	254.43	9.20	107.89	36.55	425.74	119.37	20.31	13.51
9	64.46	5.89	151.77	20.99	317.85	8.68	104.58	114.33	440.90	96.82	15.97	11.17
10	64.48	3.95	150.92	20.77	317.06	15.25	96.52	47.38	409.45	127.14	8.65	12.78
11	68.48	5.52	142.21	18.33	302.23	9.14	117.47	39.69	417.42	114.01	11.49	12.93
12	91.18	4.04	162.17	18.61	279.47	8.32	117.18	42.26	482.18	102.25	9.46	12.13
13	55.41	6.13	133.77	19.30	305.73	7.56	103.90	45.69	471.17	110.72	9.66	12.12
14	67.09	60.42	156.23	18.08	320.99	8.67	105.01	48.22	420.53	93.21	7.5	13.74
15	64.63	10.8	150.62	22.86	280.71	8.22	106.8	44.97	383.06	156.87	8.83	12.52
16	80.81	4.56	154.05	20.95	261.18	8.69	95.03	39.08	439.15	109.54	15.14	14
17	65.86	5.24	197.01	17.44	264.84	6.24	104.61	45.36	485.17	136.12	7.5	9.31
18	62.37	4.25	146.58	19.25	271.95	8.23	111.79	41.09	418.3	105.29	33.63	12.95
19	73.93	3.01	133.44	28.8	273.32	8.82	92.13	38.91	469.54	117.96	9.66	16.29
20	68.29	6.74	150.81	16.99	317.22	9.24	111.28	51.16	418.01	110.92	10.25	13.09
21	73.95	3.26	170.32	17.17	287.58	8.89	117.87	39.32	402.89	108.96	11.09	12.35
22	61.65	5.07	134.07	20.86	285.81	8.06	108.17	39.09	455.34	110.88	8.97	14.43
23	57.66	4.82	166.78	17.83	288.81	7.56	90.89	40.64	380.47	155.22	7.54	14.6
24	60.76	3.98	137.96	21.84	330.32	11.78	129.26	46.45	428.02	138.09	11.06	13.73
25	68.53	4.24	141.42	19.74	308.02	8.89	103.73	52.48	419.36	177.2	7.46	13.13
26	76.83	4.44	130.19	18.7	267.92	8.86	108	56.78	417.46	151.44	6.85	12.77
27	62.57	9.83	141.02	21.33	340.66	8.79	94.54	49.38	382.15	118.18	11.38	11.76
28	67.18	3.46	116.55	18.94	323.99	8.99	109.1	42.88	453.49	214.96	5.28	12.51
29	66.61	4.66	147.16	14.94	303.05	8.79	114.17	38.75	393.54	213.55	9.11	12.54
30	68.45	19.5	127.69	20.7	257.55	8.88	126.92	45.19	398.32	121.03	8.53	12.89
31	68.1	52.84	152.17	17.13	276.81	9.49	106.29	43.34	445.03	137.59	10.17	13.33
32	62.25	4.01	147.96	18.91	300.02	7.73	114.92	46.23	426.96	129.31	12.72	12.35
33	67.35	3.32	136.26	20.75	254.94	8.18	94.87	39.58	420.08	153.72	7.07	11.57

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
34	85	2.66	137.71	17.37	316.81	8.92	93.14	30.11	432.71	129.78	12.51	13.89
35	74.06	4.21	130.1	18.48	324.37	9.08	114.29	37.97	418.31	104.78	6.93	12.09
36	67.9	2.74	146.01	20.09	358.86	8.27	99.52	28.16	491.75	193.59	20.29	8.91
QI Min	35.15	2.46	85.78	12.93	157.28	4.64	75.65	22.88	218.25	59.39	4.68	8.8
QI Avg	67.56	7.88	143.75	19.44	294.46	8.8	106.13	46.07	425.68	131.68	11.21	12.62
QI Max	91.18	60.42	197.01	28.8	379.56	15.25	129.26	114.33	491.75	214.96	36.54	16.29

Query Execution Times (Query13~Query22, RF1, RF2):

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
0	102.19	14.83	23.50	31.85	2.78	97.75	4.57	101.04	100.26	13.20	26.16	1.33
1	150.73	22.37	35.98	74.06	4.89	153.23	6.79	232.33	183.24	24.14	151.63	3.75
2	175.90	40.70	53.36	61.22	64.78	209.01	6.06	233.74	154.41	19.31	40.40	3.08
3	173.55	23.00	49.74	61.24	3.86	173.06	8.01	278.07	149.40	20.64	34.15	2.95
4	163.51	24.06	37.03	68.04	4.37	160.97	9.24	263.07	147.25	22.49	38.18	4.04
5	179.43	25.54	29.67	56.12	3.75	162.12	44.25	244.03	182.99	20.52	65.94	3.62
6	166.06	24.06	29.09	64.60	4.06	174.73	8.32	292.55	137.21	22.40	33.49	2.19
7	158.80	30.99	42.85	74.20	5.39	274.00	8.81	184.79	153.07	21.09	32.98	2.67
8	158.88	22.96	46.41	55.06	4.78	141.95	9.49	238.37	161.55	25.12	32.51	3.26
9	181.84	23.98	53.08	61.34	4.10	181.48	8.45	217.04	148.84	23.20	31.49	2.90
10	165.57	38.99	104.99	65.93	5.22	159.62	6.81	237.68	160.65	20.88	35.41	2.97
11	172.79	26.13	118.59	65.86	5.91	158.59	9.27	208.51	161.27	21.74	44.31	3.27
12	172.48	24.36	32.55	55.36	4.36	200.84	6.60	241.08	155.52	19.92	40.14	4.53
13	175.07	22.64	42.86	52.84	4.30	158.21	8.92	224.75	182.72	22.05	35.30	3.33
14	202.07	24.23	29.94	53.63	3.38	181.35	7.98	240.32	143.69	19.07	42.38	5.33
15	187.4	22.55	37.1	156.85	5.61	157.38	50.86	232.79	171.05	25.44	83.33	3.63
16	175.04	20.79	39.19	63.55	5.04	159.28	8.73	264.78	160.32	22.65	33.78	3.59
17	169.45	32.61	36	55.03	4.61	162.06	8.99	261.01	155.52	19.67	36.12	3.82
18	166.77	109.05	31.98	78.66	4.99	177.07	8.12	224.87	161.85	24.7	64.28	3.88
19	161.06	37.49	30.39	52.32	5.43	188.73	8.29	211.93	156.57	31.61	51.29	3.99
20	157.74	19.42	34.47	155.44	4.23	152.46	8.63	230.66	152.48	16.95	53	3.57
21	177.3	24.21	37.46	66.43	5.31	157.57	6.72	339.22	152.6	21.74	34.31	3.7
22	152.86	22.23	36.54	155.23	2.82	234.82	6.77	230.96	150.72	20.27	33.22	2.44
23	172.87	43.41	39.41	73.66	3.49	285.56	7.62	237.86	164.3	18.2	33.41	3.02
24	157.76	22.07	51.51	65.07	4.06	195.66	6.74	223.54	166.56	24.42	55.5	3.37

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
25	155.08	21.2	50	64.74	4.03	268.96	7.58	255.7	152.97	16.68	53.13	4.78
26	277.15	26.11	35.61	39.82	3.23	170.74	7.47	260.63	164.24	26.1	37.84	2.88
27	170.25	109.38	50.72	66.12	5.04	192.17	3.86	256.74	143.33	21	34.07	3.74
28	167.48	21.66	34.5	52.74	6.34	158.8	6.46	262.93	165.37	21.92	35.23	2.74
29	161.71	56.31	36.77	60.21	4.66	185.08	9.43	261.1	157.38	22.57	34.58	9.55
30	175.86	23.48	32.99	59.77	4.56	189.52	7.89	215.5	157.08	20.66	61.8	3.21
31	174.29	22.42	38.05	68.94	4.54	183.6	8.38	230.6	167.24	15.44	36.08	3.21
32	156.95	19.99	117.03	54.94	3.91	159.17	4.35	260.62	156.86	20.39	46.94	3.34
33	186.05	24.44	116.31	61.29	3.68	161.78	8.22	263.94	158.59	23.65	32.78	2.19
34	200.56	21.84	33.63	67.58	3.22	221.26	4.97	270.23	147.76	23.34	60.47	3.14
35	170.05	109.6	37.64	56.61	5.79	178.62	7.17	225.2	166.45	21.63	34.19	3.1
36	176.17	19.56	29.47	59.69	4.11	149.38	4.74	231.21	150.1	18.42	33.71	3.32
QI Min	102.19	14.83	23.5	31.85	2.78	97.75	3.86	101.04	100.26	13.2	26.16	1.33
QI Avg	171.59	32.94	46.39	68.54	6.07	180.45	9.61	240.25	156.79	21.44	44.96	3.5
QI Max	277.15	109.6	118.59	156.85	64.78	285.56	50.86	339.22	183.24	31.61	151.63	9.55

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TPC Benchmark H Overview

The TPC Benchmark™ H (TPC-H) is a Decision Support benchmark. It is a suite of business-oriented ad-hoc queries and concurrent modifications. The queries and the data populating the database have been chosen to have broad industry-wide relevance while maintaining a sufficient degree of ease of implementation. This benchmark illustrates Decision Support systems that:

- Examine large volumes of data
- Execute queries with a high degree of complexity
- Give answers to critical business questions

TPC-H evaluates the performance of various Decision Support systems by the execution of sets of queries against a standard database under controlled conditions. The TPC-H queries:

- Give answers to real-world business questions
- Simulate generated ad-hoc queries
- Are far more complex than most OLTP transactions
- Include a rich breadth of operators and selectivity constraints
- Generate intensive activity on the part of the database server component of the system under test
- Are executed against a database complying to specific population and scaling requirements
- Are implemented with constraints derived from staying closely synchronized with an on-line production database

0. General Items

0.1 Benchmark Sponsor

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

This benchmark was sponsored by Telecommunications Technology Association(TTA). The implementation was developed and engineered in partnership with Altibase Corp.

0.2 Parameter Settings

Settings must be provided for all customer-tunable parameters and options that have been changed from the defaults found in actual products, including but 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 the database and OS parameters used in this benchmark.

0.3 Configuration Diagrams

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 configuration diagram for both the tested and priced system is depicted in Figure 0.1. There is no difference between the priced and tested configurations.

Figure 0.1: Benchmarked and Priced Configuration

Database Server

1 x KTNF KR580S1
- **2 – Intel® Xeon® Gold 6140 CPU @2.30GHz**
  - **18 cores per processor**
- **L1 cache 32K, L2 cache 1024K, L3 cache 25344**
- **512 GB main memory**
- **2 x 600 GB SATA HDD 10Krpm (OS Disk - RAID 1)**
- **2 x 3.84 TB SATA SSD (log Disk - RAID 1)**
- **2 x 3.84 TB SATA SSD (data Disk - RAID 1)**

Clause 1: Logical Database Design

1.1 Database Definition Statements

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 build scripts that create, populate, index and analyze the tables for the TPC-H database.

1.2 Physical Organization

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.

No column reordering was used.

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 1.5.7.

No replication was used.

Clause 2: Queries and Refresh Functions

2.1 Query Language

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

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.

The TPC source based DBGEN and QGEN version 2.18.0 was 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 2.18.0 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:

- LIMIT syntax was used to restrict the number of output rows in Q2, Q3, Q10, Q18 and Q21.
- The “dateadd” function is used to perform date arithmetic in Q1, Q4, Q5, Q6, Q10, Q12, Q14 , Q15 and Q20.
- The extract(year, date) syntax is used to extract years from dates in Q7, Q9, and Q9.
- The substring(c_phone, 1, 2) syntax is used instead of substring(c_phone from 1 for 2) in Q22.
- Naming of columns of sub-select in Q13.

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.

Clause 3: Database System Properties

3.1 ACID Properties

The ACID (Atomicity, Consistency, Isolation, and Durability) properties of transaction processing systems must be supported by the system under test during the timed portion of this benchmark. Since TPC-H is not a transaction processing benchmark, the ACID properties must be evaluated outside the timed portion of the test..

All ACID tests were conducted according to specification. The Supporting Files Archive contains the source code of the ACID test scripts.

3.2 Atomicity Requirements

The system under test must guarantee that transactions are atomic; the system will either perform all individual operations on the data, or will assure that no partially-completed operations leave any effects on the data.

3.2.1 Atomicity of 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 ORDERS, LINEITEM, and HISTORY tables.

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

1. The total price from the ORDERS 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 was COMMITTED.
4. The total price from the ORDERS 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.

3.2.2 Atomicity of Aborted Transactions

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

The following steps were performed to verify the atomicity of the aborted ACID transactions:

1. The total price from the ORDERS 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 ORDERS table and the extended price from the LINEITEM table were retrieved for the same order key. It was verified that the appropriate rows had not been changed.

3.3 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 ORDERS and LINEITEM defined by (O_ORDERKEY = L_ORDERKEY)

3.3.1 Consistency Test

Verify that ORDERS 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 ORDERS and LINEITEM tables was verified based on a sample of O_ORDERKEYs.
2. At least 100 ACID Transactions were submitted.
3. The consistency of the ORDERS and LINEITEM tables was re-verified.

The Consistency test was performed as part of the Durability test explained in Section 3.5:

3.4 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 the some order.

3.4.1 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 ran to completion and did not see any uncommitted changes made by the ACID Transaction.
3. The ACID Transaction was resumed and COMMITTED.
4. A second ACID Query transaction was started and completed. It returned the data as committed by the ACID Transaction.

3.4.2 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 a read-only and a roll-backed 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 the uncommitted changes made by the ACID Transaction. The ACID Query completed.
3. The ACID Transaction was ROLLED BACK.
4. Another ACID Query was started and completed to confirm there are no changes from the ACID transaction.

3.4.3 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, Txn1, was started for a randomly selected O_KEY, L_KEY, and DELTA1. Txn1 was suspended prior to COMMIT.
2. Another ACID Transaction, Txn2, was started using the same O_KEY and L_KEY and a randomly selected DELTA2 which is different from DELTA1.
3. Txn2 was blocked by Txn1.
4. Txn1 was allowed to COMMIT and Txn2 completed.
5. It was verified that: Txn2.L_EXTENDEDPRICE = Txn1.L_EXTENDEDPRICE + (DELTA1*(Txn1.L_EXTENDEDPRICE / Txn1.L_QUANTITY))

3.4.4 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 isolation of two update transactions after the first one is rolled back:

1. An ACID Transaction, Txn1, was started for a randomly selected O_KEY, L_KEY, and DELTA1. Txn1 was suspended prior to ROLLBACK.
2. Another ACID Transaction, Txn2, was started using the same O_KEY and L_KEY and a randomly selected DELTA2 which is different from DELTA1.
3. Txn2 was blocked by Txn1.
4. Txn1 was allowed to ROLLBACK and Txn2 completed.
5. It was verified that Txn2.L_EXTENDEDPRICE = Txn1.L_EXTENDEDPRICE.

3.4.5 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 to verify isolation of concurrent read and write transactions on different tables:

1. An ACID Transaction, Txn1, was started for a randomly selected O_KEY, L_KEY, and DELTA. The ACID Transaction, Txn1, was suspended prior to COMMIT.
2. Another Transaction, Txn2, was started and did the following: For random values of PS_PARTKEY and PS_SUPPKEY, all columns of the PARTSUPP table for which PS_PARTKEY and PS_SUPPKEY are equal, are returned.
3. Txn2 completed.
4. Txn1 was allowed to COMMIT.
5. It was verified that appropriate rows in ORDERS, LINEITEM and HISTORY tables were changed.

3.4.6 Isolation Test 6 – Update Transaction during Continuous Read-Only Query Stream

Demonstrate that 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 to verify isolation of update transactions during continuous read-only query:

1. An ACID Transaction, Txn1, executing Q1 against the qualification database, was started using a randomly selected DELTA.

2. An ACID Transaction, Txn2, was started for a randomly selected O_KEY, L_KEY and DELTA.
3. Txn2 completed and appropriate rows in the ORDERS, LINEITEM and HISTORY tables had been changed.
4. Transaction Txn1 completed executing the query Q1.
5. It was verified that appropriate rows in ORDERS, LINEITEM and HISTORY tables were changed

3.5 Durability Requirements

The system under test 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 3.5.3.

3.5.1 Failure of a Durable Medium

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 storage devices containing the TPC-H tables and indexes are mirrored across one pair of SSDs. The log files are mirrored across another pair of SSDs.

The following steps were performed to test the durability after durable media failure.

1. The ORDERS and LINEITEM tables were verified to be consistent and the HISTORY table rows were counted.
2. 37 streams of the ACID transactions were started.
3. After more than 100 transactions from each stream completed, an SSD containing database tables was removed.
4. Because mirroring was used the transactions continued without any interruption.
5. After another 100 transactions from each stream completed, an SSD containing database logs was removed.
6. Because mirroring was used the transactions continued without any interruption.
7. A sample from the durability success file was matched against the contents for the HISTORY table and it was verified that the count of committed transactions matched the number of new rows in the HISTORY table.
8. The ORDERS and LINEITEM tables were verified to be consistent.

3.5.2 System Crash / Memory Failure / Loss of External Power

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.

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

Loss of External Power: Guarantee the database and committed updates are preserved during the loss of all external power for an indefinite time period

The durability of the system crash, memory failure, and loss of external power was tested together by the following steps:

1. The ORDERS and LINEITEM tables were verified to be consistent and the HISTORY table rows were counted.
2. 37 streams of the ACID transactions are started.

3. After more than 100 transactions from each stream has completed, the power cord was removed.
4. Power was restored and the system was restarted, along with the database.
5. A sample from the durability success file was matched against the contents for the HISTORY table and it was verified that the count of committed transactions matched the number of new rows in the HISTORY table.
6. The ORDERS and LINEITEM tables were verified to be consistent.

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.

The row count for each database table is shown in Table 4.1.

Table 4.1: Number of rows per table

Table	Rows
Lineitem	600,037,902
Orders	150,000,000
Partsupp	80,000,000
Part	20,000,000
Customer	15,000,000
Supplier	1,000,000
Nation	25
Region	5

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.

The database server contains four physical disks each of which is 3,840GB SATA SSD with configured capacity 3,000GB, and two disks each of which is 600GB SAS HDD 10Krpm. The two SSDs are configured as a RAID 1 volume for the DBMS REDO log. Another two SSDs are configured as a RAID 1 volumes for the DBMS data file. Two HDDs are configured as a RAID1 volume and used for the system disk. Table 4.2 below shows the configuration of the database server

Table 4.2: Distribution of Tables and Logs Across Media

Device/Partition Name	RAID Format	Configured (Partition) Size / Physical Volume Size	Content
/dev/sda1	RAID 1	1 GB / 600 GB	BOOT
/dev/sda2	RAID 1	599 GB / 600 GB	OS
/dev/sdb	RAID 1	3,000 GB / 3,840 GB	DBMS REDO logs + Flat Files
/dev/sdc	RAID 1	3,000 GB / 3,840 GB	DBMS data files

4.3 Database partition/replication mapping

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

Horizontal partitioning was not used.

4.4 Data redundancy mechanisms

Implementations may use data redundancy mechanism(s). The type of data redundancy mechanisms(s) and any configuration parameters, i.e., RAID level must be disclosed for each device.

The redundancy levels for each component is shown in Table 4.3.

Table 4.3: Redundancy levels per items

Items	Storage Redundancy Levels
Base Tables and REDO logs	RAID 1
DBMS Temporary Space	No RAID (in memoy)
OS and DBMS Software	RAID 1

4.5 Modifications to the DBGEN

*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. If a program other than DBGEN was used to populate the database, it must be disclosed in its entirety.*

DBGEN version 2.18.0 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 00d 01h 13m 16s.

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. For the reporting of configured disk capacity, gigabyte (GB) is defined to be 2^30 bytes.

The computation of the data storage ratio is shown in Table 4.4.

Table 4.4: Data Storage Ratio Computation

Disk Type	GB per Disk*	GiB per Disk**	# of disks	Total Space (GiB)
HDD	600 GB	558.79 GiB	2	1,117.58
SSD	3,840 GB	3,576.28 GiB	4	14,305.12
Total Storage				15,422.70
Data Storage Ratio				**154.23**

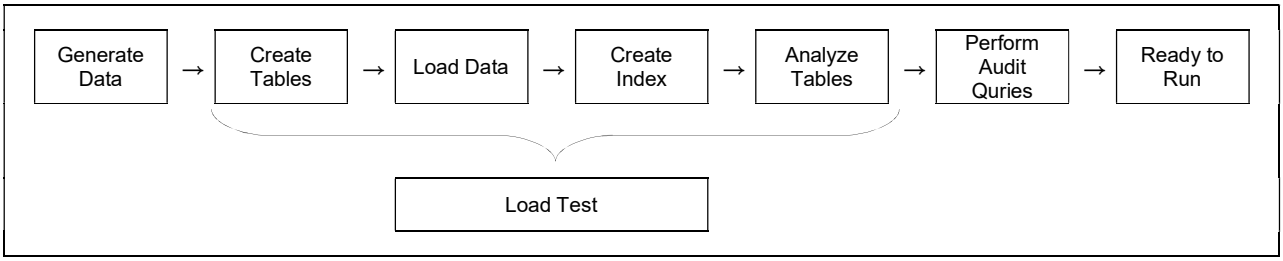
4.8 Database Load Mechanism Details and Illustration

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

The database was loaded using data generated by DBGEN and stored in flat files located on the OS partition of the system disk, as shown in Table 4.2.

The database load mechanism is depicted in Figure 4.5.

Figure 4.5: Database load mechanism



4.9 Qualification Database Configuration

Any differences between the configuration of the qualification database and the test database must be disclosed.

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

4.10 Memory Ratio

The memory to database size ratio must be disclosed.

The computation of the percentage of memory to database size is shown in Table 4.6.

Table 4.6: Percentage of Memory Computation

Memory Size (GB)	512
Scale Factor (SF)	100
Percentage of Memory	512.00%

Clause 5: Performance Metrics

5.1 System Activity Between Load and Performance Tests

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, command logs and system activity .

There was no system activity on the SUT between the conclusion of the load and the beginning of the performance test.

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 Function by refresh stream
2. Stream 0 Execution by query stream
3. RF2 Refresh Function by refresh stream

5.3 Timing Intervals for Each Query and Refresh Functions

The timing intervals (see Clause 5.3.7) for each query and for both refresh functions must be reported for the power test.

The timing intervals for each query and for both refresh functions are contained in the Numerical Quantities section of the Executive Summar at the beginning of this report..

5.4 Number of Streams for the Throughput Test

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

36 query 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 stream for the throughput test must be disclosed.

The throughput test start time and finish time for each stream are contained in the Numerical Quantities section of the Executive Summary at the beginning of this report.

5.6 Total Elapsed Time of the Measurement Interval

The total elapsed time of the measurement interval (see Clause 5.3.6) must be reported for the throughput test.

The total elapsed time of the throughput test is contained in the Numerical Quantities section of Executive Summary at the beginning of this report.

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

The start time and, finish time for each refresh function in the refresh stream for the throughput test must be disclosed.

The start and finish times for each refresh function in the refresh stream are contained in the Numerical Quantities section of the Executive Summary at the beginning of this report.

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 refresh function for each stream are contained in the Numerical Quantities section of the Executive Summary at the beginning of this report.

5.9 Performance Metrics

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

The performance metrics, and the numbers on which they are based, are contained in the Numerical Quantities section of the Executive Summary at the beginning of this report.

5.10 The Performance Metric and Numerical Quantities from Both Runs

A description of the method used to determine the reproducibility of the measurement results must be reported. This must include the performance metrics (QppH and QthH) from the reproducibility runs

Performance results from the first two executions of the TPC-H benchmark is shown in Table 5.1.

Table 5.1: Performance results for both runs

Run ID	QppH@100GB	QthH@100GB	QphH@100GB
Run1	15,733.9	122,509.5	43,903.9
Run2	16,204.6	121,986.4	44,460.6

5.11 System Activity Between Performance Tests

Any activity on the SUT that takes place between the conclusion of Run1 and the beginning of Run2 must be fully disclosed including system activity, listings of scripts or command logs along with any system reboots or database restarts.

There was no activity on the SUT between Run1 and Run 2.

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 Output Validation

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

The Supporting Files Archive contains the output of the query validation test.

Clause 6: SUT and Driver Implementation

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.

All stream executions are controlled using shell scripts. QGEN was used to produce query text at the beginning of the performance tests.

For each power-test run:

1. A shell script is started, executes RF1 and then waits for the signal from the query shell script.
2. A shell script is started, executes the 22 queries in the required order for stream 0 and then signals to the shell script started in step 1.
3. The shell script started in step 1 is released and executes RF2.

For each throughput-test run:

1. The queries as generated by QGEN are submitted in the order defined by Clause 5.3.5.4 from the driver in several streams (the number of streams is listed in the Numerical Quantities).
2. In parallel with the queries, pairs of RF1/RF2 are executed sequentially in one update stream.

The source code of the scripts used is disclosed in the Supporting Files 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 scripts used to implement the ISL are disclosed in the Supporting Files Archive.

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.

Clause 7: Pricing

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 be reported.

A detailed list of all hardware and sofrware used in the priced system is in the Executive Summary section at the beginning of this report. The price quotations are included in the 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.

A detailed list of all hardware and sofrware, including 3-year maintenance and applicable discounts, is in the Executive Summary section at the beginning of this report. The price quotations are included in the APPENDIX A.

7.3 Availability Dates

The committed delivery date for general availability (availability date) of products used in the price calculations must be reported. When the priced system includes the product with different availability, the single availability date reported on the first page of the 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.

The total system is available now.

Clause 8: Supproting Files Index Table

An index for all files included in the supporting files archive as required by Clause 8.3.2 through 8.3.8 must be provided in the report.

Table 8.1: File list per each Clause

Clause	Description	Archive File	Pathname
Clause 1	DB creation scripts	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit
	System and DB configurations	CONFIG.zip	SupportingFiles/CONFIG
Clause 2	Minor query modifications	VALID.zip	SupportingFiles/VALID/QUERY/Qual_readme.txt
Clause 3	ACID scripts	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit/acid
	ACID output	ACID.zip	SupportingFiles/ACID
Clause 4	Database Load scripts	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit
	Qualification output	VALID.zip	SupportingFiles/VALID
Clause 5	Query output results	PERFORMANCE.zip	SupportingFiles/PERFORMANCE/RUN1 SupportingFiles/PERFORMANCE/RUN2
Clause 6	Implementation Specific layer source code	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit
Clause 7	There are no files to be included for Clause 7	N/A	N/A
Clause 8	Query substitution parameters and seeds	PERFORMANCE.zip	SupportingFiles/ PERFORMANCE/QUERY/parameter*.txt
	RF function source code	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit/rf

Clause 9: Auditor Attestation

9.1 Auditor Information

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 benchmark was audited by:

InfoSizing

Doug Johnson
63 Lourdes Drive
Leominster, MA 01453-6709

Phone: +1 (978) 343-6262

www.sizing.com

9.2 Attestation Letter

The auditor's attestation letter is included in the following pages.

Attestation Letter

InfoSizing

TPC Certified Auditor

Benchmark sponsor: Hyo-Sil Kim
Telecommunications Technology Association (TTA)
Bundang-ro 47, Bundang-gu, Seongnam-city
Gyeonggi-do, 13591, Republic of Korea

February 16, 2021

I verified the TPC Benchmark H (TPC-H™ v2.18.0) performance of the following configuration:

Platform:	KTNF KR580S1
Operating System:	Red Hat Enterprise Linux 7.9
Database Manager:	Altibase v7.1
Other Software:	n/a

The results were:

Performance Metric	**43,903.9QphH@100GB**
TPC-H Power	15,733.9
TPC-H Throughput	122,509.5
Database Load Time	1h 13m 16s

Server	**KTNF KR580S1, with:**		
CPUs	2x Intel® Xeon® Gold 6140 @2.3 GHz (18 cores, 36 threads)		
Memory	512 GB		
Disks	***Qty***	***Size***	***Type***
	2	600 GB	SAS 10K rpm HDD
	4	3.84 TB	SATA 6 Gbps SSD

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:

- The database records were defined with the proper layout and size
- The database population was generated using DBGen
- The database was properly scaled to 100GB and populated accordingly
- The compliance of the database auxiliary data structures was verified
- The database load time was correctly measured and reported
- The required ACID properties were verified and met

63 Lourdes Dr. | Leominster, MA 01453 | 978-343-6562 | www.sizing.com

- 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 36 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,

Doug Johnson, TPC Certified Auditor

APPENDIX A: Price Quotations

Server (KTNF Server Hardware and 3-Year Maintenance)

견 적 서

TEL :
FAX :

TTA 貴中

참 조 :

귀사의 성공적인 사업을 진심으로 기원하며 아래와 같이 견적드립니다.
In compliance with your inquiry, we hereby
submit our quotation as mentioned here under.

견적 금액 합계 :
₩31,152,000 (부가가치세 포함)

납품 예정 일자 : 발주일로부터 4주일이내
견적 유효 기간 : 견적일로부터 120일
지 불 조 건 : 현금
견 적 담 당 : 김 종 빈 부장 (Mobile : 010-8753-5644)
견 적 일 자 : 2021년 02월 09일

KTNF
주식회사 케이티엔에프
서울시 강서구 마곡중앙 8로 3길 21
(마곡동, KTNF빌딩)
TEL : 02-865-5200 / FAX : 02-855-8814

등록번호	106-86-07697
대표이사	이 중 연
업 태	제 조
종 목	컴퓨터주변기기

항목 Item	Part Number	규 격 Specification	수량 Q'ty	단 가 Unit Price	합 계 Amount	세 액 (VAT별도)
Sys		KTNF KR580S1 Server	1	23,820,000	23,820,000	2,382,000
		KTNF KR580S1 Server				
Sys	HDD0043A	KR580S1 (BASE System)	1			-
	Processor/Cache	• Two socket Intel® Xeon® Scalable family, TDP up to 205Watts				
	Memory	• Up to 1.5TB DDR4 ECC 2400/2666MT/s RDIMMs; (24 DIMMs)				
	Expansion Slot	• Riser#1 (3 x PCIex8 Gen3), Riser#2 (3 x PCIex8 Gen3) 1x OCP2.0 Gen3 Type A connetor				
	LAN	• 2 Port Intel 1GbE RJ-45 Ethernet Controller				
	Drive Bays	• 8 x 3.5" or 2.5" 12Gbps SAS/SATA Hot-swap drive bays (Front)				
	Storage	• 4x Oculink PCIe SSD / 1x M.2 (PCIe x4) / 2x SATA3 3x miniSAS HD (12x SATA3.0)				
	FAN	• 6 x Hot-Swap system Cooling fans				
	Management	• AST2500 / 1x Dedicated mgmt RJ-45 port				
	Power Supply	• 800W(1+1) Redundant Power Supply				
		*** Option (Server 1대 사양) ***				
CPU	HAX0116A	Intel Xeon Scalable Gold 6140 (18Core 2.3GHz/24.75MB)	2			-
RAM	HCL0015A	64GB DDR4 2400 ECC RDIMM Memory	8			-
SSD	HCZ0045A	3.84TB 2.5" hot-swap SATA SSD	2			-
SSD	HCZ0045A	3.84TB 2.5" hot-swap SATA SSD	2			-
HDD	HBH0010A	600GB 2.5" hot-swap SAS HDD 10Krpm	2			-
RAID	HCH0037A	HW RAID Controller (0, 1, 10)	1			-
NIC	HBV0080A	Intel Dual Port 10G SFP+ Network Adapter	2			-
SFP+	HCW0009A	SFP+ Tranceiver	4			-
ETC	HDM0001A	Trackball Mini Keyboard	1			-
Monitor	HDM0002A	27-inch Monitor	1			-
		Maintenance -7x24x4 Care pack (3y)	1	4,500,000	4,500,000	450,000

Other Comment/Remarks

1. 상기 단가는 부가세 별도가입니다.
2. 자세한 사항은 전화주시기 바랍니다.

소 계 :	₩28,320,000
세 액 :	₩2,832,000
합 계 :	₩31,152,000

1. 상기 제품은 대외무역법 제19조 제1항에 따라 전략물자에 해당되며, 본 물품의 해외수출시 대외무역법에 따라 전략물자 기술 수출입 통합고시에서 규정하는 허가기관의 장으로부터 수출허가를 득하시기 바랍니다.
2. 본 제품을 제3자에게 양도 또는 재판매할 경우 해당 제3자에게 상기에 언급한 의무사항들을 사전에 충분히 고지하시기 바랍니다.

Linux OS (Red Hat Enterprise Linux Operation System Platform)

rockPLACE
(주)락플레이스 www.rockplace.co.kr

㈜락플레이스
135-120 서울시 강남구 신사동 634-10 윤당빌딩 3층 Tel.02)6251.7788 Fax.02)6251.6677

rockPLACE, Inc.
3F, Yundang bldg, 634-10, Shinsa-dong, Gangnam-gu,Seoul, Korea Tel : 822-6251-7788 Fax: 822-6251-6677

견 적 서

REF No.	: 2021RP02-0203		TERMS AND CONDITION
DATE	: 2021. 02. 02.		
COMPANY	: TTA		납 기 : 발주후 4주이내
ATTN	: 김효실 연구원님 귀하	TEL :	유지보수 : 납품일로부터 1년
Email	: hyosil.kim@tta.or.kr		결제조건 : 익월말 현금
FROM	: ㈜락플레이스 이왕모 과장	TEL : 010-9116-4680	유효기간 : 견적일로부터 4개월

下記와 같이 見積합니다.

㈜ 락플레이스
대표이사 서 동 식

ITEM DESCRIPTION (VAT 별도, 단위 : 원)

Part No.	Description	수량	소비자가	공급단가	공급합계
OS	Red Hat Enterprise Linux Operating System Platform				
RH00004F3	Red Hat Enterprise Linux Server, Standard (Physical or Virtual Nodes) 3Year support : Easy ISOs: OS, Source, Documentation ISO Images 가상화 Guest OS : 2guests Red Hat Network 서비스 : 3년 Phone,email Support : 09:00 – 17:00 Scope of Coverage : Standard Maximum Memory Support: Unlimited	1	4,089,000	2,400,000	2,400,000
연간기술지원	연간 방문 기술지원 (옵션)				
RP-CPS(OS)	rockPLACE Support Carepack - Linux Standard (3년) per Server 3 Year, 24x7, 4hr response 이메일, 전화, 원격지원, 현장지원 서비스 On Site Support - Installation & Startup Service Included - Problem tracking/Emergency assistance - Update, Patch 작업 지원 - 서비스, 시스템 환경, 네트워크 환경 설정 변경 지원 - 인수 시험, 성능 시험, 비상 복구 훈련 지원	1	6,000,000	3,000,000	3,000,000
소 계 금 액					5,400,000

합 계	5,400,000
부가세	540,000
합 계(부가세포함)	5,940,000

Remarks

1. Red Hat 제품은 년간 Subscription 제품이며, 기간이 만료되실 경우 Renewal을 하셔야합니다.
2. 발주 시에는 반드시 고객정보(엔드유저명, 담당자, 연락처, Email)가 있어야 합니다.
3. OnSite 방문지원이 필요하실 경우에는 케어팩을 구매하셔야 합니다.

DBMS (Altibase v7.1 for Linux)

ALTIBASE

Quotation (견적서)

견적일자 :	2021-02-01	(주)알티베이스	
견적번호 :	AT-20210201-PROJ-01	대표이사	장 재 웅 (직인생략)
SID No. :		주 소 :	서울시 구로구 디지털로 306, 808호 (구로동, 대륭포스트타워 2차)
사 업 명 :			
수 신 :	김효실 책임	전 화 :	02-2082-1000
연 락 처 :	hyosil.kim@tta.or.kr	팩 스 :	02-2082-1099
작 성 자 :	박준호 (jason.park@altibase.com)		

제안 금액 (VAT 별도) : ₩ 35,120,160

* 서버 사양 : x86 Server, 36Core 1대

* 유상 유지보수 기간 3년

(단위: 원, 부가세 별도)

No.	Description	Unit Price	Copy	서버수	Total Copy	Total Price	공급금액	할인율
1	x86 Server 36Core 1대							
	Altibase DBMS	83,520,000	1.00	1	1.0	83,520,000	24,220,800	71%
	Memory Expansion	2,500,000	-	-		-	-	
	라이선스 공급 금액						24,220,800	
2	유상 유지보수							
	24*7*4 hours of Technical Supports Fee	24,220,800			3years	72,662,400	10,899,360	85%
		-	-	-		-	-	
	유지보수 공급 금액						10,899,360	
	공급 금액 합계						35,120,160	

※ Remarks

1. 견적유효기간 : 견적일로부터 120일