TPC Benchmark™ H

Full Disclosure Report

First Edition

20–Dec–2018

Using

Goldilocks v3.1 Standard Edition

on

KTNF KR580S1

First Edition: December 2018

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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.

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Abstract

This report documents the methodology and results of the TPC Benchmark™ H (TPC-H) test conducted by TTA on the Goldilocks v3.1 Standard Edition on KTNF KR580S1

Goldilocks v3.1 Standard Edition on KR580S1

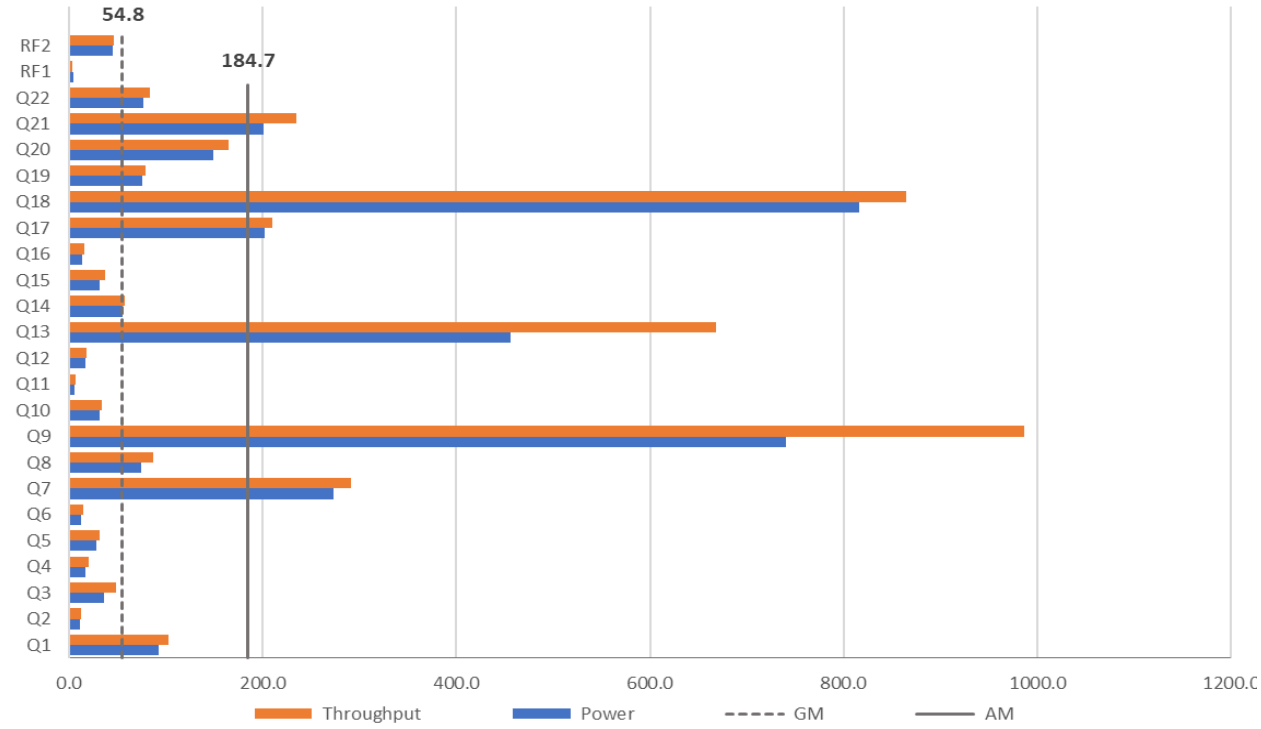
Company Name	System Name	Database Software	Opeating System
Telecommunications Technology Association	KTNF KR580S1	Goldilocks v3.1 Standard Edition	RedHat Enterprise Linux 7.6

TPC Benchmark™ H Metrics

Total System Cost	Composite Metric	Price/Performance	Availability Date
450,416,000₩ (KRW)	24,037 QphH@100GB	18,739 ₩/QphH@100GB	Available Now

	Goldilocks v3.1 Standard Edition on KTNF KR580S1	**TPC-H Rev. 2.17.3** **TPC-Pricing Rev. 2.3.0** **Report Date:** December 20, 2018
Total System Cost	**Composite Query per Hour Metric**	**Price / Performance**
450,416,000₩	**24,037 QphH@100GB**	**18,739₩/QphH@100GB**

Database Size	Database Manager	Operating System	Other Software	Availability Date
100GB	Goldilocks v3.1 Standard Edition	RHEL 7.6	None	Available Now



Database Load Time = **00d 00h 39m 37s**	Storage Redundancy Level	
Load included backup: **N**	Base Tables and REDO logs	**RAID 1**
Total Data Storage/Database Size = **196.29**	DBMS Temporary Space	**No RAID (in-memory)**
Memory/Database Size = **4,608%**	OS and DBMS Software	**No RAID**

System Components	**System Total**	**Per Node**
Nodes:	6	1
Intel(R) Xeon(R) Gold 6150 @ 2.70GHz	12	2
Cores/Threads:	216/216	36/36
Memory:	4,608GB	768GB
Internal Disk Drives (256GB SATA SSD):	12	2
(600GB SAS HDD 10Krpm):	30	5
Total Storage	**19,629GB**	**3,271.5GB**

Goldilocks v3.1 Standard Edition on KTNF KR580S1

TPC-H Rev. 2.17.3
TPC-Pricing Rev. 2.3.0

Report Date:
December 20, 2018

Description	Part Number	Key	Unit Price	Qty	Price	3-Yr. Maint. Price
Hardware						
Server - KTNF KR580S1		1	26,250,000 ₩	6	157,500,000 ₩	
DB Server-K580S1 Barebone	HDD0043A	1	(included)			
Intel Xeon Scalable Gold 6150 Processor (18Core 2.7GHz/24.75MB)	HAK0097A	1	(included)	2		
64GB DDR4 2400 ECC RDIMM Memory	HCL0015A	1	(included)	12		
256GB 2.5" SATA SSD	HCZ0032A	1	(included)	2		
600GB 2.5" hot-swap SAS HDD 10Krpm		1	(included)	5		
Broadcom MEGARAID SAS 9361-8i RAID Card (1GB Cache)	HCH0037A	1	(included)	1		
Intel 2port 10G LC Fiber Server Adapter	HBV0080A	1	(included)	1		
SFP+ Transceiver	HCW0009A	1	(included)	2		
Trackball Mini Keyboard	HDM0001A	1	(included)	1		
KTNF 27-inch Monitor	HDM0002A	1	(included)	1		
Maintenance - 7x24x4 Care Pack (3-yrs)		1	4,500,000 ₩	6		27,000,000 ₩
Server Rack(42U)	RAC0001A	1	1,150,000 ₩	1	1,150,000 ₩	
Dell EMC Switch S4128F-ON (7x24x4 Onsite Service, 3-yrs)	S4128F-ON-RA	2	6,400,000 ₩	1	6,400,000 ₩	
Hardware Sub Total					**165,050,000 ₩**	**27,000,000 ₩**
Software						
Red Hat Enterprise Linux Server Standard 3yrs	RH00004F3	3	3,978,000 ₩	6	23,868,000 ₩	
RHEL Server Standard Maintenance - 3yrs 24x7x4hrs	RH00003F3	3	6,468,000 ₩	6		38,808,000 ₩
Goldilocks v3.1 Standard Edition		4	96,000,000 ₩	6	576,000,000 ₩	
Goldilocks v3.1 Standard Edition Technical Supports – 1yr 24x7x4hrs		4	10,000,000 ₩	3		30,000,000 ₩
Software Sub Total					**599,868,000 ₩**	**68,808,000 ₩**

Discounts*		
SW Discount - RHEL	- 10,008,000 ₩	- 16,302,000 ₩
SW Discount - Goldilocks	- 384,000,000 ₩	
Discounts Sub Total	**- 394,008,000 ₩**	**- 16,302,000 ₩**
Total	**370,910,000 ₩**	**79,506,000 ₩**

* 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) DAEWON CTS CO. LTD.

3) Rockplace Inc. 4) Sunjesoft Inc.

All of the prices are based on South Korea's currency, KRW (₩, Korean Won) and excluded VAT.

3 Yr. cost of ownership KRW(₩):	**450,416,000 ₩**
QphH@100GB:	**24,037**
₩/QphH@100GB:	**18,739 ₩**

Benchmark implementation and results independantly audited by Francois Raab 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	=	196.29
Start of database load time	=	12-10-2018 17:31:28
End of database load time	=	12-10-2018 18:11:05
Database Load Time	=	00d 00h 39m 37s
Query Streams for Throughput Test	=	108
TPC-H Power	=	6,569.7
TPC-H Throughput	=	87,945.7
TPC-H Composite Query-per-Hour Rating (QphH@100GB)	=	24,307.0
Total System Price Over 3 Years (₩, KRW)	=	450,416,000₩
TPC-H Price/Performance Metric (₩/QphH@100GB)	=	18,739

Measurement Intervals:

Measurement Interval in Throughput Test (Ts)	=	9,726 seconds

Duration of Stream Execution:

Power Run	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration (sec)
	1210181105	2018-12-10 18:11:06	2018-12-10 18:11:10	2018-12-10 19:08:05	00 00:56:55 3,415
		2018-12-10 18:11:10	2018-12-10 19:08:05	2018-12-10 19:08:50	

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
1	1210181106	2018-12-10 20:22:14 2018-12-10 20:22:19	2018-12-10 19:08:49 2018-12-10 20:14:34	2018-12-10 20:22:19 2018-12-10 20:23:05	00 01:05:45 3,945
2	1210181107	2018-12-10 20:23:05 2018-12-10 20:23:09	2018-12-10 19:08:49 2018-12-10 20:16:49	2018-12-10 20:23:09 2018-12-10 20:23:56	00 01:08:00 4,080
3	1210181108	2018-12-10 20:23:56 2018-12-10 20:23:59	2018-12-10 19:08:49 2018-12-10 20:14:56	2018-12-10 20:23:59 2018-12-10 20:24:46	00 01:06:07 3,967
4	1210181109	2018-12-10 20:24:46 2018-12-10 20:24:49	2018-12-10 19:08:49 2018-12-10 20:15:46	2018-12-10 20:24:49 2018-12-10 20:25:36	00 01:06:57 4,017
5	1210181110	2018-12-10 20:25:36 2018-12-10 20:25:40	2018-12-10 19:08:49 2018-12-10 20:18:25	2018-12-10 20:25:40 2018-12-10 20:26:24	00 01:09:36 4,176
6	1210181111	2018-12-10 20:26:24 2018-12-10 20:26:27	2018-12-10 19:08:49 2018-12-10 20:10:56	2018-12-10 20:26:27 2018-12-10 20:27:12	00 01:02:07 3,727
7	1210181112	2018-12-10 20:27:12 2018-12-10 20:27:15	2018-12-10 19:08:49 2018-12-10 20:17:12	2018-12-10 20:27:15 2018-12-10 20:28:03	00 01:08:23 4,103
8	1210181113	2018-12-10 20:28:03 2018-12-10 20:28:05	2018-12-10 19:08:49 2018-12-10 20:18:37	2018-12-10 20:28:05 2018-12-10 20:28:53	00 01:09:48 4,188
9	1210181114	2018-12-10 20:28:53 2018-12-10 20:28:55	2018-12-10 19:08:49 2018-12-10 20:18:42	2018-12-10 20:28:55 2018-12-10 20:29:40	00 01:09:53 4,193
10	1210181115	2018-12-10 20:29:40 2018-12-10 20:29:43	2018-12-10 19:08:49 2018-12-10 20:17:27	2018-12-10 20:29:43 2018-12-10 20:30:28	00 01:08:38 4,118
11	1210181116	2018-12-10 20:30:28 2018-12-10 20:30:31	2018-12-10 19:08:49 2018-12-10 20:22:15	2018-12-10 20:30:31 2018-12-10 20:31:18	00 01:13:26 4,406
12	1210181117	2018-12-10 20:31:18 2018-12-10 20:31:21	2018-12-10 19:08:49 2018-12-10 20:19:52	2018-12-10 20:31:21 2018-12-10 20:32:09	00 01:11:03 4,263
13	1210181118	2018-12-10 20:32:09 2018-12-10 20:32:12	2018-12-10 19:08:49 2018-12-10 20:12:45	2018-12-10 20:32:12 2018-12-10 20:33:01	00 01:03:56 3,836
14	1210181119	2018-12-10 20:33:01 2018-12-10 20:33:04	2018-12-10 19:08:49 2018-12-10 20:18:28	2018-12-10 20:33:04 2018-12-10 20:33:52	00 01:09:39 4,179
15	1210181120	2018-12-10 20:33:52 2018-12-10 20:33:55	2018-12-10 19:08:49 2018-12-10 20:16:05	2018-12-10 20:33:55 2018-12-10 20:34:41	00 01:07:16 4,036
16	1210181121	2018-12-10 20:34:41 2018-12-10 20:34:44	2018-12-10 19:08:49 2018-12-10 20:14:48	2018-12-10 20:34:44 2018-12-10 20:35:30	00 01:05:59 3,959
17	1210181122	2018-12-10 20:35:30 2018-12-10 20:35:33	2018-12-10 19:08:49 2018-12-10 20:13:29	2018-12-10 20:35:33 2018-12-10 20:36:19	00 01:04:40 3,880

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
18	1210181123	2018-12-10 20:36:19	2018-12-10 19:08:49	2018-12-10 20:36:21	00 01:02:35 3,755
		2018-12-10 20:36:21	2018-12-10 20:11:24	2018-12-10 20:37:09	
19	1210181124	2018-12-10 20:37:09	2018-12-10 19:08:49	2018-12-10 20:37:12	00 01:07:29 4,049
		2018-12-10 20:37:12	2018-12-10 20:16:18	2018-12-10 20:37:58	
20	1210181125	2018-12-10 20:37:58	2018-12-10 19:08:49	2018-12-10 20:38:01	00 01:07:07 4,027
		2018-12-10 20:38:01	2018-12-10 20:15:56	2018-12-10 20:38:47	
21	1210181126	2018-12-10 20:38:47	2018-12-10 19:08:49	2018-12-10 20:38:49	00 01:08:06 4,086
		2018-12-10 20:38:49	2018-12-10 20:16:55	2018-12-10 20:39:36	
22	1210181127	2018-12-10 20:39:36	2018-12-10 19:08:49	2018-12-10 20:39:38	00 01:06:51 4,011
		2018-12-10 20:39:38	2018-12-10 20:15:40	2018-12-10 20:40:24	
23	1210181128	2018-12-10 20:40:24	2018-12-10 19:08:49	2018-12-10 20:40:26	00 01:09:09 4,149
		2018-12-10 20:40:26	2018-12-10 20:17:58	2018-12-10 20:41:14	
24	1210181129	2018-12-10 20:41:14	2018-12-10 19:08:49	2018-12-10 20:41:17	00 01:06:07 3,967
		2018-12-10 20:41:17	2018-12-10 20:14:56	2018-12-10 20:42:02	
25	1210181130	2018-12-10 20:42:02	2018-12-10 19:08:49	2018-12-10 20:42:05	00 01:04:07 3,847
		2018-12-10 20:42:05	2018-12-10 20:12:56	2018-12-10 20:42:51	
26	1210181131	2018-12-10 20:42:51	2018-12-10 19:08:49	2018-12-10 20:42:54	00 01:07:54 4,074
		2018-12-10 20:42:54	2018-12-10 20:16:43	2018-12-10 20:43:41	
27	1210181132	2018-12-10 20:43:41	2018-12-10 19:08:49	2018-12-10 20:43:44	00 01:09:22 4,162
		2018-12-10 20:43:44	2018-12-10 20:18:11	2018-12-10 20:44:31	
28	1210181133	2018-12-10 20:44:31	2018-12-10 19:08:49	2018-12-10 20:44:34	00 01:09:40 4,180
		2018-12-10 20:44:34	2018-12-10 20:18:29	2018-12-10 20:45:22	
29	1210181134	2018-12-10 20:45:22	2018-12-10 19:08:49	2018-12-10 20:45:25	00 01:08:28 4,108
		2018-12-10 20:45:25	2018-12-10 20:17:17	2018-12-10 20:46:13	
30	1210181135	2018-12-10 20:46:13	2018-12-10 19:08:49	2018-12-10 20:46:16	00 01:09:25 4,165
		2018-12-10 20:46:16	2018-12-10 20:18:14	2018-12-10 20:47:04	
31	1210181136	2018-12-10 20:47:04	2018-12-10 19:08:49	2018-12-10 20:47:07	00 01:08:53 4,133
		2018-12-10 20:47:07	2018-12-10 20:17:42	2018-12-10 20:47:53	
32	1210181137	2018-12-10 20:47:53	2018-12-10 19:08:49	2018-12-10 20:47:56	00 01:04:19 3,859
		2018-12-10 20:47:56	2018-12-10 20:13:08	2018-12-10 20:48:43	
33	1210181138	2018-12-10 20:48:43	2018-12-10 19:08:49	2018-12-10 20:48:46	00 01:07:13 4,033
		2018-12-10 20:48:46	2018-12-10 20:16:02	2018-12-10 20:49:32	
34	1210181139	2018-12-10 20:49:32	2018-12-10 19:08:49	2018-12-10 20:49:35	00 01:08:32 4,112
		2018-12-10 20:49:35	2018-12-10 20:17:21	2018-12-10 20:50:23	

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
35	1210181140	2018-12-10 20:50:23	2018-12-10 19:08:49	2018-12-10 20:50:26	00 01:11:04 4,264
		2018-12-10 20:50:26	2018-12-10 20:19:53	2018-12-10 20:51:16	
36	1210181141	2018-12-10 20:51:16	2018-12-10 19:08:49	2018-12-10 20:51:19	00 01:06:17 3,977
		2018-12-10 20:51:19	2018-12-10 20:15:06	2018-12-10 20:52:07	
37	1210181142	2018-12-10 20:52:07	2018-12-10 19:08:49	2018-12-10 20:52:10	00 01:03:55 3,835
		2018-12-10 20:52:10	2018-12-10 20:12:44	2018-12-10 20:52:58	
38	1210181143	2018-12-10 20:52:58	2018-12-10 19:08:49	2018-12-10 20:53:01	00 01:08:40 4,120
		2018-12-10 20:53:01	2018-12-10 20:17:29	2018-12-10 20:53:50	
39	1210181144	2018-12-10 20:53:50	2018-12-10 19:08:49	2018-12-10 20:53:53	00 01:09:34 4,174
		2018-12-10 20:53:53	2018-12-10 20:18:23	2018-12-10 20:54:42	
40	1210181145	2018-12-10 20:54:42	2018-12-10 19:08:49	2018-12-10 20:54:44	00 01:06:56 4,016
		2018-12-10 20:54:44	2018-12-10 20:15:45	2018-12-10 20:55:32	
41	1210181146	2018-12-10 20:55:32	2018-12-10 19:08:49	2018-12-10 20:55:35	00 01:12:58 4,378
		2018-12-10 20:55:35	2018-12-10 20:21:47	2018-12-10 20:56:23	
42	1210181147	2018-12-10 20:56:23	2018-12-10 19:08:49	2018-12-10 20:56:26	00 01:09:37 4,177
		2018-12-10 20:56:26	2018-12-10 20:18:26	2018-12-10 20:57:13	
43	1210181148	2018-12-10 20:57:13	2018-12-10 19:08:49	2018-12-10 20:57:16	00 01:05:04 3,904
		2018-12-10 20:57:16	2018-12-10 20:13:53	2018-12-10 20:58:03	
44	1210181149	2018-12-10 20:58:03	2018-12-10 19:08:49	2018-12-10 20:58:06	00 01:10:01 4,201
		2018-12-10 20:58:06	2018-12-10 20:18:50	2018-12-10 20:58:53	
45	1210181150	2018-12-10 20:58:53	2018-12-10 19:08:49	2018-12-10 20:58:56	00 01:06:34 3,994
		2018-12-10 20:58:56	2018-12-10 20:15:23	2018-12-10 20:59:42	
46	1210181151	2018-12-10 20:59:42	2018-12-10 19:08:49	2018-12-10 20:59:44	00 01:08:25 4,105
		2018-12-10 20:59:44	2018-12-10 20:17:14	2018-12-10 21:00:32	
47	1210181152	2018-12-10 21:00:32	2018-12-10 19:08:49	2018-12-10 21:00:35	00 01:06:03 3,963
		2018-12-10 21:00:35	2018-12-10 20:14:52	2018-12-10 21:01:21	
48	1210181153	2018-12-10 21:01:21	2018-12-10 19:08:49	2018-12-10 21:01:24	00 01:06:43 4,003
		2018-12-10 21:01:24	2018-12-10 20:15:32	2018-12-10 21:02:12	
49	1210181154	2018-12-10 21:02:12	2018-12-10 19:08:49	2018-12-10 21:02:14	00 01:08:27 4,107
		2018-12-10 21:02:14	2018-12-10 20:17:16	2018-12-10 21:03:00	
50	1210181155	2018-12-10 21:03:00	2018-12-10 19:08:49	2018-12-10 21:03:03	00 01:08:15 4,095
		2018-12-10 21:03:03	2018-12-10 20:17:04	2018-12-10 21:03:48	
51	1210181156	2018-12-10 21:03:48	2018-12-10 19:08:49	2018-12-10 21:03:51	00 01:08:31 4,111
		2018-12-10 21:03:51	2018-12-10 20:17:20	2018-12-10 21:04:37	

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
52	1210181157	2018-12-10 21:04:37	2018-12-10 19:08:49	2018-12-10 21:04:40	00 01:07:37 4,057
		2018-12-10 21:04:40	2018-12-10 20:16:26	2018-12-10 21:05:26	
53	1210181158	2018-12-10 21:05:26	2018-12-10 19:08:49	2018-12-10 21:05:29	00 01:13:12 4,392
		2018-12-10 21:05:29	2018-12-10 20:22:01	2018-12-10 21:06:14	
54	1210181159	2018-12-10 21:06:14	2018-12-10 19:08:49	2018-12-10 21:06:17	00 01:05:56 3,956
		2018-12-10 21:06:17	2018-12-10 20:14:45	2018-12-10 21:07:03	
55	1210181160	2018-12-10 21:07:03	2018-12-10 19:08:49	2018-12-10 21:07:05	00 01:09:33 4,173
		2018-12-10 21:07:05	2018-12-10 20:18:22	2018-12-10 21:07:51	
56	1210181161	2018-12-10 21:07:51	2018-12-10 19:08:49	2018-12-10 21:07:54	00 01:07:55 4,075
		2018-12-10 21:07:54	2018-12-10 20:16:44	2018-12-10 21:08:39	
57	1210181162	2018-12-10 21:08:39	2018-12-10 19:08:49	2018-12-10 21:08:41	00 01:06:07 3,967
		2018-12-10 21:08:41	2018-12-10 20:14:56	2018-12-10 21:09:28	
58	1210181163	2018-12-10 21:09:28	2018-12-10 19:08:49	2018-12-10 21:09:31	00 01:07:46 4,066
		2018-12-10 21:09:31	2018-12-10 20:16:35	2018-12-10 21:10:16	
59	1210181164	2018-12-10 21:10:16	2018-12-10 19:08:49	2018-12-10 21:10:18	00 01:12:41 4,361
		2018-12-10 21:10:18	2018-12-10 20:21:30	2018-12-10 21:11:04	
60	1210181165	2018-12-10 21:11:04	2018-12-10 19:08:49	2018-12-10 21:11:07	00 01:09:44 4,184
		2018-12-10 21:11:07	2018-12-10 20:18:33	2018-12-10 21:11:53	
61	1210181166	2018-12-10 21:11:53	2018-12-10 19:08:49	2018-12-10 21:11:56	00 01:05:48 3,948
		2018-12-10 21:11:56	2018-12-10 20:14:37	2018-12-10 21:12:41	
62	1210181167	2018-12-10 21:12:41	2018-12-10 19:08:49	2018-12-10 21:12:43	00 01:08:20 4,100
		2018-12-10 21:12:43	2018-12-10 20:17:09	2018-12-10 21:13:29	
63	1210181168	2018-12-10 21:13:29	2018-12-10 19:08:49	2018-12-10 21:13:32	00 01:10:13 4,213
		2018-12-10 21:13:32	2018-12-10 20:19:02	2018-12-10 21:14:17	
64	1210181169	2018-12-10 21:14:17	2018-12-10 19:08:49	2018-12-10 21:14:20	00 01:03:43 3,823
		2018-12-10 21:14:20	2018-12-10 20:12:32	2018-12-10 21:15:06	
65	1210181170	2018-12-10 21:15:06	2018-12-10 19:08:49	2018-12-10 21:15:09	00 01:08:17 4,097
		2018-12-10 21:15:09	2018-12-10 20:17:06	2018-12-10 21:15:54	
66	1210181171	2018-12-10 21:15:54	2018-12-10 19:08:49	2018-12-10 21:15:57	00 01:07:41 4,061
		2018-12-10 21:15:57	2018-12-10 20:16:30	2018-12-10 21:16:42	
67	1210181172	2018-12-10 21:16:42	2018-12-10 19:08:49	2018-12-10 21:16:45	00 01:04:37 3,877
		2018-12-10 21:16:45	2018-12-10 20:13:26	2018-12-10 21:17:31	
68	1210181173	2018-12-10 21:17:31	2018-12-10 19:08:49	2018-12-10 21:17:33	00 01:06:30 3,990
		2018-12-10 21:17:33	2018-12-10 20:15:19	2018-12-10 21:18:19	

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
69	1210181174	2018-12-10 21:18:19 2018-12-10 21:18:22	2018-12-10 19:08:49 2018-12-10 20:16:42	2018-12-10 21:18:22 2018-12-10 21:19:08	00 01:07:53 4,073
70	1210181175	2018-12-10 21:19:08 2018-12-10 21:19:11	2018-12-10 19:08:49 2018-12-10 20:18:28	2018-12-10 21:19:11 2018-12-10 21:19:57	00 01:09:39 4,179
71	1210181176	2018-12-10 21:19:57 2018-12-10 21:19:59	2018-12-10 19:08:49 2018-12-10 20:14:21	2018-12-10 21:19:59 2018-12-10 21:20:45	00 01:05:32 3,932
72	1210181177	2018-12-10 21:20:45 2018-12-10 21:20:48	2018-12-10 19:08:49 2018-12-10 20:13:49	2018-12-10 21:20:48 2018-12-10 21:21:33	00 01:05:00 3,900
73	1210181178	2018-12-10 21:21:33 2018-12-10 21:21:35	2018-12-10 19:08:49 2018-12-10 20:13:58	2018-12-10 21:21:35 2018-12-10 21:22:22	00 01:05:09 3,909
74	1210181179	2018-12-10 21:22:22 2018-12-10 21:22:25	2018-12-10 19:08:49 2018-12-10 20:16:25	2018-12-10 21:22:25 2018-12-10 21:23:11	00 01:07:36 4,056
75	1210181180	2018-12-10 21:23:11 2018-12-10 21:23:13	2018-12-10 19:08:49 2018-12-10 20:16:56	2018-12-10 21:23:13 2018-12-10 21:24:01	00 01:08:07 4,087
76	1210181181	2018-12-10 21:24:01 2018-12-10 21:24:04	2018-12-10 19:08:49 2018-12-10 20:18:47	2018-12-10 21:24:04 2018-12-10 21:24:51	00 01:09:58 4,198
77	1210181182	2018-12-10 21:24:51 2018-12-10 21:24:54	2018-12-10 19:08:49 2018-12-10 20:16:20	2018-12-10 21:24:54 2018-12-10 21:25:42	00 01:07:31 4,051
78	1210181183	2018-12-10 21:25:42 2018-12-10 21:25:45	2018-12-10 19:08:49 2018-12-10 20:14:15	2018-12-10 21:25:45 2018-12-10 21:26:31	00 01:05:26 3,926
79	1210181184	2018-12-10 21:26:31 2018-12-10 21:26:33	2018-12-10 19:08:49 2018-12-10 20:18:01	2018-12-10 21:26:33 2018-12-10 21:27:19	00 01:09:12 4,152
80	1210181185	2018-12-10 21:27:19 2018-12-10 21:27:22	2018-12-10 19:08:49 2018-12-10 20:12:59	2018-12-10 21:27:22 2018-12-10 21:28:07	00 01:04:10 3,850
81	1210181186	2018-12-10 21:28:07 2018-12-10 21:28:10	2018-12-10 19:08:49 2018-12-10 20:17:17	2018-12-10 21:28:10 2018-12-10 21:28:56	00 01:08:28 4,108
82	1210181187	2018-12-10 21:28:56 2018-12-10 21:28:58	2018-12-10 19:08:49 2018-12-10 20:18:10	2018-12-10 21:28:58 2018-12-10 21:29:44	00 01:09:21 4,161
83	1210181188	2018-12-10 21:29:44 2018-12-10 21:29:46	2018-12-10 19:08:49 2018-12-10 20:16:27	2018-12-10 21:29:46 2018-12-10 21:30:34	00 01:07:38 4,058
84	1210181189	2018-12-10 21:30:34 2018-12-10 21:30:36	2018-12-10 19:08:49 2018-12-10 20:13:55	2018-12-10 21:30:36 2018-12-10 21:31:23	00 01:05:06 3,906
85	1210181190	2018-12-10 21:31:23 2018-12-10 21:31:25	2018-12-10 19:08:49 2018-12-10 20:16:56	2018-12-10 21:31:25 2018-12-10 21:32:13	00 01:08:07 4,087

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
86	1210181191	2018-12-10 21:32:13	2018-12-10 19:08:49	2018-12-10 21:32:15	00 01:07:44 4,064
		2018-12-10 21:32:15	2018-12-10 20:16:33	2018-12-10 21:33:00	
87	1210181192	2018-12-10 21:33:00	2018-12-10 19:08:49	2018-12-10 21:33:03	00 01:07:38 4,058
		2018-12-10 21:33:03	2018-12-10 20:16:27	2018-12-10 21:33:50	
88	1210181193	2018-12-10 21:33:50	2018-12-10 19:08:49	2018-12-10 21:33:52	00 01:07:49 4,069
		2018-12-10 21:33:52	2018-12-10 20:16:38	2018-12-10 21:34:38	
89	1210181194	2018-12-10 21:34:38	2018-12-10 19:08:49	2018-12-10 21:34:41	00 01:04:47 3,887
		2018-12-10 21:34:41	2018-12-10 20:13:36	2018-12-10 21:35:26	
90	1210181195	2018-12-10 21:35:26	2018-12-10 19:08:49	2018-12-10 21:35:29	00 01:07:57 4,077
		2018-12-10 21:35:29	2018-12-10 20:16:46	2018-12-10 21:36:15	
91	1210181196	2018-12-10 21:36:15	2018-12-10 19:08:49	2018-12-10 21:36:18	00 01:07:27 4,047
		2018-12-10 21:36:18	2018-12-10 20:16:16	2018-12-10 21:37:04	
92	1210181197	2018-12-10 21:37:04	2018-12-10 19:08:49	2018-12-10 21:37:07	00 01:08:32 4,112
		2018-12-10 21:37:07	2018-12-10 20:17:21	2018-12-10 21:37:52	
93	1210181198	2018-12-10 21:37:52	2018-12-10 19:08:49	2018-12-10 21:37:55	00 01:07:58 4,078
		2018-12-10 21:37:55	2018-12-10 20:16:47	2018-12-10 21:38:41	
94	1210181199	2018-12-10 21:38:41	2018-12-10 19:08:49	2018-12-10 21:38:44	00 01:09:53 4,193
		2018-12-10 21:38:44	2018-12-10 20:18:42	2018-12-10 21:39:31	
95	1210181200	2018-12-10 21:39:31	2018-12-10 19:08:49	2018-12-10 21:39:33	00 01:08:24 4,104
		2018-12-10 21:39:33	2018-12-10 20:17:13	2018-12-10 21:40:20	
96	1210181201	2018-12-10 21:40:20	2018-12-10 19:08:49	2018-12-10 21:40:22	00 01:09:17 4,157
		2018-12-10 21:40:22	2018-12-10 20:18:06	2018-12-10 21:41:09	
97	1210181202	2018-12-10 21:41:09	2018-12-10 19:08:49	2018-12-10 21:41:12	00 01:07:33 4,053
		2018-12-10 21:41:12	2018-12-10 20:16:22	2018-12-10 21:41:59	
98	1210181203	2018-12-10 21:41:59	2018-12-10 19:08:49	2018-12-10 21:42:02	00 01:08:21 4,101
		2018-12-10 21:42:02	2018-12-10 20:17:10	2018-12-10 21:42:48	
99	1210181204	2018-12-10 21:42:48	2018-12-10 19:08:49	2018-12-10 21:42:50	00 01:08:35 4,115
		2018-12-10 21:42:50	2018-12-10 20:17:24	2018-12-10 21:43:35	
100	1210181205	2018-12-10 21:43:35	2018-12-10 19:08:49	2018-12-10 21:43:38	00 01:08:33 4,113
		2018-12-10 21:43:38	2018-12-10 20:17:22	2018-12-10 21:44:22	
101	1210181206	2018-12-10 21:44:22	2018-12-10 19:08:49	2018-12-10 21:44:25	00 01:09:22 4,162
		2018-12-10 21:44:25	2018-12-10 20:18:11	2018-12-10 21:45:11	
102	1210181207	2018-12-10 21:45:11	2018-12-10 19:08:49	2018-12-10 21:45:14	00 01:05:24 3,924
		2018-12-10 21:45:14	2018-12-10 20:14:13	2018-12-10 21:46:00	

Throughput Stream	Seed	RF1 Start RF1 End	Query Start Query End	RF2 Start RF2 End	Duration
103	1210181208	2018-12-10 21:46:00	2018-12-10 19:08:49	2018-12-10 21:46:03	00 01:08:28 4,108
		2018-12-10 21:46:03	2018-12-10 20:17:17	2018-12-10 21:46:50	
104	1210181209	2018-12-10 21:46:50	2018-12-10 19:08:49	2018-12-10 21:46:52	00 01:07:28 4,048
		2018-12-10 21:46:52	2018-12-10 20:16:17	2018-12-10 21:47:38	
105	1210181210	2018-12-10 21:47:38	2018-12-10 19:08:49	2018-12-10 21:47:41	00 01:08:08 4,088
		2018-12-10 21:47:41	2018-12-10 20:16:57	2018-12-10 21:48:27	
106	1210181211	2018-12-10 21:48:27	2018-12-10 19:08:49	2018-12-10 21:48:30	00 01:07:33 4,053
		2018-12-10 21:48:30	2018-12-10 20:16:22	2018-12-10 21:49:16	
107	1210181212	2018-12-10 21:49:16	2018-12-10 19:08:49	2018-12-10 21:49:19	00 01:08:58 4,138
		2018-12-10 21:49:19	2018-12-10 20:17:47	2018-12-10 21:50:07	
108	1210181213	2018-12-10 21:50:07	2018-12-10 19:08:49	2018-12-10 21:50:09	00 01:07:48 4,068
		2018-12-10 21:50:09	2018-12-10 20:16:37	2018-12-10 21:50:55	

Query Execution Times (Query1~Query12):

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
0	92.2	11.4	36.4	17.1	27.6	12.1	273.3	73.7	740.0	31.6	5.3	17.0
1	99.5	10.3	50.9	18.2	29.0	12.3	317.2	80.5	978.5	30.9	6.5	17.3
2	102.6	10.9	50.5	19.2	32.3	27.4	290.0	84.8	1,028.3	38.4	6.2	17.9
3	102.8	9.7	47.3	21.6	32.7	18.0	261.5	103.8	971.5	32.1	6.2	18.2
4	103.0	11.4	47.9	19.8	39.6	15.3	291.9	84.7	914.5	32.1	6.7	19.0
5	102.9	10.4	47.6	18.9	31.1	13.7	327.5	83.1	1,029.1	31.9	7.0	18.0
6	102.2	9.9	55.8	18.4	30.2	14.7	256.7	85.9	871.5	42.2	6.2	18.0
7	101.4	12.1	46.2	18.3	28.5	13.1	271.2	82.4	1,054.3	33.6	6.4	17.7
8	100.6	11.8	45.3	19.8	36.2	13.0	335.3	83.4	1,023.9	32.0	6.1	18.8
9	102.2	10.4	46.6	19.3	27.4	14.5	311.2	103.7	1,097.2	33.0	6.5	18.2
10	103.1	12.8	46.4	19.0	29.8	23.2	256.2	83.0	1,081.2	31.3	6.5	18.2
11	104.7	11.5	44.9	18.7	30.5	13.7	261.3	85.0	1,160.6	33.9	6.7	17.9
12	112.0	11.7	44.5	20.0	31.0	14.0	330.5	87.7	1,127.2	30.9	6.7	18.0
13	100.2	10.6	49.1	18.3	27.7	13.2	278.5	79.7	849.5	34.9	6.5	17.8
14	100.4	24.1	40.1	20.0	33.5	12.8	284.6	88.4	1,039.9	30.9	6.0	17.7
15	103.9	9.8	47.1	19.4	31.3	13.9	326.7	89.6	1,003.3	32.4	6.1	17.9
16	114.6	9.9	52.4	19.2	30.6	14.9	268.8	82.7	883.2	33.4	6.6	17.8

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
17	99.4	10.5	64.9	18.7	33.2	13.4	301.7	83.7	854.8	32.0	7.1	16.5
18	103.2	10.1	46.0	25.2	31.4	13.1	253.2	84.5	817.4	32.3	6.6	17.7
19	100.3	11.4	44.3	27.7	29.9	13.5	314.7	83.4	1,011.9	31.5	5.9	24.5
20	102.0	9.5	46.6	21.8	31.1	13.3	261.1	84.3	1,062.0	33.4	6.4	17.4
21	100.0	9.2	46.5	19.5	31.5	13.0	300.0	84.8	980.7	31.1	7.1	18.0
22	103.0	17.3	44.6	18.8	31.6	13.1	295.6	83.1	858.6	33.0	6.9	18.2
23	101.7	13.5	44.9	20.0	29.8	13.6	273.1	88.4	1,013.0	32.9	6.4	17.8
24	102.2	11.8	50.9	18.7	32.1	12.7	297.8	80.4	823.1	32.4	6.3	18.0
25	101.4	11.5	45.8	19.7	33.6	12.8	269.9	87.9	823.7	35.4	7.0	17.0
26	101.1	10.8	44.9	19.1	38.0	12.4	327.7	87.0	1,004.8	32.7	6.7	17.7
27	102.8	11.4	46.3	20.1	29.8	14.4	263.5	86.8	1,017.8	31.6	6.2	18.2
28	108.6	10.3	48.3	20.0	31.2	13.8	308.0	88.1	1,047.1	47.4	5.8	18.6
29	99.9	10.5	45.6	18.9	30.4	13.1	307.4	93.3	930.4	45.9	6.5	17.4
30	102.7	10.3	46.9	18.7	32.6	13.5	345.6	85.4	1,033.0	32.5	6.6	18.3
31	99.8	25.6	51.9	19.4	32.7	13.0	327.0	79.5	1,043.9	30.7	6.5	17.9
32	103.4	10.6	47.9	19.9	30.4	13.7	267.8	88.7	830.7	32.2	6.2	21.5
33	101.0	10.8	48.1	19.6	31.7	13.9	288.5	84.3	972.8	32.2	6.8	17.4
34	113.0	9.5	49.8	19.1	29.9	13.7	271.1	85.7	919.2	30.6	7.4	17.6
35	103.4	10.9	45.8	19.2	30.3	12.9	301.7	87.9	1,067.1	32.6	6.1	17.7
36	99.4	11.0	46.9	21.2	31.0	13.5	261.7	88.4	928.9	32.0	6.7	18.2
37	100.4	11.6	44.3	18.0	30.4	12.9	262.7	82.6	966.5	30.8	6.5	17.2
38	101.1	11.5	45.2	21.8	38.3	14.9	270.6	86.2	957.6	32.3	7.0	17.5
39	102.4	9.8	67.8	19.0	30.1	13.0	318.1	89.4	979.0	32.8	6.4	17.2
40	100.0	10.3	47.0	19.6	31.4	13.9	259.0	82.5	918.9	32.7	6.8	18.9
41	100.3	22.5	45.7	19.1	29.7	14.1	255.7	85.8	1,165.8	32.3	6.4	16.9
42	100.9	10.5	45.0	19.4	28.4	14.7	313.6	84.7	1,097.8	31.0	6.7	17.9
43	100.0	10.7	44.9	18.5	33.6	22.4	277.6	87.6	841.1	39.3	5.8	17.8
44	101.7	9.7	42.1	22.1	31.4	19.1	276.5	119.6	1,101.1	33.2	6.1	17.6
45	102.7	12.5	50.4	19.7	45.0	13.6	262.6	86.7	968.9	33.0	6.3	18.0
46	98.4	11.2	46.1	19.4	29.2	13.2	268.9	83.9	1,011.8	32.1	6.6	18.2
47	100.2	9.9	52.6	18.7	29.3	13.9	271.2	83.4	922.5	45.4	6.5	17.8
48	100.4	13.9	44.2	20.0	30.6	13.6	314.6	87.3	858.7	32.2	6.9	18.1
49	101.1	9.9	46.1	18.6	32.6	11.4	306.3	79.6	1,126.7	31.7	5.6	17.3
50	101.0	9.5	46.0	19.3	29.1	13.8	321.7	111.0	1,097.1	34.1	6.6	17.5

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
51	103.6	11.5	47.2	20.2	29.5	24.3	298.9	83.4	997.6	31.4	6.0	18.2
52	102.9	10.0	46.1	19.2	30.5	13.8	304.5	86.0	936.4	35.1	7.2	19.4
53	110.9	10.8	38.6	19.5	30.3	11.9	357.2	87.1	1,167.5	29.4	6.2	17.4
54	100.0	13.6	48.7	18.0	29.6	12.3	313.4	84.4	883.6	32.4	6.1	17.7
55	100.6	25.7	44.1	20.4	35.4	13.0	298.2	80.2	1,017.8	27.7	5.8	17.5
56	103.0	9.5	48.6	19.1	30.8	14.2	262.5	89.2	1,052.0	34.4	6.2	17.7
57	112.3	13.9	49.4	19.6	30.1	13.2	266.8	86.0	898.4	33.1	6.1	18.1
58	103.8	11.3	63.3	19.6	32.7	13.7	266.3	83.9	905.8	32.2	6.8	17.9
59	101.7	13.4	45.5	25.3	31.4	13.8	256.3	84.7	1,152.4	31.7	6.9	18.1
60	99.4	10.7	46.1	28.9	31.5	13.3	318.0	84.7	1,116.2	32.7	7.0	26.8
61	100.0	10.8	50.8	21.7	33.5	13.7	262.7	87.9	871.3	34.2	7.0	17.8
62	100.3	10.0	44.6	19.4	31.5	13.7	322.1	84.9	997.2	34.5	6.9	18.2
63	104.6	14.0	47.4	19.9	31.7	13.8	274.0	84.1	1,099.7	34.5	6.6	18.3
64	104.4	11.1	44.3	19.1	29.2	14.3	258.7	87.3	888.4	30.8	6.7	17.3
65	99.5	12.1	47.8	20.0	30.3	12.6	349.4	84.3	1,023.9	32.2	6.5	17.7
66	100.6	14.2	47.0	19.8	30.6	14.3	259.6	83.4	1,008.9	33.7	6.9	17.7
67	100.7	11.4	49.3	19.6	37.3	13.2	273.3	85.6	820.8	33.5	7.0	17.7
68	100.6	10.8	48.4	19.7	31.4	14.0	320.3	83.5	953.2	30.2	6.2	18.2
69	110.5	11.7	45.6	20.4	31.5	13.7	307.8	86.6	962.6	45.3	6.5	18.7
70	100.4	11.6	46.4	18.7	29.9	14.4	258.8	95.8	1,085.1	48.7	6.0	17.0
71	100.2	9.8	46.2	18.8	32.9	12.8	330.3	82.7	874.3	32.9	6.5	16.9
72	102.3	12.1	46.5	18.4	31.3	13.5	259.4	84.9	930.1	30.8	6.8	17.7
73	100.3	9.6	50.8	19.6	32.9	14.7	263.7	94.8	861.1	32.9	6.6	21.3
74	100.9	10.1	46.1	19.9	32.3	12.9	316.1	86.1	874.0	31.8	6.9	18.0
75	112.2	8.6	53.0	19.9	30.7	13.8	285.8	87.4	985.0	32.7	7.3	18.0
76	101.8	13.0	47.1	19.6	30.6	13.4	260.0	88.7	1,096.1	34.2	5.7	18.0
77	99.3	10.0	46.4	20.6	31.7	13.4	319.6	82.7	1,030.7	31.7	6.1	16.3
78	103.2	12.9	47.3	19.5	33.7	12.8	311.1	84.3	812.6	32.0	6.9	18.0
79	101.9	11.2	45.3	20.8	35.1	11.7	302.3	78.8	1,048.8	30.9	6.3	16.6
80	100.6	10.3	62.7	19.0	32.9	14.9	266.2	83.5	871.5	33.3	6.4	17.7
81	102.0	9.7	50.4	19.7	30.8	14.1	301.5	86.5	1,051.7	29.1	6.6	17.9
82	102.5	15.3	44.5	18.6	31.4	13.7	258.1	87.0	1,058.7	33.5	6.5	17.3
83	99.7	10.1	49.2	19.5	29.9	14.2	258.7	83.9	1,001.4	32.4	7.1	17.5
84	101.5	11.2	48.7	19.1	31.4	21.1	316.5	87.4	877.6	37.5	6.6	17.7

Stream ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
85	101.3	11.1	44.1	21.2	30.4	15.0	308.5	99.3	1,035.7	30.0	5.9	17.7
86	101.6	21.4	52.3	19.2	40.4	15.8	304.4	86.7	854.1	35.7	6.8	19.1
87	104.9	11.1	51.6	19.2	31.3	13.4	262.7	87.1	997.7	31.9	7.4	17.3
88	102.0	9.7	52.2	19.1	30.6	12.8	262.8	84.9	1,026.9	50.8	6.8	17.8
89	99.0	12.6	45.6	19.4	29.0	13.1	260.5	88.7	852.5	31.8	6.6	17.1
90	99.7	11.3	46.7	18.9	37.1	13.0	305.3	86.8	903.0	32.0	6.5	18.0
91	100.4	9.7	45.7	19.0	29.6	12.4	303.7	99.4	1,052.9	31.4	6.1	17.7
92	101.2	12.3	48.1	19.3	27.7	25.9	314.6	81.8	1,018.2	33.3	6.2	17.6
93	103.4	9.8	47.7	19.9	29.8	13.9	266.4	86.1	984.0	34.9	6.5	17.7
94	113.0	11.0	44.7	19.8	29.5	13.9	330.5	84.9	1,106.7	30.6	7.1	17.4
95	102.0	10.4	48.1	19.3	31.0	13.2	311.4	83.5	1,058.0	32.0	6.3	17.9
96	99.5	12.1	39.5	19.7	33.4	12.8	301.6	85.4	1,142.1	30.9	6.4	17.2
97	100.5	10.9	49.5	17.9	32.7	13.0	285.7	90.3	1,012.0	35.0	6.6	17.8
98	115.6	9.8	53.7	20.2	30.9	15.0	323.7	83.9	1,067.6	32.6	6.1	17.0
99	104.9	11.5	59.9	20.0	30.2	13.0	259.6	85.6	1,069.1	34.3	7.2	17.2
100	99.0	12.6	48.3	25.1	33.6	13.9	274.0	86.1	1,063.8	31.6	7.4	18.2
101	99.7	10.0	48.9	30.4	31.5	12.7	283.2	84.8	1,058.0	33.1	6.6	26.2
102	100.1	12.3	47.4	20.6	32.4	13.6	307.6	87.6	890.3	31.8	6.7	17.5
103	102.0	9.4	44.9	17.9	29.1	12.5	267.3	79.4	1,084.7	32.1	6.3	16.8
104	103.9	10.8	47.8	19.3	30.7	13.8	317.4	81.8	919.9	33.6	6.3	18.3
105	102.7	11.5	48.8	19.2	31.1	14.2	262.7	89.4	1,038.2	32.7	6.2	17.4
106	101.7	10.8	47.4	19.2	30.7	12.4	315.5	83.3	840.0	33.2	6.1	17.7
107	101.4	11.5	46.4	18.9	30.8	14.1	325.2	86.5	1,037.3	32.8	6.8	18.3
108	100.5	11.9	44.4	19.8	38.1	13.1	318.8	87.2	1,058.5	34.1	7.2	18.2
Min.	**92.2**	**8.6**	**36.4**	**17.1**	**27.4**	**11.4**	**253.2**	**73.7**	**740.0**	**27.7**	**5.3**	**16.3**
Avg.	**102.3**	**11.7**	**47.8**	**19.9**	**31.6**	**14.2**	**290.9**	**86.4**	**984.3**	**33.5**	**6.5**	**18.1**
Max.	**115.6**	**25.7**	**67.8**	**30.4**	**45.0**	**27.4**	**357.2**	**119.6**	**1,167.5**	**50.8**	**7.4**	**26.8**

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

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
0	456.4	54.9	31.5	13.6	201.6	816.4	75.8	148.7	200.6	76.4	4.2	45.2
1	634.0	51.7	33.0	15.3	191.1	814.6	74.2	140.0	256.6	82.7	4.1	45.9

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
2	624.8	50.5	35.3	15.6	219.7	841.0	75.9	178.2	236.2	93.1	3.6	47.2
3	659.9	61.2	34.4	14.5	191.3	846.6	79.0	134.3	238.1	81.7	3.5	46.5
4	709.3	52.6	37.1	16.1	196.8	855.3	81.1	157.4	244.2	80.5	3.4	47.1
5	685.7	51.5	37.0	16.0	213.5	863.7	77.9	164.4	253.3	90.8	3.3	44.0
6	548.1	54.4	42.2	14.7	205.1	798.7	80.9	147.6	242.4	80.0	3.2	45.1
7	649.3	54.9	33.6	14.6	265.5	867.6	73.8	141.9	229.0	87.2	3.1	47.4
8	719.9	56.8	35.2	17.0	192.6	869.0	102.1	163.9	228.0	76.6	2.8	47.1
9	670.5	48.9	36.1	13.2	203.3	885.4	82.6	150.5	236.1	74.8	2.9	44.3
10	637.3	50.0	38.0	15.2	213.7	871.2	79.4	186.7	232.2	82.7	2.9	45.7
11	646.8	63.1	51.1	16.0	229.7	986.1	77.4	222.1	227.9	95.7	2.9	46.9
12	674.8	49.6	33.3	15.8	230.4	865.8	77.6	166.2	231.8	82.7	2.9	48.2
13	668.9	58.1	35.3	15.1	183.1	836.5	76.5	143.8	257.0	74.8	3.0	48.5
14	704.8	53.0	36.1	14.8	238.0	863.0	83.9	166.0	225.8	94.1	3.0	48.7
15	555.8	54.4	35.8	22.3	192.0	878.2	80.3	191.5	233.1	90.5	2.8	46.2
16	726.4	54.9	37.0	14.8	180.5	834.1	78.9	177.9	236.8	82.7	2.9	45.9
17	673.4	58.0	32.7	17.0	201.7	823.8	77.9	151.6	235.9	70.8	2.7	45.7
18	664.1	72.9	34.3	14.4	194.6	813.3	78.3	155.0	217.4	68.7	2.8	47.5
19	661.1	55.0	35.4	15.3	177.8	878.9	76.9	139.2	223.5	86.1	2.9	46.0
20	659.4	58.0	53.8	17.6	188.3	823.0	77.3	129.2	235.1	95.4	2.7	46.0
21	688.8	58.7	35.7	16.3	195.8	859.3	75.5	203.4	222.9	86.9	2.8	46.5
22	673.4	82.9	33.1	21.9	237.7	879.5	78.8	154.7	240.0	84.5	2.7	45.0
23	658.9	54.1	35.9	15.9	211.3	957.4	79.7	161.0	230.7	87.8	2.8	47.5
24	664.9	53.6	34.9	14.7	224.5	906.5	79.8	174.0	243.2	83.1	2.8	45.7
25	704.9	56.4	34.9	15.6	187.4	868.3	77.8	132.7	230.5	71.6	2.7	45.8
26	715.3	54.7	34.6	13.8	178.9	835.5	79.2	121.3	242.3	94.6	2.8	47.6
27	727.5	76.8	34.7	15.5	247.3	876.6	75.6	131.3	244.9	81.9	2.8	47.3
28	630.5	58.3	35.7	14.9	201.1	930.4	81.9	159.1	236.8	83.1	2.8	48.1
29	711.4	52.9	34.1	15.1	225.4	918.1	74.5	155.2	228.3	73.2	2.8	48.4
30	671.4	54.8	36.4	15.6	198.5	901.8	80.9	129.7	236.4	92.8	2.7	48.2
31	629.3	48.8	35.4	15.4	205.3	814.4	78.8	242.1	234.7	80.2	2.8	45.7
32	651.9	49.1	57.3	15.4	196.3	851.6	76.2	181.0	230.9	75.7	2.7	47.9
33	681.2	54.9	53.8	15.7	221.8	830.5	80.6	146.2	234.3	85.8	2.7	45.9
34	704.5	52.7	35.9	14.6	264.4	885.5	78.5	193.8	232.8	81.8	2.8	48.7
35	719.0	75.2	32.4	16.6	259.5	859.0	74.3	172.2	223.5	95.8	2.7	49.8

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
36	691.1	54.8	33.9	15.1	226.7	821.0	78.4	193.0	223.2	80.0	2.7	48.3
37	567.7	60.3	34.8	14.7	209.7	818.9	76.1	160.8	225.0	82.3	2.6	48.8
38	684.8	56.7	36.7	14.4	224.9	893.2	77.5	209.2	237.9	80.0	2.8	48.7
39	664.1	52.8	34.3	15.9	197.3	880.2	78.6	249.4	234.1	81.4	2.7	49.0
40	681.6	58.2	47.6	16.7	224.1	858.5	78.0	196.5	231.0	82.3	2.8	48.1
41	685.5	75.0	34.0	16.3	232.3	916.6	80.7	214.0	240.2	87.9	2.6	47.9
42	651.7	52.2	33.9	15.7	204.7	895.2	79.2	148.0	239.4	85.8	2.7	47.2
43	699.8	55.1	34.8	14.5	220.9	816.6	80.2	165.3	229.3	87.7	2.7	47.2
44	727.4	58.3	34.9	13.0	173.4	873.8	75.8	134.5	230.5	97.9	2.7	47.7
45	627.3	53.0	35.6	16.0	190.2	908.9	78.2	138.2	249.4	76.3	2.6	45.8
46	692.8	56.5	34.5	15.0	222.0	878.2	76.2	153.6	253.8	82.3	2.7	47.8
47	716.2	52.5	37.0	15.2	194.5	839.5	75.1	152.1	227.6	80.6	2.6	46.4
48	645.0	54.1	33.7	14.6	192.1	951.2	74.2	174.8	240.3	81.7	2.7	47.8
49	633.9	50.6	34.3	15.6	178.6	856.0	91.6	145.4	222.0	91.3	2.6	45.9
50	590.0	57.7	36.1	14.9	187.5	883.6	75.2	137.2	231.3	73.3	2.7	45.5
51	732.2	51.5	38.0	15.2	213.9	819.3	78.6	176.8	227.3	85.5	2.5	46.0
52	713.3	58.8	54.2	15.2	206.2	839.6	79.9	165.1	229.2	83.3	2.6	46.4
53	703.9	47.5	33.5	16.4	261.8	875.2	77.0	167.7	234.9	86.7	2.6	45.6
54	661.5	55.0	33.9	15.2	198.7	837.5	76.1	172.4	262.1	82.8	2.7	45.7
55	716.2	63.9	35.6	15.6	250.2	847.7	76.0	183.4	218.9	78.0	2.7	45.7
56	673.3	55.6	35.6	18.1	185.6	894.9	76.6	138.5	238.5	70.2	2.7	45.2
57	728.5	53.3	35.6	15.5	177.6	849.7	78.6	158.6	242.5	79.6	2.7	46.7
58	717.0	59.1	35.1	17.8	258.9	871.3	81.4	148.5	238.4	79.9	2.6	45.0
59	703.5	73.8	36.6	13.9	249.6	916.3	77.9	191.5	236.8	79.3	2.6	46.0
60	679.8	58.0	34.5	14.6	219.2	823.8	80.2	134.9	237.7	84.7	2.7	45.8
61	710.2	59.4	49.5	21.5	231.0	807.9	79.0	160.0	235.7	81.5	2.6	45.1
62	696.1	57.7	36.2	16.6	170.4	866.2	75.2	187.0	233.6	77.2	2.6	45.8
63	702.4	71.6	36.5	24.5	183.5	905.7	79.7	131.1	235.7	93.0	2.6	45.7
64	597.9	48.3	33.5	15.1	220.2	872.3	73.4	153.8	222.5	73.1	2.7	46.1
65	682.0	52.8	35.4	14.9	182.9	830.9	75.4	174.4	228.5	82.6	2.7	45.2
66	657.7	51.0	34.7	15.3	200.4	886.1	77.2	177.7	242.3	80.9	2.6	45.8
67	733.4	55.7	35.5	15.2	189.3	844.3	77.7	139.3	239.2	77.4	2.7	45.5
68	640.5	81.3	37.2	15.4	217.1	837.8	74.4	135.8	238.3	74.7	2.7	46.1
69	704.7	53.5	35.1	14.9	183.9	854.8	80.1	164.4	238.2	81.2	2.6	46.2

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
70	616.5	54.5	35.8	15.2	214.7	919.5	86.4	182.9	229.2	90.6	2.6	45.8
71	682.1	49.8	33.9	15.0	201.8	824.7	74.1	198.8	218.3	68.3	2.6	46.2
72	679.3	50.5	35.1	15.5	186.1	823.6	81.1	168.8	226.0	79.1	2.6	44.8
73	688.9	60.1	49.8	14.8	199.2	834.9	84.3	164.7	228.2	74.8	2.5	46.9
74	728.2	59.7	56.3	15.3	222.8	860.6	76.8	159.1	229.3	92.2	2.7	45.7
75	697.7	56.9	36.6	15.3	226.0	861.3	78.7	136.5	236.2	86.3	2.6	48.0
76	677.6	73.6	33.7	15.9	255.4	847.4	76.9	166.3	231.0	90.3	2.6	47.0
77	584.8	51.9	35.7	15.2	195.0	907.8	78.0	152.5	233.7	86.8	2.6	48.8
78	709.8	60.4	35.2	14.3	210.8	803.7	75.5	202.1	237.3	81.8	2.6	45.9
79	630.8	59.5	32.9	15.5	197.4	894.9	75.2	214.5	228.2	92.9	2.6	45.9
80	592.7	56.9	35.7	15.0	214.1	867.2	79.5	151.1	222.9	94.7	2.5	45.4
81	650.4	54.6	47.2	15.7	188.1	868.5	77.8	165.7	236.9	81.9	2.6	45.6
82	667.3	80.5	36.1	14.6	256.7	864.0	82.4	167.0	227.0	77.6	2.6	45.6
83	688.8	59.5	34.7	15.3	192.0	850.0	78.5	178.9	253.8	82.3	2.6	47.4
84	672.0	57.4	35.8	14.8	206.5	821.8	80.5	129.2	237.8	72.6	2.6	46.4
85	645.6	54.6	34.5	14.4	222.4	856.8	72.2	151.0	226.2	88.0	2.5	47.8
86	773.7	60.7	36.8	15.3	195.1	867.1	79.2	149.9	243.7	84.2	2.5	45.0
87	657.2	50.6	33.2	15.2	195.9	923.4	74.0	143.6	243.3	84.6	2.5	46.8
88	563.9	49.0	38.8	13.8	233.3	916.5	75.2	184.1	232.9	84.2	2.6	45.7
89	623.7	60.1	34.4	15.7	235.2	889.2	73.0	162.7	218.1	98.5	2.6	45.6
90	674.0	57.5	33.7	15.2	183.6	916.8	102.2	205.0	228.8	81.0	2.5	46.4
91	649.6	50.9	36.9	14.6	187.0	845.7	75.5	141.3	227.1	89.7	2.7	46.4
92	711.0	56.1	43.2	16.3	191.7	842.3	80.0	138.2	235.2	90.6	2.6	45.4
93	673.7	54.0	50.4	15.3	205.8	889.5	80.7	162.2	239.9	85.3	2.6	46.3
94	618.5	48.8	33.4	15.3	220.5	888.1	79.2	173.8	221.8	83.8	2.5	47.2
95	670.8	55.8	33.7	15.7	194.0	809.1	78.7	172.6	254.1	85.6	2.5	46.2
96	687.9	51.1	35.5	14.6	200.1	817.1	83.4	150.4	238.2	77.2	2.5	47.2
97	636.8	55.3	34.9	22.1	196.0	860.7	73.7	190.2	233.0	77.2	2.6	47.4
98	606.9	53.0	34.8	15.5	173.9	909.0	76.2	132.5	234.2	87.7	2.5	45.8
99	659.9	52.0	36.0	18.4	221.3	873.1	78.5	132.5	245.5	83.7	2.5	44.8
100	559.1	76.4	36.3	14.1	238.7	855.7	77.4	221.9	232.6	86.2	2.6	44.7
101	693.8	60.2	36.7	16.1	211.6	829.3	79.4	196.3	232.7	79.7	2.6	46.2
102	563.5	51.2	48.3	17.6	251.4	877.8	75.4	164.1	221.8	84.2	2.6	46.7
103	615.9	63.2	32.5	15.5	189.9	880.0	74.2	218.3	230.6	84.6	2.5	46.9

Stream ID	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	RF2
104	663.3	69.4	34.0	22.1	191.0	916.9	76.3	144.9	236.8	88.5	2.5	45.6
105	663.5	55.5	35.2	15.2	189.9	904.5	79.3	136.4	241.7	91.5	2.6	46.4
106	756.9	54.6	36.0	15.2	241.4	827.1	79.6	203.9	234.6	84.4	2.7	46.5
107	682.8	55.7	33.1	16.0	206.3	865.3	79.7	159.3	228.2	81.3	2.5	48.3
108	594.5	54.3	36.3	15.4	209.4	846.8	75.7	150.2	250.1	82.3	2.5	45.7
Min.	**456.4**	**47.5**	**31.5**	**13.0**	**170.4**	**798.7**	**72.2**	**121.3**	**200.6**	**68.3**	**2.5**	**44.0**
Avg.	**666.0**	**57.2**	**37.0**	**15.7**	**209.1**	**864.6**	**78.5**	**164.9**	**234.3**	**83.4**	**2.7**	**46.5**
Max.	**773.7**	**82.9**	**57.3**	**24.5**	**265.5**	**986.1**	**102.2**	**249.4**	**262.1**	**98.5**	**4.2**	**49.8**

Table of Contents

Overview

The TPC BenchmarkTM 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

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 TTA, Telecommunications Technology Association. The implementation was developed and engineered in partnership with SUNJESOFT Inc. and KTNF (Korean Technology and Future).

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*

The Supporting Files Archive contains the system and Goldilocks 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.

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

Figure 0.1: Benchmarked and Priced Configuration

Dell EMC Switch S4128-ON

Database Server

6 x KTNF KR580S1

- 2 x Intel Xeon Gold 6150 2.70GHz
- 12 x 64GB DDR4 Memory
- 2 x 256GB SATA SSD
- 5 x 600GB SAS HDD 10Krpm
- 1 x 10Gb Ethernet

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. All listings must be reported in the supporting files archive.

The Supporting Files Archive contains the programs and 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. The physical organization of tables must be reported in the supporting files archive.

The Supporting Files Archive contains the table create statements and further details about other physical organization of the table and indices.

1.3 Horizontal Partitioning

Horizontal partitioning of tables and rows in the test and qualification databases (see Clause 1.5.4) must be disclosed. Scripts to perform horizontal partitioning must be reported in the supporting files archive.

Horizontal partitioning was used for all tables except NATION, REGION, SUPPLIER and CUSTOMER. Refer to the table/index create statements in the Supporting Files Archive for more details.

1.4 Replication

Any replication of physical objects must be disclosed and must conform to the requirements of Clause 1.5.7. Scripts to perform any replication must be reported in the supporting files archive.

The tables NATION, REGION, SUPPLIER and CUSTOMER where fully replicated on every node (6 copies total). The remaining tables were horizontally partitioned across the three node groups (3 partitions per table). Each horizontal partition was replicated on the two nodes of the node group.

1.5 Tunable Parameters

Script or text for all hardware and software tunable parameters must be reported in the supporting files archive.

All hardware and software parameters changed from their defaults are reported in the Supporting Files Archive.

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.

DBGEN version 2.17.3 and QGEN version 2.17.3 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 2.17.3 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:

- FETCH syntax was used to restrict the number of output rows in Q2, Q3, Q10, Q18 and Q21.

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 3 (Serializable).

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 results of the ACID tests must be disclosed along with a description of how the ACID requirements were met. All code (including queries, stored procedures etc.) used to test the ACID requirements and their entire output must be reported in the supporting files archive.

The tests conducted to demonstrate compliance for each of the ACID requirements are detailed in sections 3.2 to 3.5 of this FDR. The source code for the ACID test is included in the Supporting Files Archive.

3.2 Atomicity

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

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.

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

Consistency is the property of the application that requires any execution of transactions to take the database from one consistent state to another.

3.3.1 Consistency Test

Verify that ORDERS and LINEITEM tables are initially consistent, submit the prescribed number of ACID Transactions with randomly selected input parameters, and re-verify the consistency of the ORDERS and LINEITEM.

1. The consistency of the ORDERS and LINEITEM tables was verified prior to each durability test.
2. At least 100 ACID Transactions were submitted by 109 execution streams during each durability test.
3. The consistency of the ORDERS and LINEITEM tables was re-verified at the end of each durability test.

3.4 Isolation

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 proper order.

All Isolation tests were executed twice: Once with all transactions invoked from the same node, and once with transactions invoked from different nodes in the cluster.

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.

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. The ACID Query 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.

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.
3. The ACID Transaction was ROLLED BACK.
4. The ACID Query completed.

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.

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.

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.

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.

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.

3.5 Durability

The SUT 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 two pairs of HDDs. The log files are mirrored across one 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. 109 streams of the ACID transactions were started.
3. After more than 100 transactions from each stream completed, an HDD containing database tables was removed from one of the database nodes.
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 from another database nodes.
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

Each of these requirements were verified during two durability tests: single-node test and full-cluster test.

The following steps were performed during the single-node test.

1. The ORDERS and LINEITEM tables were verified to be consistent and the HISTORY table rows were counted.
2. 109 streams of the ACID transactions are started.
3. After more than 100 transactions from each stream has completed, the power cord was removed from one of the database node.
4. Transactions continued to execute on the remaining nodes.
5. After the test completed, power was restored to the failed node, the system was restarted, along with the database.
6. 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.
7. The ORDERS and LINEITEM tables were verified to be consistent.

The following steps were performed during the full-cluster test.

1. ORDERS and LINEITEM tables were verified to be consistent and the HISTORY table rows were counted.
2. 109 streams of the ACID transactions are started.
3. After more than 100 transactions from each stream has completed, the power cord was removed from all six database nodes within less than 5 sec.
4. Power was restored to the failed nodes, the systems were 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.

3.5.3 Failure of a Cluster Interconnect

The following steps were performed to test the durability after failure of the cluster network interconnect.

1. ORDERS and LINEITEM tables were verified to be consistent and the HISTORY table rows were counted.
2. 109 streams of the ACID transactions were started.
3. After more than 100 transactions from each stream completed, the power cord was removed from the network switch.
4. Power was restored to the failed switch, the database cluster was restarted.
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 Starting 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

Each node contains two physical disks (256GB SATA SSD) configured as a RAID 1 volume for the DBMS REDO log, and four physical disks(600GB SAS HDD 10Krpm) configured as two RAID 1 volumes for the DBMS data file. A single physical disk (600GB SAS HDD 10Krpm) was used as system disk. Table 4.2 Below shows the configuration of node1. The configurations of the other five nodes are identical to node1.

Table 4.2: Distribution of Tables and Logs Across Media

Partion Name	Type	Partition Size / Volume Size	Contents
/dev/sdd1	RAID 0	200MB / 600GB	BOOT
/dev/sdd2	RAID 0	530GB / 600GB	OS + Flat Files
/dev/sda1	RAID 1	246GB / 256GB	DBMS REDO logs
/dev/sdb1	RAID 1	550GB / 600GB	DBMS data files
/dev/sdc1	RAID 1	550GB / 600GB	DBMS data files

4.3 Database partition/replication mapping

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

Horizontal partitioning was used for base tables LINEITEM, ORDERS, PARTSUPP and PART. All the Tables are fully replicated within each group. User tables are loaded in the Goldilocks in-memory database. In-memory database pages from the user and system tables are saved in DBMS data files on permanent storage devices. Seven DBMS data files were used to save user tables and the corresponding database pages were hashed across these seven files. One additional DBMS data file was used to save the database pages from the system tables. Table 4.3 below details how the DBMS data files were layedout on two dedicated RAID 1 volumes.

Table 4.3: Layout of DBMS data files

Media	Filename	Size(GB)
sdb1	system_data.dbf	4
	tpch_data_02.dbf	10
	tpch_data_04.dbf	10
	tpch_data_06.dbf	10
sdc1	tpch_data_01.dbf	10
	tpch_data_03.dbf	10
	tpch_data_05.dbf	10
	tpch_data_07.dbf	10

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 4.4.

Table 4.4: 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	No RAID

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 reported in the supporting files archive.*

DBGEN from TPC-H Rev. 2.17.3 was used for this result.

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 00h 39m 37s.

4.7 Data Storage Ratio

The data storage ratio must be disclosed. It is computed as the ratio between the total amount of priced disk space, and the chosen test database size as defined in Clause 4.1.3.

The computation of the data storage ratio is shown in Table 4.5.

Table 4.5: Data Storage Ratio Computation

Disk Type	# of Disks	Space per Disk*	Sub-Total Disk Space
600GB HDD	30 (5x6)	558.9GB	16,767GB
256GB SSD	12 (2x6)	238.5GB	2,862GB
		Total Space	**19,629GB**
		Data Storage Ratio	**196.29**

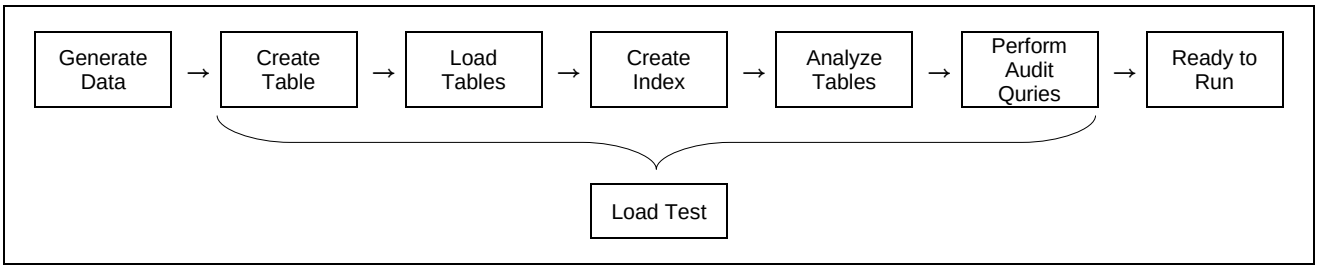
4.8 Database Load Mechanism Details and Illustration

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 cluster nodes, as shown in Table 4.2.

The database load mechanism is depicted in Figure 4.1.

Figure 4.1: 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)	4,608
Scale Factor (SF)	100
Percentage of Memory	4,608.00%

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 reported in the **supporting files archive** 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 reported in the **supporting files archive.***

The following steps were used to implement the power test:

1. RF1 Refresh Transaction
2. Stream 00 Execution
3. RF2 Refresh Transaction

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 output for each query and for both refresh functions must be reported in the supporting files archive.

The timing intervals for each query and for both refresh functions are contained in the Numerical Quantities section of the Executive Summary, located at the beginning of this document.

5.4 Number of Streams for the Throughput Test

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

108 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 output for each query stream for the throughput test must be reported in the supporting files archive..

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

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, located at the beginning of this document.

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 output of each refresh function in the refresh stream for the throughput test must be reported in the supporting files archive.

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

5.8 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, located at the beginning of this document.

5.9 The Performance Metric and Numerical Quantities from Both Runs

The performance metric and numerical quantities from both runs must be disclosed.

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	6,569.7	87,945.7	24,037.0
Run2	6,682.0	86,997.6	24,110.5

5.10 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.

5.11 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. A shell scipt is started and executes SQL scripts for the 108 query streams, in parallel.
2. A shell script is started and executes 108 pairs of RF1/RF2 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 Configuration must be reported. The listing for each separately Orderable item must have vendor Part Number, description, and applicable

release/revision level, price source, unit price, quantity, extended price, applicable Discounted price and 3year maintenance price. If package-pricing is used, the vendor Part Number of the package and a description uniquely identifying each of the Components of the package must be disclosed to a sufficient level of detail to meet the requirements of 1.4.1.1.

The Executive Summary contains a list of the priced hardware and software, including 3-year maintenance and any applicable discounts.

7.2 Total Three-Year Price

The total 3-year price of the Priced Configuration must be reported, including: hardware, software, and maintenance charges. The justification of any Discounts applied must be disclosed in the price sheet. Sufficient detail of what items are being discounted and by how much they are being discounted must be provided so that the Discount amount used in the computation of the total system cost can be independently reproduced.

The Executive Summary contains the details for the total 3-year pricing of the configuration.

7.3 Availability Dates

The committed Availability Date of Components used in the price calculations must be reported. The Availability Date must be reported on the first page of the Executive Summary and with a precision of one day. When the priced system includes products with different availability dates, the reported Availability

Date for the priced system must be a date at which all Components are committed to be Generally Available. Each Component used in the Priced Configuration is considered to be Available on the Availability Date unless an earlier date is specified.

All components of the Priced Configuration are 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	OS and DB parameter settings	CONFIG.zip	SupportingFiles/CONFIG
Clause 2	DB creation scripts	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit
Clause 3	ACID scripts	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit
	ACID output	ACID.zip	SupportingFiles/ACID
Clause 4	DB Load scripts	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit
	Qualification output	QUAL.zip	SupportingFiles/QUAL
Clause 5	Query output results	RUN1.zip RUN2.zip	SupportingFiles/ RUN1 SupportingFiles/ 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	RUNS.zip	SupportingFiles/RUNS/QUERY
	RF function source	TPC-H-Kit.zip	SupportingFiles/TPC-H-Kit

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

Francois Raab
20 Kreg Ln
Manitou Springs, CO 80829

Phone: +1 (719) 473-7555

www.sizing.com

9.2 Attestation Letter

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

Attestation Letter

Chan Lim (Charlie) Park
Senior Research Engineer
Telecommunications Technology Association (TTA)
Bundang-ro 47, Bundang-gu, Seongnam-city
Gyeonggi-do, 13591, Republic of Korea

December 18, 2018

I verified the TPC Benchmark H (TPC-HTM v2.17.3) performance of the following configuration:

Platform:	KTNF KR580S1 (6-node cluster)
Operating System:	Red Hat Enterprise Linux Server 7.6
Database Manager:	Goldilocks v3.1 Standard Edition

The results were:

Performance Metric	**24,037** QphH@100GB
TPC-H Power	6,569.7
TPC-H Throughput	87,945.7
Database Load Time	00h 39m 37s

Server	**KTNF KR580S1 (6-node cluster)**		
CPUs	12 x Intel Xeon Gold 6150 Processor (2.7GHz, 24.75MB L3)		
Memory	4,608 GB (768 GB per node)		
Disks	***Qty***	***Size***	***Type***
	12	256 GB	2.5" SATA SSD
	30	600 GB	2.5" SAS HDD 10Krpm

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

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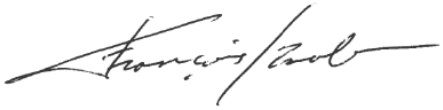
- The compliance of the database auxiliary data structures was verified
- The database load time was correctly measured and reported
- The required ACID properties were verified and met
- The query input variables were generated by QGen
- The query text was produced using minor modifications and no query 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 108 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, TPC Certified Auditor

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Appendix: Price Quotations

Server (KTNF Server 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 :
₩29,700,000 (부가가치세 포함)

납품 예정 일자 :	발주일로부터 4주일이내
견적 유효 기간 :	견적일로부터 7일
지 불 조 건 :	현금
견 적 담 당 :	길 종 법 부장 (Mobile : 010-8753-5644)
견 적 일 자 :	2018년 12월 10일

KTNF
KOREA TECHNOLOGY AND FUTURE

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	컴 퓨 터 주 변 기 기

항목 Item	Part Number	규 격 Specification	수량 Q'ty	단 가 Unit Price	합 계 Amount	세 액 (VAT별도)
		Maintenance -7x24x4 Care pack (3y)	6	4,500,000	27,000,000	2,700,000

Other Comment/Remarks

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

소 계 :	₩27,000,000
세 액 :	₩2,700,000
합 계 :	**₩29,700,000**

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 제3자에세 양도 또는 재판매할 경우 해당 제3자에게 상기에 언급한 의무사항들을 사전에 충분히 고지하시기 바랍니다.

Server (KTNF Server Hardware Price)

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 :
₩174,515,000 (부가가치세 포함)

납품 예정 일자 :	발주일로부터 4주일이내
견적 유효 기간 :	견적일로부터 7일
지 불 조 건 :	현금
견 적 담 당 :	길 종 법 부장 (Mobile : 010-8753-5644)
견 적 일 자 :	2018년 12월 10일

KTNF
KOREA TECHNOLOGY AND FUTURE

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**	**6**	**26,250,000**	**157,500,000**	**15,750,000**
		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	HAK0097A	**Intel Xeon Scalable Processor (18Core 2.7GHz/24.75MB, 165W)**	2			-
RAM	HCL0015A	**64GB DDR4 2400 ECC RDIMM Memory**	12			-
SSD	HCZ0032A	**256GB 2.5" SATA SSD**	2			-
HDD		**600GB 2.5" hot-swap SAS HDD 10Krpm**	5			-
RAID	HCH0037A	**HW RAID Controller (0, 1, 10)**	1			-
NIC	HBV0080A	**Intel Dual Port 10G SFP+ Network Adapter**	1			-
SFP+	HCW0009A	**SFP+ Tranceiver**	2			-
ETC	HDM0001A	**Trackball Mini Keyboard**	1			-
Monitor	HDM0002A	**27-inch Monitor**	1			-
	RAC0001A	**Server Rack (H:42U x D:1000mm x W:600mm)**	1	1,150,000	1,150,000	115,000

Other Comment/Remarks

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

소 계 :	₩158,650,000
세 액 :	₩15,865,000
합 계 :	**₩174,515,000**

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 제3자에세 양도 또는 재판매할 경우 해당 제3자에게 상기에 언급한 의무사항들을 사전에 충분히 고지하시기 바랍니다.

Network Switch (Dell EMC Switch)

견 적 서

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106 - 81 - 21127

서울 용산구 원효로 3가 52-2

대표이사 : 정 명 천

TEL : 02-2004-7718

FAX : 02-702-4844

견적담당 : 정 세 희 부장

휴대폰 : 010-4207-0246

E-mail : sehee.jung@dwcts.co.kr

수 신 : TTA 귀중

참 조 :

아래와 같이 견적합니다.

견적금액 : 7,040,000 원(VAT포함)

견적일자 : 2018년 12월 6일

결제조건 : 현금 선입금

유효기간 : 견적 후 7일

납품일자 : 양사 협의

구분	MIS Code	사양	수량	공급단가 (VAT별도)	공급금액 (VAT별도)
		Dell EMC Switch S4128F-ON, 1U, PHY-less, 28 x 10GbE SFP+, 2 x QSFP28, IO to PSU, 2 PSU, OS10	**1**	5,700,000	5,700,000
		Dell Networking, Transceiver, SFP+, 10GbE, SR, 850nm Wavelength, 300m Reach, 12-Pack	2		
		Dell Networking Cable, OM4 LC/LC Fiber Cable, (Optics required), 3 Meter	24		
		Medium Jumper Cord (2M), C13-C14, 10A (China/Korea)	2		
		OS10 Enterprise S4128F-ON	1		
		3Yr ProSupport & Mission Critical:(7x24) 4-hour Onsite Service	1		
		configruation and Rack mount	**1**	700,000	700,000
		network configration, setting, firmware upgread			
		4시간 지원 (설정 지원일 경우 설정 사항 및 특이 사항 전달, 장애 지원일 경우 원인 파악 사항 및 세부 사항 전달)			
* Remark				공 급 가	6,400,000
				부 가 세	640,000
				합계금액	7,040,000

* 위 견적서 검토 후, 발주 진행 시, 아래 내용을 작성하셔서 회신하여 주시거나 귀사 발주서를 fax나 메일로 보내주시기 바랍니다.(명판 및 인감날인)

1. 발주담당자:
2. 담당자연락처:
3. 배송지정보(주소/수령인/연락처):
4. 결제 조건 및 예정일 :

명판 및 직인 날인

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.	: 2018RP12-0703		TERMS AND CONDITION
DATE	: 2018. 12. 07.		
COMPANY	: 한국정보통신기술협회		납 기 : 발주후 4주이내
ATTN	: 박 찬 림 선임님 귀하	TEL : 010-5110-2692	유지보수 : 납품일로부터 1년
Email	: charliepark@tta.or.kr		결제조건 : 익월말 현금
FROM	: ㈜ 락플레이스 정 경환 차장	TEL : 010-4298-3447	유효기간 : 견적일로부터 1개월

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 Phone,email Support : 09:00 ~ 17:00 Scope of Coverage : Standard	6	3,978,000	2,310,000	13,860,000
RH00003F3	Red Hat Enterprise Linux Server, Premium (Physical or Virtual Nodes) 3Year Phone,email Support : 24 x 7 Scope of Coverage : Premium	6	6,468,000	3,751,000	22,506,000
공통 내용	support : Easy ISOs: OS, Source, Documentation ISO Images CPU Socket 수 : 2 CPU 가상화 Guest OS : 2guests Red Hat Network 서비스 : 3년 Maximum Memory Support: Unlimited				
소 계 금 액					36,366,000

합 계	36,366,000
부가세	3,636,600
합 계(부가세포함)	40,002,600

Remarks

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

DBMS (Goldilocks Standard Edition for Linux)

견 적 서

㈜한국정보통신기술협회 貴中

Title : TPC-H Performance & Quality Authentification

SUNJESOFT
(주)선재소프트

대표이사 : 김 기 완

수 신 : 이태석 선임
견적일자 : 2018년 12월 10일
유효기간 : 견적일로부터 1개월

주 소 : 서울시 영등포구 당산로17
금강펜테리움IT타워 604호
영업대표 : 영업본부 최준호 전무
전화번호 : 010-2351-3753
e-mail :bada@sunjesoft.com

*** Goldilocks Standard Edition for LINUX 6식(3x2 Cluster environment)** (단위 : 원)

No.	Description	Unit Price	Q'ty	Total Price	Offer Price
1	Goldilocks DBMS Server	96,000,000	6 Set(s)	576,000,000	192,000,000
	- Query Processes Module				
	- Storage Management Module				
	- Cluster Management Module				
	Goldilocks DBMS License Fee	**License Proposal Price**			**192,000,000**
2	DBMS Implementation & Support	10,000,000	3 Set(s)	30,000,000	30,000,000
	Goldilocks Technical Supports Fee(3yr)	**Support Proposal Price**			**30,000,000**
Total Amount(VAT Exclude)				606,000,000	**222,000,000**

Goldilocks Total Amount (Offer Price)	**222,000,000**

* For Technical supports, it indicates 24 x 7 x 4 hours of support