Alibaba Cloud

Alibaba Cloud Computing Ltd.

TPC Express Benchmark™ Big Bench (TPCx-BB)

Full Disclosure Report

for

Alibaba Cloud MaxCompute

(with 14x Compute Nodes,

3x Storage Nodes

3x Admin Nodes)

using

MaxCompute v3.37

and

Alibaba Group Enterprise Linux Server 7.2 (Paladin)

First Edition

August 18, 2021

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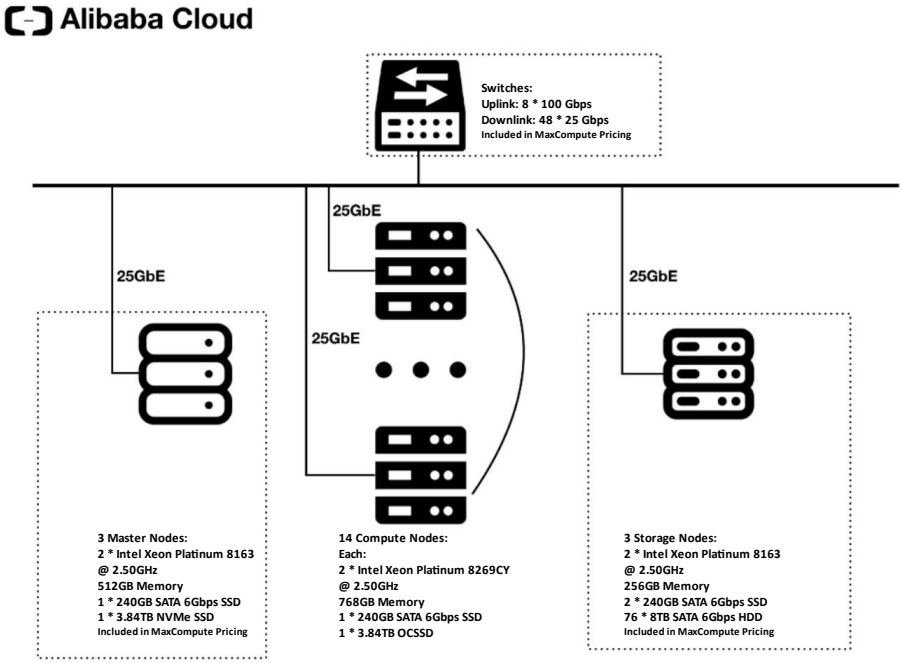
Alibaba Cloud	**Alibaba Cloud MaxCompute**	TPCx-BB Rev. v1.5.0 TPC-Pricing Rev. v2.7.0 Report Date: August 18, 2021
Total System Cost	TPCx-BB Performance Metric	Price/Performance
1,072,194 USD	**16,649.75** BBQpm@30000	**64.40 USD** $/BBQpm@30000

Framework	Operating System	Other Software	Availability Date	Scale Factor	Streams
MaxCompute v3.37	Alibaba Group Enterprise Linux Server 7.2 (Paladin)	None	August 1, 2021	30000	3

System Configuration



Physical Storage/Scale Factor: 63.16	Scale Factor/Physical Memory: 2.30

Servers: Total Processors/Cores/Threads	3x Admin Nodes / 14x Compute Node / 3x Storage Node 40/1,016/2,032	
3x Master Node: 2x Intel® Xeon® Platinum 8163 CPU @ 2.50GHz 512 GiB Onboard SATA Controller 1x 240 GB SATA 6 Gbps SSD 1x 3.84 TB NVMe SSD Mellanox MT27710 ConnectX-4 Lx	**14x Compute Node (Compute):** 2x Intel(R) Xeon(R) Platinum 8269CY CPU @ 2.50GHz 768 GiB Onboard SATA Controller 1x 240 GB SATA 6 Gbps SSD 1x 3.84 TB OCSSD Mellanox MT27710 ConnectX-4 Lx	**3x Storage Node (Storage):** 2x Intel(R) Xeon(R) Platinum 8163 CPU @ 2.50GHz 256 GiB Onboard SATA Controller 2x 240 GB SATA 6 Gbps SSD 76x 8 TB SATA 6 Gbps HDD Mellanox MT27710 ConnectX-4 Lx
Connectivity:	Network Switch (8x 100 Gbps Up; 48x 25 Gbps Down)	

Description	Part Number	Source	Unit Price	Qty	Ext. Price	3-Year Maint.
License Compute and Software Services						
MaxCompute Annual Subscription (1,400 CU)	Asia Pacific SE 1 (Singapore)	1	$369,600.00	3	$1,108,800.00	
Master Node				3		
Intel® Xeon® Platinum 8163 @ 2.50 GHz				2		
32 GB Memory				16		
240 GB SATA 6 Gbps SSD				1		
3.84 TB NVMe SSD				1		
Compute Node				14		
Intel® Xeon® Platinum 8269CY @ 2.50 GHz				2		
32 GB Memory				24		
240 GB SATA 6 Gbps SSD				1		
3.84 TB OCSSD				1		
Storage Node				3		
Intel® Xeon® Platinum 8163 @ 2.50 GHz				2		
32 GB Memory				8		
240 GB SATA 6 Gbps SSD				2		
8 TB SATA 6 Gbps HDD				76		
Network Switches (8x100Gbps Up; 48x25Gbps Down)				NA		
1-Year Annual Subscription Discount (30%)			-$110,880.00	3	-$332,640.00	
MaxCompute Storage for 1 year		1	$1,378.96	3	$4,136.88	
30000 Scale Factor (6.15 TB compressed)						
MaxCompute Enterprise Service for 1 year		1	$96,000.00	3		$288,000.00
24x7, 4 hour response						
	License Compute and Software Services Sub-Total				**$780,296.88**	**$288,000.00**
Other Components						
13-inch MacBook Pro 1.4GHz (includes 2 spares)		2	$1,299.00	3	$3,897.00	
	Other Components Sub-Total				**$3,897.00**	**$0.00**

Pricing:1 = Alibaba; 2 = Apple.com

(1) All discounts are based on US list prices and for similar quantities and configurations. The discounts are based on the overall specific components pricing from respective vendors in this single quotation. Discounts for similarly sized configurations will be similar to those quoted here, but may vary based on the components in the configuration.

Audited by Doug Johnson, InfoSizing

Three-Year Cost of Ownership	**$1,072,194**
BBQpm@30000	**16,649.75**
$/BBQpm@30000	**$ 64.40**

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

Numerical Quantities

Scale Factor	30000
Streams	3
SUT Validation Test	PASS

Performance Run (Run 1)

Overall Run Start Time	2021-08-08 14:22:39.016
Overall Run End Time	2021-08-08 18:57:29.358
Overall Run Elapsed Time	16,490.342
Load Test Start Time	2021-08-08 14:22:39.017
Load Test End Time	2021-08-08 14:51:25.654
Load Test Elapsed Time	1,726.637
Power Test Start Time	2021-08-08 14:51:25.655
Power Test End Time	2021-08-08 16:21:20.338
Power Test Elapsed Time	5,394.683
Throughput Test Start Time	2021-08-08 16:21:20.338
Throughput Test End Time	2021-08-08 18:57:29.357
Throughput Test Elapsed Time	9,369.019
Performance Metric (BBQpm@ 30000)	16,649.75

Repeatability Run (Run 2)

Overall Run Start Time	2021-08-08 19:54:20.148
Overall Run End Time	2021-08-09 00:20:12.004
Overall Run Elapsed Time	15,951.856
Load Test Start Time	2021-08-08 19:54:20.149
Load Test End Time	2021-08-08 20:22:59.335
Load Test Elapsed Time	1,719.186
Power Test Start Time	2021-08-08 20:22:59.336
Power Test End Time	2021-08-08 21:48:08.337
Power Test Elapsed Time	5,109.001
Throughput Test Start Time	2021-08-08 21:48:08.338
Throughput Test End Time	2021-08-09 00:20:12.003
Throughput Test Elapsed Time	9,123.665
Performance Metric (BBQpm@ 30000)	17,226.79

Performance Run Report (Run 1)

```
**********
TPCx-BB
Result
v1.5.0
**********
INFO: T_LOAD = 1726.637
INFO: T_LD = 0.1 * T_LOAD: 172.6637
INFO: T_PT = 3019.1282532288
INFO: T_T_PUT = 9369.019
INFO: T_TT = 3123.00633333333
INFO: === Checking validity of the final result ===
INFO: OK: All required BigBench phases were performed.
INFO: OK: All 30 queries were running in the power test.
INFO: OK: All 30 queries were running in the first throughput test.
INFO: OK: Pretend mode was inactive. All commands were executed.
INFO: === Final result ===
INFO: VALID BBQpm@30000 = 16649.7509532956
```

Repeatability Run Report (Run 2)

```
**********
TPCx-BB
Result
v1.5.0
**********
INFO: T_LOAD = 1719.186
INFO: T_LD = 0.1 * T_LOAD: 171.9186
INFO: T_PT = 2886.2692958111
INFO: T_T_PUT = 9123.665
INFO: T_TT = 3041.22166666666
INFO: === Checking validity of the final result ===
INFO: OK: All required BigBench phases were performed.
INFO: OK: All 30 queries were running in the power test.
INFO: OK: All 30 queries were running in the first throughput test.
INFO: OK: Pretend mode was inactive. All commands were executed.
INFO: === Final result ===
INFO: VALID BBQpm@30000 = 17226.7967953113
```

Summary details of the run reports are shown above. For the complete run reports, see the Support Files Archive.

Table of Contents

Abstract

This document contains the methodology and results of the TPC Express Benchmark™ Big Bench (TPCx-BB) test conducted in conformance with the requirements of the TPCx-BB Standard Specification, Revision v1.5.0.

The test was conducted at a Scale Factor of 30000 with 20 nodes (14x Compute Node, 3x Storage Node) running MaxCompute v3.37 on Alibaba Group Enterprise Linux Server 7.2 (Paladin).

Measured Configuration

Company Name	Cluster Node	Virtualization	Operating System
Alibaba Cloud Computing Ltd.	3x Admin Nodes 14x Compute Node 3x Storage Node	n/a	Alibaba Group Enterprise Linux Server 7.2 (Paladin)

TPC Express Benchmark© Big Bench Metrics

Total System Cost	BBQpm@30000	Price/Performance	Availability Date
1,072,194 USD	16,649.75	64.40 USD	August 1, 2021

Preface

TPC Express Benchmark™ Big Bench Overview

Big data analytics is a growing field of research and business. The significant decrease in the overall cost of hardware, the emergence of Open Source based analytics frameworks, along with the greater depth of data mining capabilities allows new types of data sources to be correlated with traditional data sources. For example, online retailers used to record only successful transactions on their website, whereas modern systems are capable of recording every interaction. The former allowed for simple shopping basket analysis techniques, while the current level of detail in monitoring makes detailed user modeling possible. The growing demands on data management systems and the new forms of analysis have led to the development of a new type of ***Big Data Analytics Systems (BDAS)****.*

Similar to the advent of ***Database Management Systems****, there is a vastly growing ecosystem of diverse approaches to enabling Big Data Analytics Systems. This leads to a dilemma for customers of* ***BDAS****, as there are no realistic and proven measures to compare different* ***BDAS*** *solutions. To address this, TPC has developed TPCx-BB (BigBench), which is an express benchmark for comparing* ***BDAS*** *solutions. The TPCx-BB Benchmark was developed to cover essential functional and business aspects of big data use cases. The benchmark allows for an objective measurement of* ***BDAS*** *System under Test, and provides the industry with verifiable performance, price/performance, and availability metrics.*

The TPCx-BB kit is available from the TPC website (see www.tpc.org for more information). Users must sign-up and agree to the TPCx-BB End User Licensing Agreement (EULA) to download the kit. All related work (such as collaterals, papers, derivatives) must acknowledge the TPC and include the TPCx-BB copyright. The TPCx-BB kit includes: TPCx-BB Specification document (this document), TPCx-BB Users Guide documentation, shell scripts to set up the benchmark environment, Java code to execute the benchmark workload, Data Generator, ***Query*** *files, and Benchmark Driver.*

The purpose of TPC benchmarks is to provide relevant, objective performance data to industry users. To achieve that purpose, TPC benchmark specifications require that benchmark tests be implemented with systems, products, technologies and pricing that:

- *Are generally available to users;*
- *Are relevant to the market segment that the individual TPC benchmark models or represents (e.g., TPCx-BB models and represents a Big Data Analytics System such as Hadoop ecosystem or Hadoop File-system API compatible systems);*
- *Would plausibly be implemented by a significant number of users in the market segment the benchmark models or represents.*

The use of new systems, products, technologies (hardware or software) and pricing is encouraged so long as they meet the requirements above. Specifically prohibited are benchmark systems, products, technologies or pricing (hereafter referred to as "implementations") whose primary purpose is performance optimization of TPC benchmark results without any corresponding applicability to real-world applications and environments. In other words, all "benchmark special" implementations that improve benchmark results but not real-world performance or pricing, are prohibited.

The rules for pricing are included in the TPC Pricing Specification and rules for energy measurement are included in the TPC Energy Specification.

Further information is available at www.tpc.org

Clause 1: General Items

1.1 Test Sponsor

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

This benchmark was sponsored by Alibaba Cloud Computing Ltd.

1.2 Parameter Settings

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

- *Configuration parameters and options for server, storage, network and other hardware components used by the SUT.*
- *Configuration parameters and options for Operating System and file system components used by the SUT.*
- *Configuration parameters and options for any other software components (e.g compiler optimization options) used by the SUT.*

Comment 1: In the event that some parameters and options are set multiple times, it must be easily discernible by an interested reader when the parameter or option was modified and what new value it received each time.

Comment 2: This requirement can be satisfied by providing a full list of all parameters and options, as long as all those that have been modified from their default values have been clearly identified and these parameters and options are only set once.

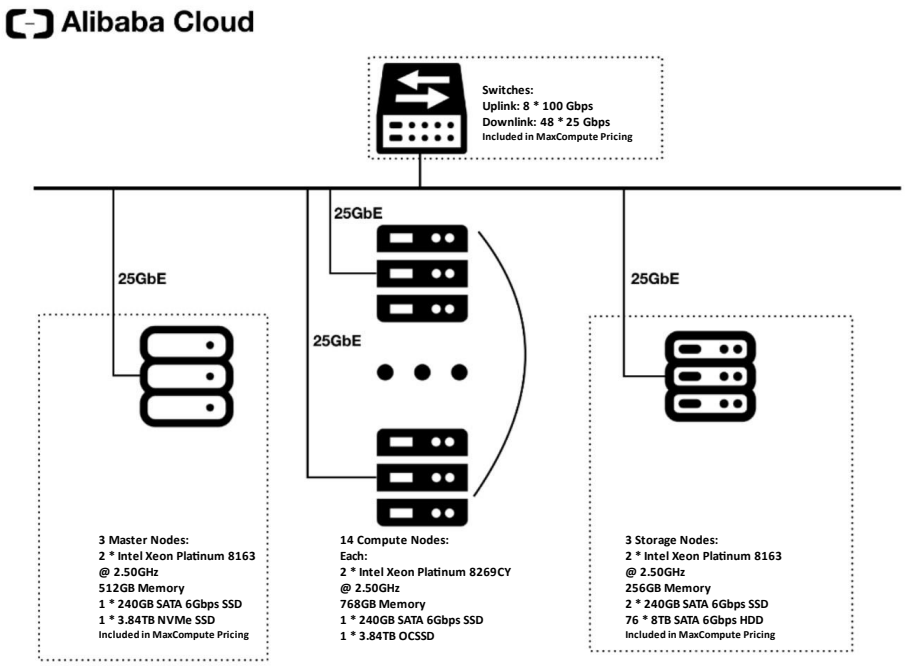
The Supporting Files Archive contains the parameters and options used to configure the components involved in this benchmark.

1.3 Configuration Diagrams

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

- *Total number of nodes used;*
- *Total number and type of processors used/total number of cores used/total number of threads used (including sizes of L2 and L3 caches);*
- *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 and speed for switches and other hardware components physically used in the test or are incorporated into the pricing structure;*
- *Type and the run-time execution location of software components.*

Measured Configuration



The measured configuration consisted of:

Total Nodes:	20
Total Processors/Cores/Threads:	40/1,016/2,032
Total Memory:	13,056 GiB
Total Number of Storage Devices:	268
Total Storage Capacity:	1,894,800
Network:	Network Switch (8x 100 Gbps Up; 48x 25 Gbps Down)

3x Master Nodes each with:	**14x Compute Node (Compute):**	**3x Storage Node (Storage):**
2/48/96 (processors/cores/threads)	2/52/104	2/48/96
2x Intel(R) Xeon(R) Platinum 8163 CPU @ 2.50GHz	2x Intel(R) Xeon(R) Platinum 8269CY CPU @ 2.50GHz	2x Intel(R) Xeon(R) Platinum 8163 CPU @ 2.50GHz
512 GiB	768 GiB	256 GiB
Onboard SATA Controller	Onboard SATA Controller	Onboard SATA Controller
1x 240 GB SATA 6 Gbps SSD	1x 240 GB SATA 6 Gbps SSD	2x 240 GB SATA 6 Gbps SSD
1x 3.84 TB NVMe SSD	1x 3.84 TB OCSSD	76x 8 TB SATA 6 Gbps HDD
Mellanox MT27710 ConnectX-4 Lx	Mellanox MT27710 ConnectX-4 Lx	Mellanox MT27710 ConnectX-4 Lx

The distribution of software components over server nodes is detailed in section 2.1.

Priced Configuration

There are no differences between the priced and measured configurations.

Clause 2: Software Components and Dataset Distribution

2.1 Roles and Dataset Distribution

The distribution of dataset across all media must be explicitly described.
The distribution of various software components across the system must be explicitly described.

Table 1.4 describes the distribution of the dataset across all media in the system.

Table 1.4: Software Components and Dataset Distribution

Server	Role(s)	Count	Virtual	Host Names	HW/SW Configuration	Storage Setup
Maxcompute Master Nodes	Pangu master Fuxi Master Nuwa	3	N	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/master-nodelist.txt	2 * Intel Xeon Platinum 8163 @ 2.50GHz 512GB Memory 1 * 240GB SATA 6Gbps SSD 1 * 3.84TB NVMe SSD 2 * 25Gb OS: Linux 3.10.0-327.ali2014.alios7.x86_64 Apsara: 1.11_u32	OS: 1 * 240GB SATA 6Gbps SSD Data Drive: 1 * 3.84TB NVMe SSD
Maxcompute Compute Nodes	Fuxi tubo	14	N	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/nodelist.txt	2 * Intel Xeon Platinum 8269CY @ 2.50GHz 768GB Memory 1 * 240GB SATA 6Gbps SSD 1 * 3.84TB OCSSD 2 * 25Gb OS: Linux 3.10.0-327.ali2016.alios7.x86_64 Apsara: 1.11_u32	OS: 1 * 240GB SATA 6Gbps SSD Data Drive: 1 * 3.84TB OCSSD
Maxcompute Storage Nodes	Pangu ChunkServer	3	N	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/storage-nodelist.txt	2 * Intel Xeon Platinum 8163 @ 2.50GHz 256GB Memory 2 * 240GB SATA 6Gbps SSD 76 * 8TB SATA 6Gbps HDD OS: Linux 3.10.0-327.ali2010.rc7.alios7.x86_64 Apsara: 1.11_u32	OS: 2 * 240GB SATA 6Gbps SSD Data Drive: 76 * 8TB SATA 6Gbps HD

2.2 Distributed File System Implementation

Distributed file system implementation and corresponding Hadoop File System API version must be disclosed.

MaxCompute v3.37.

2.3 Engine Implementation

The Engine implementation and corresponding version must be disclosed.

Component	Version
MaxCompute	3.37

2.4 Frameworks

Frameworks and Engine used in the benchmark should be disclosed.

Framework	Version
MaxCompute	3.37

2.5 Applied Patches

Any additional vendor supported patches applied to the SUT should be disclosed.

No additional patches were applied.

Clause 3: Workload Related Items

3.1 Hardware & Software Tunable

Script or text used to set for all hardware and software tunable parameters must be reported.

The Supporting Files Archive contains all configuration scripts.

3.2 Kit Version

Version number of the TPCx-BB kit must be included in the Report.

TPCx-BB Kit Version
v1.5.0

3.3 Run Report

The run report generated by TPCx-BB benchmark kit must be included in the Report.

The Supporting File Archive contains the full run report. Following are summary extracts from both runs.

- **Run1 Report Summary (Performance Run)**

```
**********
TPCx-BB
Result
v1.5.0
**********
INFO: T_LOAD = 1726.637
INFO: T_LD = 0.1 * T_LOAD: 172.6637
INFO: T_PT = 3019.1282532288
INFO: T_T_PUT = 9369.019
INFO: T_TT = 3123.00633333333
INFO: === Checking validity of the final result ===
INFO: OK: All required BigBench phases were performed.
INFO: OK: All 30 queries were running in the power test.
INFO: OK: All 30 queries were running in the first throughput test.
INFO: OK: Pretend mode was inactive. All commands were executed.
INFO: === Final result ===
INFO: VALID BBQpm@30000 = 16649.7509532956
```

- **Run2 Report Summary (Repeatability Run)**

```
**********
TPCx-BB
Result
v1.5.0
**********
INFO: T_LOAD = 1719.186
INFO: T_LD = 0.1 * T_LOAD: 171.9186
INFO: T_PT = 2886.2692958111
INFO: T_T_PUT = 9123.665
INFO: T_TT = 3041.22166666666
INFO: === Checking validity of the final result ===
INFO: OK: All required BigBench phases were performed.
INFO: OK: All 30 queries were running in the power test.
INFO: OK: All 30 queries were running in the first throughput test.
INFO: OK: Pretend mode was inactive. All commands were executed.
INFO: === Final result ===
INFO: VALID BBQpm@30000 = 17226.7967953113
```

3.4 Query Elapsed Times

Elapsed times of all power and throughput Queries needs to be reported from the Performance Run, grouped respectively as Structured, semi-structured and unstructured buckets.

Type	Query	Power	Stream 1	Stream 2	Stream 3
Structured	1	42.638	48.707	59.100	71.740
	6	41.956	262.567	517.400	42.311
	7	50.696	176.684	130.995	575.735
	9	26.700	185.942	171.958	39.699
	11	25.466	31.303	25.029	111.645
	13	40.376	58.283	38.552	54.988
	14	24.377	110.446	76.630	179.479
	15	37.134	53.105	90.604	39.327
	16	90.976	182.434	399.048	1,043.891
	17	34.818	36.684	76.203	36.807
	20	170.439	410.645	180.975	350.745
	21	109.481	113.620	273.892	378.969
	22	24.854	120.822	23.052	156.126
	23	60.877	194.525	200.408	104.619
	24	55.966	145.298	82.409	100.958
	25	185.240	304.090	833.385	237.371
	26	297.917	274.482	456.427	288.846
	29	69.339	106.650	131.088	71.643
Semi-structured	2	601.209	675.941	600.854	1,171.184
	3	344.499	298.501	364.034	304.178
	4	331.483	831.186	345.940	348.598
	5	547.013	869.363	1,168.981	602.823
	8	163.105	217.126	207.858	477.004
	12	66.272	237.036	91.718	70.862
	30	480.985	1,030.088	500.501	685.144
Unstructured	10	178.082	174.686	210.556	349.340
	18	954.707	967.465	1,089.659	990.765
	19	184.108	183.708	598.772	323.869
	27	40.402	37.001	74.098	44.113
	28	113.530	152.419	117.122	116.226

3.5 Validation Test Output

Output report from successful SUT Validation test must be included in the Report.

Query Number	Query Execution	Output Validation
1	PASS	PASS
2	PASS	PASS
3	PASS	PASS
4	PASS	PASS
5	PASS	PASS
6	PASS	PASS
7	PASS	PASS
8	PASS	PASS
9	PASS	PASS
10	PASS	PASS
11	PASS	PASS
12	PASS	PASS
13	PASS	PASS
14	PASS	PASS
15	PASS	PASS
16	PASS	PASS
17	PASS	PASS
18	PASS	PASS
19	PASS	PASS
20	PASS	PASS
21	PASS	PASS
22	PASS	PASS
23	PASS	PASS
24	PASS	PASS
25	PASS	PASS
26	PASS	PASS
27	PASS	PASS
28	PASS	PASS
29	PASS	PASS
30	PASS	PASS

3.6 Global Framework Parameters

Global Framework parameter settings files must be included in the Report.

The Supporting File Archive contains the global framework parameter settings files.

3.7 Kit Modifications

Test Sponsor kit modifications files must be included in the Report.

The following files were modified by the Test Sponsor to facilitate system, platform and Framework differences.

- bigBench-configs/conf/userSettings.conf
- bigBench-configs/sql/conf/engineSettings.conf
- bigBench-configs/sql/conf/engineSettings.sql
- bigBench-configs/sql/queries/q01/engineLocalSettings.sql
- bigBench-configs/sql/queries/q02/engineLocalSettings.sql
- bigBench-configs/sql/queries/q03/engineLocalSettings.sql
- bigBench-configs/sql/queries/q04/engineLocalSettings.sql
- bigBench-configs/sql/queries/q05/engineLocalSettings.sql
- bigBench-configs/sql/queries/q06/engineLocalSettings.sql
- bigBench-configs/sql/queries/q07/engineLocalSettings.sql
- bigBench-configs/sql/queries/q08/engineLocalSettings.sql
- bigBench-configs/sql/queries/q09/engineLocalSettings.sql
- bigBench-configs/sql/queries/q10/engineLocalSettings.sql
- bigBench-configs/sql/queries/q11/engineLocalSettings.sql
- bigBench-configs/sql/queries/q12/engineLocalSettings.sql
- bigBench-configs/sql/queries/q13/engineLocalSettings.sql
- bigBench-configs/sql/queries/q14/engineLocalSettings.sql
- bigBench-configs/sql/queries/q15/engineLocalSettings.sql
- bigBench-configs/sql/queries/q16/engineLocalSettings.sql
- bigBench-configs/sql/queries/q17/engineLocalSettings.sql
- bigBench-configs/sql/queries/q18/engineLocalSettings.sql
- bigBench-configs/sql/queries/q19/engineLocalSettings.sql
- bigBench-configs/sql/queries/q20/engineLocalSettings.sql
- bigBench-configs/sql/queries/q21/engineLocalSettings.sql
- bigBench-configs/sql/queries/q22/engineLocalSettings.sql
- bigBench-configs/sql/queries/q23/engineLocalSettings.sql
- bigBench-configs/sql/queries/q24/engineLocalSettings.sql
- bigBench-configs/sql/queries/q25/engineLocalSettings.sql
- bigBench-configs/sql/queries/q26/engineLocalSettings.sql
- bigBench-configs/sql/queries/q27/engineLocalSettings.sql
- bigBench-configs/sql/queries/q28/engineLocalSettings.sql
- bigBench-configs/sql/queries/q29/engineLocalSettings.sql
- bigBench-configs/sql/queries/q30/engineLocalSettings.sql

Clause 4: SUT Related Items

4.1 Specialized Hardware/Software

Specialized Hardware/Software used in the SUT must be included.

No specialized hardware or software was used.

4.2 Framework Configuration Files

All Framework configuration files from SUT, for the performance run.

All Framework configuration files are included in the Supporting Files Archive.

4.3 SUT Environment Information

SUT environment info in form of envinfo.log from a representative worker node form every role in the server.

All envinfo.log files are included in the Supporting Files Archive.

4.4 Data Storage to Scale Factor Ratio

The data storage ratio must be disclosed.

Nodes	Disks	Size (GB)	Total (GB)
17	1	240	4,080
17	1	3,840	65,280
3	2	240	1,440
3	76	8,000	1,824,000

Total Storage (GB)	1,894,800
Scale Factor	30000
Data Storage Ratio	63.16

4.5 Scale Factor to Memory Ratio

The Scale Factor to memory ratio must be disclosed.

Nodes	Memory (GB)	Total (GB)
3	512	1,536
14	768	10,752
3	256	768

Scale Factor	30000
Total Memory (GB)	13,056
SF / Memory Ratio	2.30

Clause 5: Metrics and Scale Factors

5.1 Performance Run Metric

The Reported Performance Metric (BBQpm@SF for the Performance Run) must be disclosed in the Report.

Performance Run
BBQpm@30000 16,649.75

5.2 Repeatability Run Metric

The Performance Metric (BBQpm@SF) for the Repeatability Run must be disclosed in the Report..

Repeatability Run
BBQpm@30000 17,226.79

5.3 Price-Performance Metric

The Reported Performance Metric (BBQpm@SF for the Performance Run) must be disclosed in the Report.

Price / Performance
$BBQpm@30000 64.40

5.4 Scale Factor

The Scale Factor used for the Result must be disclosed in the Report.

Scale Factor
30000

5.5 Stream Count

The number of streams in the throughput run used for the Result must be disclosed in the Report.

Streams
3

5.6 Elapsed Run Times

The total elapsed time for the execution of the Performance Run and Repeatability Run must be disclosed in the Report.

Run	Elapsed Time	Seconds
Run 1	00 04:34:50.342	16,490.342
Run 2	00 04:25:51.856	15,951.856

5.7 Elapsed Test Times

The total time for each of the three tests must be disclosed for the Performance Run and the Repeatability Run.

Test	Performance Run	Repeatability Run
Load Test	1,726.637	1,719.186
Power Test	5,394.683	5,109.001
Throughput Test	9,369.019	9,123.665

Auditors' Information and Attestation Letter

The auditor's agency name, address, phone number, and Attestation letter 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 Doug Johnson, InfoSizing.

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

This benchmark's Full Disclosure Report (FDR) can be downloaded from www.tpc.org.

A copy of the auditor's attestation letter is included in the next two pages.

InfoSizing
The Right Metric For Sizing IT

TPC Certified Auditor

Xiening Dai
205 108th Ave NE, Suite 400
Bellevue, WA 98004

August 17, 2021

I verified the TPC Express Benchmark™ BB v1.5.0 performance of the following configuration:

Platform:	Alibaba Cloud MaxCompute (w/ 3x Master Nodes, 14x Compute Nodes, 3 Storage Nodes)
Operating System:	Alibaba Group Enterprise Linux Server 7.2 (Paladin)
Framework:	MaxCompute v3.37

The results were:

Performance Metric	**16,649.75 BBQpm@30000**
Run Elapsed Time	00 04:34:50.342 (16,490.342 Seconds)

Cluster	**3x Master Nodes, 14x Compute Nodes, 3x Storage Nodes**
CPUs	2x Intel® Xeon® Platinum 8163 (2.50 GHz, 24-core, 33 MB L3) (Master, Storage nodes) 2x Intel® Xeon® Platinum 8269CY (2.50 GHz, 18-core, 35.75 MB L3) (Compute nodes)
Memory	512GiB (Master nodes), 768GiB (Compute nodes), 256GiB (Storage nodes)

Storage

Qty	*Size*	*Type*
1	240 GB	SATA 6Gbps SSD (Master, Compute nodes)
2	240 GB	SATA 6Gbps SSD (Storage nodes)
1	3.84 TB	NVMe SSD (Master nodes)
1	3.84 TB	OCSSD (Compute nodes)
76	8 TB	SATA 6Gbps HDD (Storage nodes)

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark.

The following verification items were given special attention:

- All TPC-provided components were verified to be v1.5.0
- No modifications were made to any of the Java code
- Any and all modifications to shell scripts were reviewed for compliance

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

- The tested Scale Factor (30000GB) was confirmed to be valid for publication
- All validation queries executed successfully and produced compliant results
- No errors were reported during the run
- The elapsed times for all phases and runs were correctly measured and reported
- The Storage and Memory Ratios were correctly calculated and reported
- 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 Auditor

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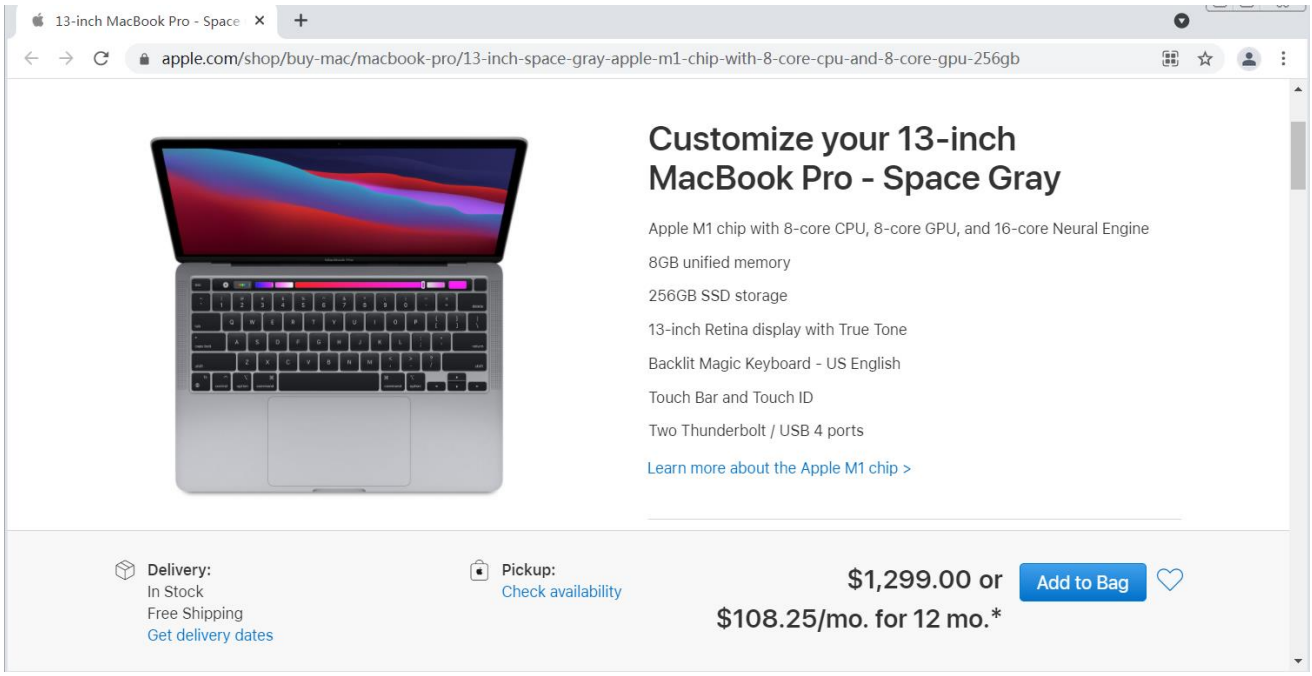
Third Party Price Quotes

Apple.com



Supporting File Index

The following index outlines the information included in the supporting files archive.

Description	Archive File Pathname
Clause 1 - General Items	
The Supporting Files Archive contains the parameters and options used to configure the components involved in this benchmark	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB
Validation Run Files	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Validation-Run-logs-20210808-133637-sql-sf30000
Performance Run Files	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000
Repeatability Run Files	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Repeatability-Run-logs-20210809-003321-sql-sf30000
Clause 3 - Workload Related Items	
Benchmark Generic Parameters	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/bigBench-configs/conf/userSettings.conf
Query Parameters used in the benchmark execution Settings	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/bigBench-configs/sql/conf/queryParameters.sql
Benchmark Global Framework Parameters Settings	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/bigBench-configs/sql/conf/engineSettings.sql
Benchmark Global Framework Parameters Settings	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/bigBench-configs/sql/population/odpsCreateLoad.sql
Load Test script	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/bigBench-configs/sql/queries/q[01-30]/engineLocalSettings.conf
Queries specific optimization parameters settings	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/bigBench-configs/conf/userSettings.conf
Clause 4 - SUT Related Items	
Data Redundancy report	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/pangu_redundant_info_20210809-003423.txt
Benchmark execution script	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/TPCxBB_FullBenchmark_sequence_run.sh
Hardware and Software Report from a representative master node	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/envInfo-s54a04374.cloud.eo166/envInfo.log
Hardware and Software Report from a representative compute node	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/envInfo-s37a09328.cloud.eo166/envInfo.log
Hardware and Software Report from a representative storage node	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/envInfo-s39e12451.cloud.eo166/envInfo.log
Clause 5 - Metric and Scale Factor Related Items	
Benchmark Performance Report	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Performance-Run-logs-20210808-190937-sql-sf30000/run-logs/BigBenchResult.log
Validation Test Report	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/Validation-Run-logs-20210808-133637-sql-sf30000/run-logs/BigBenchResult.log
Clause 6 – Other	
master Nodes	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/master-nodelist.txt
compute Nodes	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/nodelist.txt
storage Nodes	Support-Files-for-Alibaba-Maxcompute-14nodes-30TB/storage-nodelist.txt