TPC Express Benchmark™ IoT
Full Disclosure Report

TimechoDB 1.3.2.2
Based on Apache IoTDB

running on

Alibaba Cloud Elastic Compute Service

with

CentOS Stream 8 64-bit

First Edition – July 2024

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Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary because of these and other factors.

Therefore, the TPC Express Benchmark™ 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

Timecho conducted the TPC Express Benchmark™ IoT (TPCx-IoT) on a 2-node TimechoDB cluster with two-way replication, with each node deployed on a separate Alibaba Cloud Elastic Compute Service instance. The software used included TimechoDB 1.3.2.2. This report provides full disclosure of the methodology and results. All testing was conducted in conformance with the requirements of the TPCx-IoT Standard Specification, Revision 2.1.1. The benchmark results are summarized below.
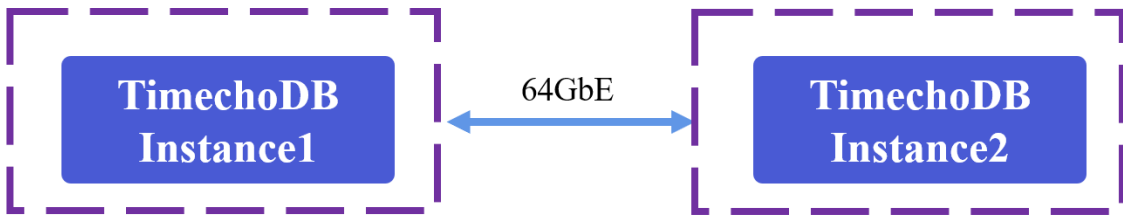
Configuration Summary

Sponsor	Cluster Nodes	Storage Software	Operating System
Timecho	Alibaba Cloud Elastic Compute Service Server	TimechoDB 1.3.2.2 based on Apache IoTDB	CentOS Stream 8 64-bit (Security Hardened)

TPC Express Benchmark™ IoT Metrics

Total System Cost(USD)	IoTps	USD/KIoTps	Avaliability Date
$288,471.48	8,260,764.81	$34.92	July 24, 2024

Executive Summary

The <u>Executive Summary</u> follows on the next several pages.

timecho	**TimechoDB 1.3.2.2** **based on Apache IoTDB**	TPCx-IoT 2.1.1
		TPC Pricing 2.9.0
		Report Date July 24,2024

Total System Cost	TPCx-IoT Performance Metric	Price/Performance
$288,471.48 USD	**8,260,764.81 IoTps**	**$34.92 USD/kIoTps**

Servers	Operating System	Other Software	Avaliability Date
ecs.g8a.48xlarge	CentOS Stream 8 64-bit	None	July 24, 2024

System Under Test Configuration Overview

TimechoDB Instance1 ←→ 64GbE ←→ **TimechoDB Instance2**

Server 1:
1 x ecs.g8a.48xlarge
CentOS Stream 8 64-bit
192 vCPU Processor
768 GB Memory
10 x 800GB Enhanced SSD

Server 2:
1 x ecs.g8a.48xlarge
CentOS Stream 8 64-bit
192 vCPU Processor
768 GB Memory
10 x 800GB Enhanced SSD

Total Servers:	2 Alibaba Cloud ECSs -2x ecs.g8a.48xlarge
Total Processors/Cores/Threads:	2/192/384
Server Configuration:	2x TimechoDB Instances
Processor:	1x ecs.g8a.48xlarge (AMD EPYC 9T24 96-Core Processor)
Memory:	768GB
Storage Device:	10x 800GB Alibaba Cloud ESSD
Network Controller:	Bandwidth: 64 Gbps
Connectivity:	Alibaba Cloud Elastic Compute Service

timecho	TimechoDB 1.3.2.2 based on Apache IoTDB	TPCx-IoT 2.1.1
		TPC Pricing 2.9.0
		Report Date July 24,2024

Description	Part Number	Source	List Price (USD)	Qty	Extended Price (USD)	3 yr. Maint. Price (USD
Licensed Compute Services						
Alibaba Cloud Elastic Compute Service 1-Year Plan Auto-renewal		1	59,525.79	6	357,154.74	included
- Alibaba Cloud ECS Instance: ecs.g8a.48xlarge	ecs.g8a.48xlarge	1	included	2		
- 128GB ESSD System Disk		1	included	2		
- 800GB ESSD Data Disk		1	included	20		
- Private Network		1	included	1		
					Sub-Total	$357,154.74 USD
Licensed Software Services						
CentOS Stream 8 64-bit		1	included	2		
3-Year TimechoDB 1.3.2.2 License (incl. 1-year 24*7 Support)		2	60,000	1	60,000	
1-Year TimechoDB 24*7 Support		2	12,000	2	24,000	
					Sub-Total	$84,000 USD
Discounts*						
Alibaba Cloud ECS (38.05%)		1	(22,647.21)	6	(135,883.26)	
3-Year TimechoDB 1.3.2.2 License		2	(12,000)	1	(12,000)	
1-Year TimechoDB 24*7 Support		2	(2,400)	2	(4,800)	
					Sub-Total	($152,683.26 USD)
					Total	**$288,471.48 USD**

Price Sources:	Three-Year Cost of Ownership:	$288,471.48 USD
1) Alibaba Cloud, 2) Timecho		
*38.05% OFF discount is directly applied for over 12 months subscription in all Alibaba Cloud regions.	**IoTps:**	**8,260,764.81**
*20% OFF discount is based on list price for the deployment of small clusters of TimechoDB.	**USD/kIoTps:**	**$34.92 USD/kIoTps**

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

![timecho logo]	**TimechoDB 1.3.2.2** **based on Apache IoTDB**	TPCx-IoT 2.1.1
		TPC Pricing 2.9.0
		Report Date July 24,2024

Numerical Quantities

Scale Factor	18,000,000,000

Performance Run (Run1)

Warmup Run Start Time	2024-07-03 14:25:46.000
Warmup Run End Time	2024-07-03 15:00:56.000
Warmup Run Elapsed Time	2,109.933
Measured Run Start Time	2024-07-03 15:00:57.000
Measured Run End Time	2024-07-03 15:35:29.000
Measured Run Elapsed Time	2,071.376
Performance Metric (IoTps)	8,689,875.72

Repeatability Run (Run2)

Warmup Run Start Time	2024-07-03 15:40:32.000
Warmup Run End Time	2024-07-03 16:13:29.000
Warmup Run Elapsed Time	1,976.523
Measured Run Start Time	2024-07-03 16:13:30.000
Measured Run End Time	2024-07-03 16:49:49.000
Measured Run Elapsed Time	2,178.975
Performance Metric (IoTps)	8,260,764.81

	TimechoDB 1.3.2.2 based on Apache IoTDB	TPCx-IoT 2.1.1
timecho		TPC Pricing 2.9.0
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Performance Run Report (Run1)

===

TPCx-IoT Performance Metric (IoTps) Report

Test Run1 details	Total Time For Warmup Run In Seconds = 2,109.933
Test Run1 details	Total Time In Seconds = 2,071.376
	Total Number of Records = 18,000,000,000

TPCx-IoT Performance Metric (IoTps): 8,689,875.72

===

Repeatability Run Report (Run2)

===

Test Run2 details	Total Time For Warmup Run In Seconds = 1,976.523
Test Run2 details	Total Time In Seconds = 2,178.975
	Total Number of Records = 18,000,000,000

TPCx-IoT Performance Metric (IoTps): 8,260,764.81

===

![timecho logo]	**TimechoDB 1.3.2.2** **based on Apache IoTDB**	TPCx-IoT 2.1.1
		TPC Pricing 2.9.0
		Report Date July 24,2024

Revision History

Date	Edition	Description
July 24, 2024	First	Initial Publication

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Clause 0 Preamble

0.1 TPC Express Benchmark™ IoT Overview

TPC Express Benchmark™ IoT (TPCx-IoT) was developed to provide an objective measure of hardware, operating system and commercial NoSQL database software distributions, and to provide the industry with verifiable performance, price-performance and availability metrics. The benchmark models a continuous system availability of 24 hours a day, 7 days a week.

Even though the modeled application is simple, the results are highly relevant to hardware and software dealing with IoT gateway systems in general. TPCx-IoT stresses both hardware and software including database APIs and network connections to the database. This workload can be used to assess a broad range of NoSQL databases. TPCx-IoT can be used to assess a range of NoSQL implementations in a technically rigorous and directly comparable and vendor-neutral manner. The metric effectively represents the total number of records that can be inserted into a NoSQL database per second while running queries against the database.

The TPCx-IoT kit is available from the TPC (See www.tpc.org/tpcx-iot for more information). Users must sign up and agree to the TPCx-IoT User Licensing Agreement (ULA) to download the kit. Re-distribution of the kit is prohibited. All related work (such as collaterals, papers, derivatives) must acknowledge the TPC and include TPCx-IoT copyright. The TPCx-IoT Kit includes: the TPCx-IoT Specification document, the TPCx-IoT Users Guide document, shell scripts to set up the benchmark environment and Java code to execute the benchmark load.

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- IoT models and represents a NoSQL database mimicking an IoT gateway system)
- 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. 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 Timecho Technology (Beijing) Co. 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 component incorporated into the pricing structure;*

   • *Configuration parameters and options for operating system and file system component incorporated into the pricing structure;*

   • *Configuration parameters and options for any other software component incorporated into the pricing structure;*

   • *Compiler optimization options.*

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 used to configure the components involved in this benchmark.

1.3 Configuration Diagrams

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

   • *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 (for example, 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*

1.3.1 Measured Configuration
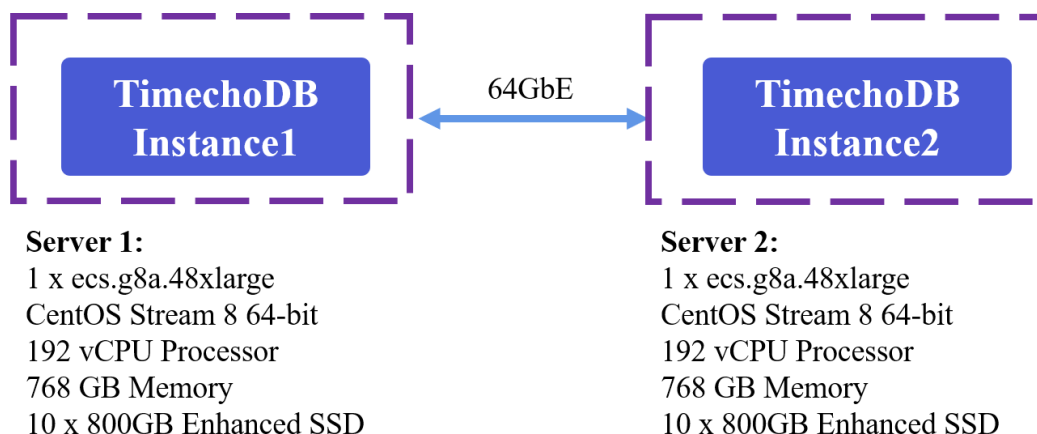
Figure 1-1 shows the measured configuration.

Server 1:
1 x ecs.g8a.48xlarge
CentOS Stream 8 64-bit
192 vCPU Processor
768 GB Memory
10 x 800GB Enhanced SSD

Server 2:
1 x ecs.g8a.48xlarge
CentOS Stream 8 64-bit
192 vCPU Processor
768 GB Memory
10 x 800GB Enhanced SSD

Figure 1-1 Measured Configuration

The measured configuration consisted of:

Total Nodes:	2
Total Processors/Cores/Threads:	2/192/384
Total Memory:	1,536GB
Total Number of Storage Devices:	20
Total Storage Capacity:	16,000GB
Connectivity:	2x Alibaba Cloud ECS Service (Bandwidth: 64Gbps)
Servers:	TimechoDB Instance
Processors/Cores/Threads:	1/96/192
Processor Model:	1x ecs.g8a.48xlarge(AMD EPYC 9T24 96-Core Processor)
Memory:	768GB
Storage Devices:	10x 800GB Alibaba Cloud ESSD
Network:	Bandwidth: 64Gbps

The distribution of software components over server nodes is detailed in section 1.5.

1.3.2 Priced Configuration

There are no differences between the priced configuration and the measured configuration.

1.4 Dataset Distribution

The distribution of dataset across all media must be explicitly described.

Table 1-1 describes the distribution of the dataset across all storage media in the system.

Server	Storage	Disk Drive	Description of Content
1-2	System Storage	1x 128GB Alibaba Cloud ESSD	Operating System, Swap, Root, Temp
	Data Storage	10x 800GB Alibaba Cloud ESSD	TimechoDB Data

Table 1-1 Dataset Distribution Across Storage Media

1.5 Software Component Distribution

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

Table describes the distribution of the software components across the system.

Server	TimechoDB ConfigNode	TimechoDB DataNode
1	X	X
2	X	X

Table 1-2 Software Component Distribution Across Nodes

The storage system software used was TimechoDB 1.3.2.2.

Clause 2 Workload Related Items

2.1 Hardware and Software Tunable Parameters

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

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

2.2 Run Report

The run report generated by the TPCx-IoT Kit for Performance Run and Repeatability Run must be reported.

The Supporting Files Archive contains the full run report. The following excerpts from the run report summarize the Performance Run and the Repeatability Run.

Performance Run Report (Run1)

```
================================================================================
        TPCx-IoT Performance Metric (IoTps) Report
        Test Run1 details              Total Time For Warmup Run In Seconds = 2,109.933
        Test Run1 details              Total Time In Seconds = 2,071.376
                                       Total Number of Records = 18,000,000,000

        TPCx-IoT Performance Metric (IoTps): 8,689,875.72
================================================================================
```

Repeatability Run Report (Run2)

```
        Test Run2 details              Total Time For Warmup Run In Seconds = 1,976.523
        Test Run2 details              Total Time In Seconds = 2,178.975
                                       Total Number of Records = 18,000,000,000

        TPCx-IoT Performance Metric (IoTps): 8,260,764.81
================================================================================
```

2.3 Benchmark Kit Identification

The version of the TPCx-IoT kit and checksums for key files are listed below.

TPCx-IoT Kit Version	2.1.1

File	MD5
TPC-IoT-master.sh	cc24620cfdee08290d771c5471a8d1ee
tpcx-iot/timechodb-binding/lib/core- 0.13.0-SNAPSHOT.jar	446b5d2220e9e4e79a9f47fa58c82b7e
IoT_cluster_validate_suite.sh	b2342754095f973ce27f43c28d3ca0ae

2.4 Benchmark Kit Changes

No modifications were made to the TPC provided kit.

Clause 3 Scale Factor and Metrics

3.1 Scale Factor, Performance, Price-Performance

The metrics for Run 1 and Run 2 are summarized below.

	Run1	Run2
Scale Factor	18,000,000,000	18,000,000,000
Measured Run Time (seconds)	2,071.376	2,178.975
IoTps	8,689,875.72	8,260,764.81

Run2 Price-Performance: 34.92 $/kIoTps

Third-Party Price Quotes

Alibaba Cloud, Elastic Compute Service (ECS)

Vendor

Alibaba Cloud, https://www.alibabacloud.com/

Quotation

The Elastic Compute Service (ECS) can be purchased directly on Alibaba Cloud at: https://www.alibabacloud.com/en/product/ecs?_p_lc=1

The server configuration is as detailed below:

Item	Configuration
ECS	China (Beijing) General-purpose Type g8a / ecs.g8a.48xlarge (192 vCPU 768 GiB) Image: CentOS Stream 8 64-bit (Security Hardened) System Disk: Enterprise SSD (ESSD) 128GiB, Release with Instance PL1 (up to 50,000 IOPS per disk) Data Disk (10 Disks): ESSD AutoPL Disk 800GiB, Release with Instance Pay-by-bandwidth 10Mbps

Notes:

The quote in the following screenshots represents 1-year subscription with auto-renewal.

The actual price of the product, offered by the official website, includes a 38.05% discount off the list price automatically.

The VAT rate of 6% applied for software services in China is included.

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Enterprise SSD (... ▼   128   GiB   1   8200   PL1 (Each PL1 ESSD can deliver u... ▼   ☑ Release with Instance

☐ Encryption

Cloud Disk Performance   Disk performance varies based on the Cloud Disk category. Learn about Cloud Disk performance metrics.

Cloud Disk Capacity   The total size of Cloud Disks that you can create is subject to a quota.

Data Disk   ＋ Add Data Disk (10/16)

Category	Size	Quantity	IOPS	Performance	Actions
Enterprise SSD (... ▼	800 GiB	10	41800	PL1 (Each PL1 ESSD can deliver u... ▼	☑ System-assigned Device Name ☑ Release with Instance
					☐ Encryption
					Create from Snapshot

Snapshot 🔶   Policy for System Disk   Select an automatic snapshot policy ▼   🔄 Create Automatic Snapshot Policy ⬈

REC   Policy for Data Disks   Select an automatic snapshot policy ▼   🔄

Snapshot Service Features   Snapshots can be automatically created to periodically back up disk data and reduce the risk of data loss arising from various situ... Show

Note   The selected automatic snapshot policies apply only to the disks that you create for the instances this time. For disks that are created after the instances are created, you must apply automatic snapshot policies separately.

▼ NAS File System(Optional)

Bandwidths & Security Groups

Public IP Address   ☑ Assign Public IPv4 Address

The system assigns an IP address. You can also use a more flexible EIP solution. For more information, see Configure and associate an EIP>.

Bandwidth Billing Method   [Pay-by-bandwidth]   [Pay-by-traffic]

Bandwidth | 1 | 2 | 3 | 5 | **10** | 50 | 100 | 200 | Mbps   — 10 ＋ Mbps

Mitigation Capacity   Alibaba Cloud provides a DDoS mitigation capacity of up to 5 Gbit/s free of charge. Learn More > | Improve Mitigation Capacity >

Security Group ⓘ   Existing Security Group   **New Security Group**

How to configure a
security group

Security Group Name   custom-security-group-20240724

Security Group Type   [Basic Security Group]   [Advanced Security Group]   Comparison Between Basic and Advanced Security Groups

**Open IPv4
Ports/Protocols**   ☑ SSH (TCP:22)   ☑ HTTP (TCP:80)   ☑ HTTPS (TCP:443)
                    ☑ RDP (TCP:3389)   ☑ ICMP (IPv4)

Note   If you select SSH (TCP:22), a security group rule that uses 0.0.0.0/0 as the source is added to allow inbound access from all IP addresses on port 22. After you create instances, we recommend that you modify the security group rule to allow inbound access only from specific IP addresses.

ENI ⓘ   Specify a vSwitch

IPv6   Specify a vSwitch.

▲ ENI | IPv6(Optional)

Management

Logon Credential   [Key Pair]   [Custom Password]   [Set Later]

Logon Username   ◉ root   ○ ecs-user

The root account is the most privileged account of an operating system. You may face security risks if you use root as your logon username. We recommend that you use ecs-user instead. Learn More>

Key Pair ⓘ   Test ▼   🔄 Create Key Pair ⬈

Tag   ＋ Add Tags (0/20)
How to design tags   A tag is a case-sensitive key-value pair. The specified tags are added to all the instances and disks that you are creating.

Timecho, TimechoDB 3-Year Subscription

timecho

Company Name	Quote No.:	PPxxxxxxxx
Contact Person	Date:	2024-07-01
E-Mail	Customer ID:	xxxxxxxx
Company Address		
Zip code and City	Contact:	xxxxxxxx
	E-Mail:	contact@timecho.com
	Telefon:	+86 (0) 10-62780978
		+49 (0) 711-81048763

Quote No. PPxxxxxxxx

Dear Sir or Madam,

Thank you for your inquiry. We offer our products and services exclusively under the following conditions. The offer is based on the data and requirements available at the time of the offer.

No.	Product	Qty	List Price	Supply Price	Total Price
01	TimechoDB v1.3.2.2 based on Apache IoTDB - 2-node Cluster with 2-way Replication - Timecho Monitoring Dashboard - Timecho Workbench - OpsKit (Cluster Management Tool) - 1-year Free Support	1	60,000	48,000	48,000 USD
02	Maintenance 1-year Support 24*7 inkl. remote troubleshooting, debug, updates, data migration tools, etc.	2	12,000	9,600	19,200 USD
			Total:		67,200 USD

Notes:

Quotation: TimechoDB Cluster Edition License (2 Nodes) and 3 years Maintenance.

Maintenance: Free maintenance for 1 year after the contract, 20% of maintenance rate applied afterwards.

Payment terms: Payment within 21 days from receipt of invoice without deductions.

The VAT rate of 13% applied for software goods is included.

Quotation validity period: 90 days from the date of quote.

Best regards,

Timecho Team

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