TPC Express Benchmark™ IoT Full Disclosure Report

Machbase 5.7.13

running on

Supermicro A+ Server 2014TP-HTR
(TwinPro™ with 4x H12SST-PS Nodes)

with

Red Hat Enterprise Linux Server Release 7.7

TPCx-IoT Version 1.0.5
Report Edition First
Report Submitted April 14, 2020
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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
TTA conducted the TPCx-IoT Benchmark™ on the Supermicro A+ Server 2014TP-HTR with 4x H12SST-PS Nodes. The software used included Machbase 5.7.13. 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 1.0.

The benchmark results are summarized below.

Configuration Summary

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Cluster Nodes</th>
<th>Storage Software</th>
<th>Operating System</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTA</td>
<td>Supermicro A+ Server 2014TP-HTR</td>
<td>Machbase 5.7.13</td>
<td>Red Hat Enterprise Linux Release 7.7</td>
</tr>
</tbody>
</table>

TPC Express Benchmark™ IoT Metrics

<table>
<thead>
<tr>
<th>Total System Cost (USD)</th>
<th>IoTps</th>
<th>USD/IoTps</th>
<th>Availability Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>$429,659</td>
<td>2,480,917.60</td>
<td>$0.18</td>
<td>April 14, 2020</td>
</tr>
</tbody>
</table>

Executive Summary
The Executive Summary follows on the next several pages.
EXECUTIVE SUMMARY

Machbase 5.7.13

<table>
<thead>
<tr>
<th>Total System Cost</th>
<th>TPCx-IoT Performance Metric</th>
<th>Price/Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$429,659 USD</td>
<td>2,480,917.60 IoTps</td>
<td>$0.18 USD/IoTps</td>
</tr>
</tbody>
</table>

Servers          Operating System          Other Software       Availability Date
Supermicro A+ Server 2014TP-HTR  Red Hat Enterprise Linux Server Release 7.7  None  April 14, 2020

System Under Test Configuration Overview

1 x Supermicro A+ Server 2014TP-HTR
TwinPro™ with 4x H12SST-PS Nodes, each with:

1 x Master Node
1 x AMD EPYC 7702P 64-Core Processor
8 x 64GB (512GB) Memory
1 x 100GbE 2-Port Adaptor
1 x 25GbE 2-Port and 10GbE 2-Port Adaptor
1 x 960GB SATA SSD
1 x 1TB M.2 PCIe SSD

3 x Data Nodes
1 x AMD EPYC 7F72 24-Core Processor
8 x 32GB (256GB) Memory
1 x 100GbE 2-Port Adapter
1 x 25GbE 2-Port and 10GbE 2-Port Adaptor
1 x 960GB SATA SSD
4 x 3.84TB M.2 PCIe SSD

Total Servers: 1x Supermicro A+ Server 2014TP-HTR (TwinPro™ with 4x H12SST-PS Nodes)
Total Processors/Cores/Threads: 4/136/272

Server Configuration:
Processor 1x Master Node
1x AMD EPYC 7702P (2.00GHz, 64-core, 256 MB L3)
512GB

Memory
1x 960GB SATA SSD
1x 1TB M.2 PCIe SSD Gen3

Storage Device
1x Mellanox MCX516A-CCAT 100GbE
1x Supermicro AOC-MH25G-m2S2TM 10GbE and 25GbE

Network Controller
Mellanox SN2700 100GbE Switch
(2x 2014TP-HTR) + (1x SN2700) = (2x1) + (1x1) = 3 RU

Connectivity
Total Rack Units: Mellanox SN2700 100GbE Switch

TPCx-IoT 1.0.5  TTA  Report Date
Full Disclosure Report  Machbase 5.7.13  April 14, 2020
**EXECUTIVE SUMMARY**

- **Machbase 5.7.13**
- **TPC-IoT**: 1.0.5
- **TPC Pricing**: 2.5.0
- **Report Date**: Apr. 14, 2020

### Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Source</th>
<th>List Price (USD)</th>
<th>Qty</th>
<th>Extended Price (USD)</th>
<th>3 yr. Maint. Price (USD)</th>
</tr>
</thead>
</table>

#### Server Hardware
- **Supermicro A+ Server 2014TP-HTR**
- **AMD EPYC 7702P 64-Core Processor**
- **SK hynix 64GB PC4-3200**
- **SK hynix 32GB PC4-3200**
- **Mellanox 100GbE Dual-Port NIC**
- **1Tb NVMe SSD Toshiba KG5020NV1T02**
- **3.84TB NVMe SSD Samsung PM983**
- **Samsung PM883 960GB SATA 6Gb/s V4 TLC 2.5” 7mm (1.3 DWPD)**
- **ASSEMBLY FEE**
- **Maintenance - 7x24x4 Care Pack (3-yr)**

#### Network
- **Mellanox MSN2700-CS2F Spectrum 100GbE 1U Open Ethernet Switch**
- **Mellanox SUP-SN2000-CL-S-3S-4H Technical Support and Warranty - Silver 3 Year with 4 Hours On-Site Support for SN2700 Cumulus Series Switch**
- **Mellanox MCP1600-E002E30 Passive Copper Cable IB EDR up to 100Gb/s QSFP28 2m Black 30AWG**

#### Software
- **Red Hat Enterprise Linux Server7.7 with Premium Support 1 Year**
- **Machbase v5.7.13 Cluster Edition (includes 1y 7x24x4 Technical Support)**
- **Machbase v5.7.13 Cluster Edition 7x24x4 Technical Support**

#### Infrastructure
- **HP EliteDisplay E243 23.8-inch Monitor (w/ spares)**
- **HP Slim USB Keyboard and Mouse (w/ spares)**

#### Discounts*
- **Machbase v5.7.13 Cluster Edition (includes 1y 7x24x4 Technical Support)**
- **Machbase v5.7.13 Cluster Edition 7x24x4 Technical Support**

### Price Source
- 1) Supermicro Computer Inc. 2) Mellanox Technologies, Ltd.
- 3) Red Hat Inc. 4) Machbase Inc. 5) Hewlett Packard Inc.

### Three-Year Cost of Ownership:

- **TPCx-IoT**: $429,659 USD
- **IoTps**: 2,480,917.60 USD
- **USD/IoTps**: $0.18 USD

---

*All discounts are based on US 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.*

---

**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.**
### Numerical Quantities

| Scale Factor | 4500000000 |

### Performance Run (Run2)

| Warmup Run Start Time | 2020-03-01 22:46:43.000 |
| Warmup Run End Time | 2020-03-01 23:17:05.000 |
| Warmup Run Elapsed Time | 1,821.296 |

| Measured Run Start Time | 2020-03-01 23:17:05.000 |
| Measured Run End Time | 2020-03-01 23:47:20.000 |
| Measured Run Elapsed Time | 1,813.845 |

| Performance Metric (IoTps) | 2,480,917.60 |

### Repeatability Run (Run1)

| Warmup Run Start Time | 2020-03-01 21:43:09.000 |
| Warmup Run End Time | 2020-03-01 22:13:16.000 |
| Warmup Run Elapsed Time | 1,806.022 |

| Measured Run Start Time | 2020-03-01 22:13:16.000 |
| Measured Run End Time | 2020-03-01 22:43:29.000 |
| Measured Run Elapsed Time | 1,812.287 |

| Performance Metric (IoTps) | 2,483,050.42 |
Performance Run Report (Run2)

TPCx-IoT Performance Metric (IoTps) Report
Test Run2 details : Total Time For Warmup Run In Seconds = 1,821.296
Test Run2 details : Total Time In Seconds = 1,813.845
Total Number of Records = 4500000000

TPCx-IoT Performance Metric (IoTps): 2480917.6087

Repeatability Run Report (Run1)

TPCx-IoT Performance Metric (IoTps) Report
Test Run1 details : Total Time For Warmup Run In Seconds = 1,806.022
Test Run1 details : Total Time In Seconds = 1,812.287
Total Number of Records = 4500000000

TPCx-IoT Performance Metric (IoTps): 2483050.4219

Summary details of the run reports are show above. For the complete run reports, see the Supporting Files Archive.
## Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Edition</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>April 14, 2020</td>
<td>First</td>
<td>Initial Publication</td>
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</tbody>
</table>
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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. Redistribution 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 Telecommunications Technology Association.

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 and options 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.

![Mellanox SN2700 100Gb Ethernet Switch](image)

**1 x Supermicro A+ Server 2014TP-HTR**

TwinPro™ with 4x H12SST-PS Nodes, each with:

**1 x Master Node**
- 1 x AMD EPYC 7702P 64-Core Processor
- 8 x 64GB (512GB) Memory
- 1 x 100GbE 2-Port Adaptor
- 1 x 960GB SATA SSD
- 1 x 1TB M.2 PCIe SSD

**3 x Data Nodes**
- 1 x AMD EPYC 7F72 24-Core Processor
- 8 x 32GB (256GB) Memory
- 1 x 100GbE 2-Port Adaptor
- 1 x 25GbE 2-Port and 10GbE 2-Port Adaptor
- 1 x 960GB SATA SSD
- 4 x 3.84TB M.2 PCIe SSD

The measured configuration consisted of:
- Total Nodes: 4
- Total Processors/Cores/Threads: 4/136/272
- Total Memory: 1.28TB
- Total Number of Storage Devices: 17
- Total Storage Capacity: 50.92TB

Connectivity: Mellanox SN2700 100GbE Switch

<table>
<thead>
<tr>
<th>Servers</th>
<th>1x Master Node:</th>
<th>3x Data Nodes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processors/Cores/Threads:</td>
<td>1/64/128</td>
<td>1/24/48</td>
</tr>
<tr>
<td>Processor Model:</td>
<td>1x AMD EPYC 7702P (2.00GHz, 64-core, 256MB L3)</td>
<td>1x AMD EPYC 7F72 (3.20GHz, 24-core, 192MB L3)</td>
</tr>
<tr>
<td>Memory:</td>
<td>512 GiB</td>
<td>256 GiB</td>
</tr>
<tr>
<td>Storage Devices:</td>
<td>1x 960GB SATA SSD</td>
<td>1x 960GB SATA SSD</td>
</tr>
<tr>
<td></td>
<td>1x 1TB M.2 PCIe SSD Gen3</td>
<td>4x 3.84TB M.2 PCIe SSD Gen3</td>
</tr>
<tr>
<td>Network Controller:</td>
<td>1x Mellanox MCX516A-CCAT 100GbE 1x Supermicro AOC-MH25G-m2s2TM 10GbE and 25GbE</td>
<td>1x Mellanox MCX516A-CCAT 100GbE 1x Supermicro AOC-MH25G-m2s2TM 10GbE and 25GbE</td>
</tr>
</tbody>
</table>

The distribution of software components over server nodes is detailed in section 1.5.
1.3.2 Priced Configuration
All nodes in the measured configuration used 1x Samsung PM863 Series 960GB SATA SSD as a system disk. All nodes in the priced configuration use 1x Samsung PM883 Series 960GB SATA SSD as a substitute. The substitution was allowed under TPC Pricing rules based on the following data.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Priced 960GB SATA SSD</th>
<th>Measured 960GB SATA SSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model (Part Number)</td>
<td>PM883 (MZ7LH960HAJR)</td>
<td>PM863 (MZLM960N)</td>
</tr>
<tr>
<td>Interface</td>
<td>SATA3 6Gb/s</td>
<td>SATA3 6Gb/s</td>
</tr>
<tr>
<td>NAND type</td>
<td>Samsung V-NAND</td>
<td>Samsung V-NAND</td>
</tr>
<tr>
<td>Sequential Read/Write (up to)</td>
<td>550/520 MB/s</td>
<td>520/480 MB/s</td>
</tr>
<tr>
<td>Random Read/Write (up to)</td>
<td>98K/28K IOPS</td>
<td>97K/24K IOPS</td>
</tr>
<tr>
<td>Form Factor</td>
<td>2.5 inch</td>
<td>2.5 inch</td>
</tr>
<tr>
<td>Launch Date</td>
<td>2018/04</td>
<td>2015/07</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Server</th>
<th>Storage</th>
<th>Disk Drive</th>
<th>Description of Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.5 SATA 6Gb/s M.2 PCIe Gen3</td>
<td>1 x 960GB SATA SSD 1 x 1TB NVMe SSD</td>
<td>Operating System, Root, Swap Machbase Broker</td>
</tr>
<tr>
<td>2-4</td>
<td>2.5 SATA 6Gb/s M.2 PCIe Gen3</td>
<td>1 x 960GB SATA SSD 4 x 3.84TB NVMe SSD</td>
<td>Operating System, Root, Swap Machbase Data, coordinator</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Server</th>
<th>Broker</th>
<th>Coordinator</th>
<th>Warehouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 1-2 Software Component Distribution Across Nodes

The storage system software used was Machbase 5.7.13.
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 all configuration scripts.

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.

Run Report for Run 1 (Repeatability Run)

```
===============================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run 1 details :  Total Time For Warmup Run In Seconds = 1,806.022
Test Run 1 details :  Total Time In Seconds = 1,812.287
                      Total Number of Records = 4500000000

TPCx-IoT Performance Metric (IoTps): 2483050.4219

===============================================
```

Run Report for Run 2 (Performance Run)

```
===============================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run 2 details :  Total Time For Warmup Run In Seconds = 1,821.296
Test Run 2 details :  Total Time In Seconds = 1,813.845
                      Total Number of Records = 4500000000

TPCx-IoT Performance Metric (IoTps): 2480917.6087

===============================================
```
2.3 Benchmark Kit Identification

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

<table>
<thead>
<tr>
<th>TPCx-IoT Kit Version</th>
<th>File</th>
<th>MD5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0.5</td>
<td>TPC-IoT-master.sh</td>
<td>aabeca02709f778295fcd1891ce3f74e</td>
</tr>
<tr>
<td></td>
<td>tpcx-iot/machbase-binding/lib/core-0.13.0-SNAPSHOT.jar</td>
<td>18b59e748a7026036e85e2e70ba45af5</td>
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<tr>
<td></td>
<td>IoT_cluster_validate_suite.sh</td>
<td>1d85705dc67fb3c767d7a1fe8775275f</td>
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</tbody>
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2.4 Benchmark Kit Changes

No modifications were made to 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.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale Factor</td>
<td>4500000000</td>
<td>4500000000</td>
</tr>
<tr>
<td>Measured Run Time (seconds)</td>
<td>1,812.287</td>
<td>1,813.845</td>
</tr>
<tr>
<td>IoTps</td>
<td>2,483,050.42</td>
<td>2,480,917.60</td>
</tr>
</tbody>
</table>

Run2 Price-Performance: 0.18 $/IoTps
## Third-Party Price Quotes

**Super Micro Computer Inc.**

### Quotation

<table>
<thead>
<tr>
<th>Date</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/04/2020</td>
<td>1</td>
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</table>

**Quotation Number:** 0000367579  
**Expiration Date:** 04/17/2020

**Sold To:**  
ADVANCED MICRO DEVICES, INC (CA)  
DEBBIE CHRISTOPHER  
2485 AUGUSTINE DRIVE  
SANTA CLARA CA 95054-3002  
USA

**Ship To:**  
ADVANCED MICRO DEVICES, INC (CA)  
DEBBIE CHRISTOPHER  
2485 AUGUSTINE DRIVE  
SANTA CLARA CA 95054-3002  
USA

<table>
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<th>Reference</th>
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<th>Salesperson</th>
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<table>
<thead>
<tr>
<th>Qty.</th>
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**Comments:**  
Quote is valid for 120 days from quotation date of March 10th, 2020

**Terms:**  
NET 45 DAYS

**Order Discount:**  
Subtotal: 45,260.84  
Total sales tax: 0.00  
Total order: 45,260.84

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TPCx-IoT 1.0.5  
Full Disclosure Report  
Machbase 5.7.13  
Report Date  
April 14, 2020
Mellanox Technologies, Ltd
Mellanox SUP-SN2000-CL-S-3S-4H Technical Support and Warranty - Silver 3 Year with 4 Hours On-Site Support for SN2700 Cumulus Series Switch

Availability: In stock
$3,345.00

Technology: Ethernet
Contract Length: 3 Years
Program Level: Silver

Quantity: 1

Add to Cart
Get a Quote

One-Year Hardware Warranty
Services & Support Call (855) 897-1098
Mellanox Specialists Send us an Email
Red Hat Inc.

**Shopping Cart**

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Continue shopping  
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**Total**

|               | 331,240 | 364,364 |

<< REMARK >>

- Here is a quote for applying a Machbase time series database for TTA.
- Quotation: Machbase Cluster Edition Run-Time License 4 nodes and 3 years Maintenance (1 Year for free)
- Maintenance: Free maintenance for one year after the contract, 15% of maintenance rate applied afterwards.
- Payment terms: Cash payment terms. (Within 30 days of issue of tax invoice)
- Server installation condition: It is recommended to separate DB server and Storage server.
- Installation: Cluster Edition - 7 Days, DB Table Guide is separately guided with DB Professional Service.
- Quotation validity period: 120 days from the date of quotation
## Supporting File Index

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