Telecommunications Technology Association

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	March 30, 2020

First Edition – March 2020

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Abstract

TTA conducted the TPC Express Benchmark™ IoT (TPCx-IoT) 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 1.0.5.

The benchmark results are summarized below.

Configuration Summary

Sponsor	Cluster Nodes	Storage Software	Operating System
TTA	Supermicro A+ Server 2014TP-HTR	Machbase 5.7.13	Red Hat Enterprise Linux Release 7.7

TPC Express Benchmark™ IoT Metrics

Total System Cost (USD)	IoTps	USD/IoTps	Availability Date
$419,793	2,199,052.90	$0.20	Currently Available

Executive Summary

The Executive Summary follows on the next several pages.

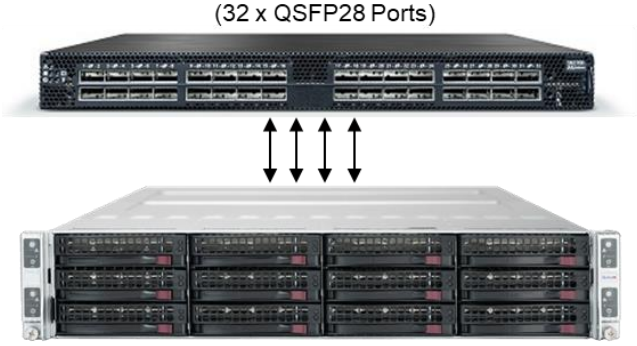
TTA	**Machbase 5.7.13**	TPCx-IoT 1.0.5 TPC Pricing 2.5.0 Report Date Mar. 30, 2020

Total System Cost	TPCx-IoT Performance Metric	Price/Performance
$419,793 USD	**2,199,052.90 IoTps**	**$0.20 USD/IoTps**

Servers	Operating System	Other Software	Availability Date
Supermicro A+ Server 2014TP-HTR	Red Hat Enterprise Linux Server Release 7.7	None	Currently Available

System Under Test Configuration Overview

Mellanox SN2700 100Gb Ethernet Switch
(32 x QSFP28 Ports)



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

1 x Master Node
- 1 x AMD EPYC 7502P 32-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 1TB M.2 PCIe SSD

3 x Data Nodes
- 1 x AMD EPYC 7502P 32-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 1TB M.2 PCIe SSD
- 2 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:	4/128/256	
Server Configuration:	1x Master Node	3x Data Nodes
Processor	1x AMD EPYC 7502P (2.50GHz, 32-core, 128 MB L3)	1x AMD EPYC 7502P (2.50GHz, 32-core, 128 MB L3)
Memory	512 GiB	256 GiB
Storage Device	1x 1TB M.2 PCIe SSD Gen3	1x 1TB M.2 PCIe SSD Gen3 2x 3.84TB M.2 PCIe SSD Gen3
Network Controller	1x Mellanox MCX516A-CCAT 100GbE 1x Supermicro AOC-MH25G-m2S2TM 10GbE and 25GbE	1x Mellanox MCX516A-CCAT 100GbE 1x Supermicro AOC-MH25G-m2S2TM 10GbE and 25GbE
Connectivity	Mellanox SN2700 100GbE Switch	
Total Rack Units:	(2x 2014TP-HTR) + (1x SN2700) = (2x1) + (1x1) = 3 RU	

Machbase 5.7.13

TPCx-IoT	1.0.5
TPC Pricing	2.5.0
Report Date	Mar. 30, 2020

Description	Part Number	Source	List Price (USD)	Qty	Extended Price (USD)	3 yr. Maint. Price (USD)
Server Hardware						
Supermicro A+ Server 2014TP-HTR	AS -2014TP-HTR	1	4,500.00	1	4,500.00	
AMD EPYC 7502P 32-Core Processor	PSE-ROM7502-0054	1	2,857.75	4	11,431.00	
SK hynix 64GB PC4-3200	MEM-DR464L-HL02-ER32	1	320.74	8	2,565.92	
SK hynix 32GB PC4-3200	MEM-DR432L-HL01-ER32	1	159.51	24	3,828.24	
Mellanox 100GbE Dual-Port NIC	AOC-MCX516A-CCAT	1	976.35	4	3,905.40	
2-port 25GbE SFP28 Mellanox CX-4 Lx EN and 2-port 10GbE RJ45 Intel X550	AOC-MH25G-m2S2TM	1	287.39	4	1,149.56	
1 TB NVMe SSD Toshiba KXG50ZNV1T02	HDS-TMN0-KXG50ZNV1T02	1	175.00	4	700.00	
3.84TB NVMe SSD Samsung PM983	HDS-SMN1-MZ1LB3T8HMLA07	1	677.35	6	4,064.10	
ASSEMBLY FEE	MC0037	1	250.00	1	250.00	
Maintenance - 7x24x4 Care Pack (3-yrs)	OS4HR3	1	3,000.00	1		3,000.00
				Sub-Total	32,394.22	3,000.00
Network						
Mellanox MSN2700-CS2F Spectrum 100GbE 1U Open Ethernet Switch	MSN2700-CS2F	2	33,003.00	1	33,003.00	
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	SUP-SN2000-CL-S-3S-4H	2	3,345.00	1		3,345.00
Mellanox MCP1600-E002E30 Passive Copper Cable IB EDR up to 100Gb/s QSFP28 2m Black 30AWG	MCP1600-E002E30	2	145.00	4	580.00	
				Sub-Total	33,583.00	3,345.00
Software						
Red Hat Enterprise Linux Server7.7 with Premium Support 1 Year	RH00003	3	1,299.00	12		15,588.00
Machbase v5.7.13 Cluster Edition (includes 1y 7x24x4 Technical Support)	-	4	98,000.00	4	392,000.00	
Machbase v5.7.13 Cluster Edition 7x24x4 Technical Support	-	4	58,800.00	2		117,600.00
				Sub-Total	392,000.00	133,188.00
Infrastructure						
HP EliteDisplay E243 23.8-inch Monitor (w/ spares)	1FH47A8#ABA	5	179.00	3	537.00	
HP Slim USB Keyboard and Mouse (w/ spares)	T6T83UT#ABA	5	35.00	3	105.00	
				Sub-Total	642.00	-
Discounts*						
Machbase v5.7.13 Cluster Edition (includes 1y 7x24x4 Technical Support)					(137,200.00)	
Machbase v5.7.13 Cluster Edition 7x24x4 Technical Support						(41,160.00)
				Sub-Total	(137,200.00)	(41,160.00)
				Total	**$321,419.22 USD**	**$98,373.00 USD**

Price Source
1) Super Micro Computer Inc. 2) Mellanox Technologies, Ltd.
3) Red Hat Inc. 4) Machbase Inc. 5) Hewlett Packard Inc.
Audited by Pre-Publication Board
*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.

Three-Year Cost of Ownership:	**$419,793 USD**
IoTps:	**2,199,052.90**
USD/IoTps:	**$0.20 USD**

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.

	Machbase 5.7.13	TPCx-IoT	1.0.5
		TPC Pricing	2.5.0
		Report Date	Mar. 30, 2020

Numerical Quantities

Scale Factor	4100000000

Performance Run (Run2)

Warmup Run Start Time	2020-02-19 22:05:25.000
Warmup Run End Time	2020-02-19 22:36:25.000
Warmup Run Elapsed Time	1,860.143
Measured Run Start Time	2020-02-19 22:36:26.000
Measured Run End Time	2020-02-19 23:07:31.000
Measured Run Elapsed Time	1,864.439
Performance Metric (IoTps)	**2,199,052.90**

Repeatability Run (Run1)

Warmup Run Start Time	2020-02-19 21:00:02.000
Warmup Run End Time	2020-02-19 21:31:12.000
Warmup Run Elapsed Time	1,868.691
Measured Run Start Time	2020-02-19 21:31:12.000
Measured Run End Time	2020-02-19 22:02:09.000
Measured Run Elapsed Time	1,855.897
Performance Metric (IoTps)	2,209,174.32

Performance Run Report (Run2)

```
================================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run2 details :     Total Time For Warmup Run In Seconds = 1,860.143
Test Run2 details :     Total Time In Seconds = 1,864.439
                        Total Number of Records = 4100000000

TPCx-IoT Performance Metric (IoTps): 2199052.9054

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

Repeatability Run Report (Run1)

```
================================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run1 details :     Total Time For Warmup Run In Seconds = 1,868.691
Test Run1 details :     Total Time In Seconds = 1,855.897
                        Total Number of Records = 4100000000

TPCx-IoT Performance Metric (IoTps): 2209174.3237

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

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

Revision History

Date	Edition	Description
March 30, 2020	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 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.

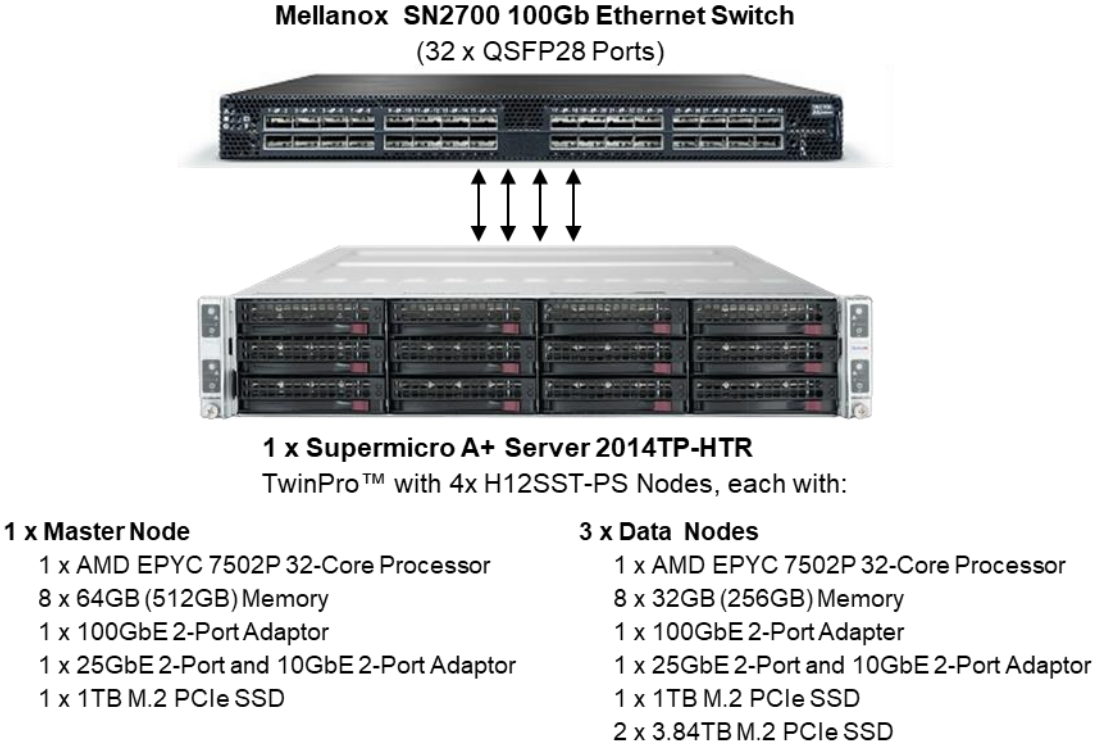

Figure 1-1 Measured Configuration

The measured configuration consisted of:

Total Nodes:	4	
Total Processors/Cores/Threads:	4/128/256	
Total Memory:	1.53TB	
Total Number of Storage Devices:	10	
Total Storage Capacity	27.04TB	
Connectivity:	Mellanox SN2700 100GbE Switch	
Servers	1x Master Node:	3x Data Nodes:
Processors/Cores/Threads:	1/32/64	1/32/64
Processor Model:	1x AMD EPYC 7502P (2.50GHz, 32-core, 128MB L3)	1x AMD EPYC 7502P (2.50GHz, 32-core, 128MB L3)
Memory:	512 GiB	256 GiB
Storage Devices:	1x 1TB M.2 PCIe SSD Gen3	1x 1TB M.2 PCIe SSD Gen3 2x 3.84TB M.2 PCIe SSD Gen3
Network Controller:	1x Mellanox MCX516A-CCAT 100GbE 1x Supermicro AOC-MH25G-m2s2TM 10GbE and 25GbE	1x Mellanox MCX516A-CCAT 100GbE 1x Supermicro AOC-MH25G-m2s2TM 10GbE and 25GbE

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	M.2 PCIe Gen3	1 x 1TB NVMe SSD	Machbase Broker, Operating System, Root, Swap
2-4	M.2 PCIe Gen3	1 x 1TB NVMe SSD 2 x 3.84TB NVMe SSD	Operating System, Root, Swap Machbase Data, coordinator

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	Broker	Coordinator	Warehouse
1	X		
2		X	X
3			X
4			X

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 = 1,868.691
Test Run 1 details :    Total Time In Seconds = 1,855.897
                        Total Number of Records = 4100000000

TPCx-IoT Performance Metric (IoTps): 2209174.3237

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

Run Report for Run 2 (Performance Run)

```
================================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run 2 details :    Total Time For Warmup Run In Seconds = 1,860.143
Test Run 2 details :    Total Time In Seconds = 1,864.439
                        Total Number of Records = 4100000000

TPCx-IoT Performance Metric (IoTps): 2199052.9054

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

2.3 Benchmark Kit Identification

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

TPCx-IoT Kit Version	1.0.5

File	MD5
TPC-IoT-master.sh	aabeca02709f778295fcd1891ce3f74e
tpcx-iot/machbase-binding/lib/core-0.13.0-SNAPSHOT.jar	18b59e748a7026036e85e2e70ba45af5
IoT_cluster_validate_suite.sh	1d85705dc67fb3c767d7a1fe8775275f

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.

	Run 1	Run 2
Scale Factor	4100000000	4100000000
Measured Run Time (seconds)	1,855.897	1,864.439
IoTps	2,209,174.32	2,199,052.90

Run2 Price-Performance: 0.20 $/IoTps

Third-Party Price Quotes

Super Micro Computer Inc.

SUPERMICRO

Quotation

Date	Page
03/04/2020	1
Quotation Number	
8600387579	
Expiration Date	
04/03/2020	

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San Jose, CA 95131
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Phone: (408) 503-8000 Fax: (408) 503-8008
Please email PO to Supermicro Order Desk: epos@supermicro.com and cc Supermicro Sales Representative.

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USA

Reference	Customer No.	Salesperson	Incoterms	Ship Via	Payment Terms
	AM00360U00	VIVIAN HUYEN	Ex Works	FED STD OVNIGHT CUST	NET 45 DAYS

Qty. Ord.	Item Number	Description	Unit Price	UoM	Extended Price
1	AS -2014TP-HTR	H12SST-PS, CSE-827HQ+ -R2K04BP2, UP,SATA 2U 4 Nodes 3.5"	4,500.00	EA	4,500.00
4	PSE-ROM7502-0054	Rome 7502 DP/UP 32C/64T 2.5G 128M 180W 4094, HF, RoHS	2,857.75	EA	11,431.00
8	MEM-DR464L-HL02-ER32	64GB DDR4-3200 2Rx4 (16Gb) ECC RDIMM	320.74	EA	2,565.92
24	MEM-DR432L-HL01-ER32	32GB DDR4-3200 2Rx4 ECC REG DIMM	159.51	EA	3,828.24
4	AOC-MCX516A-CCAT	MCX516A-CCAT ConnectX-5 EN,100GbE 2-p QSFP28,PCIe3x1	976.35	EA	3,905.40
4	AOC-MH25G-M2S2TM-O	SIOM 2+ 2-port 25G & 10G, SFP28 & RJ45, Mellanox (Retail)	287.39	EA	1,149.56
4	HDS-TMN0-KXG50ZNV1T02	(EOL)Toshiba XG5 1TB NVMe M.2 22x80mm < 1DWPD	175.00	EA	700.00
6	HDS-SMN1-MZ1LB3T8HMLA07	Samsung PM983 3.84TB NVMe PCIe3x4 V4 M.2 22x110mm (1.3 DWPD)	677.35	EA	4,064.10
1	MC0037	ASSEMBLY FEE	250.00	EA	250.00
1	OS4HR3	3 YR ONSITE 24X7X4 SERVICE	3,000.00	EA	3,000.00

Comments:

Less Order Discount	
Subtotal	35,394.22
Total sales tax	0.00
Total order	35,394.22

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MPN: MSN2700-CS2F Condition: **New**

Availability:	Limited
MSRP:	**$33,003.00**
Switch Family:	SN2000
Condition:	New
Max Ports:	32x100GbE
Connector Type:	QSFP28
Max Speed:	100GbE
ECCN:	5A991
Operating System:	Mellanox Onyx
Technology:	Ethernet
Product Brief:	Download MSN2700-CS2F

Recommended Support:

None

Quantity: 1

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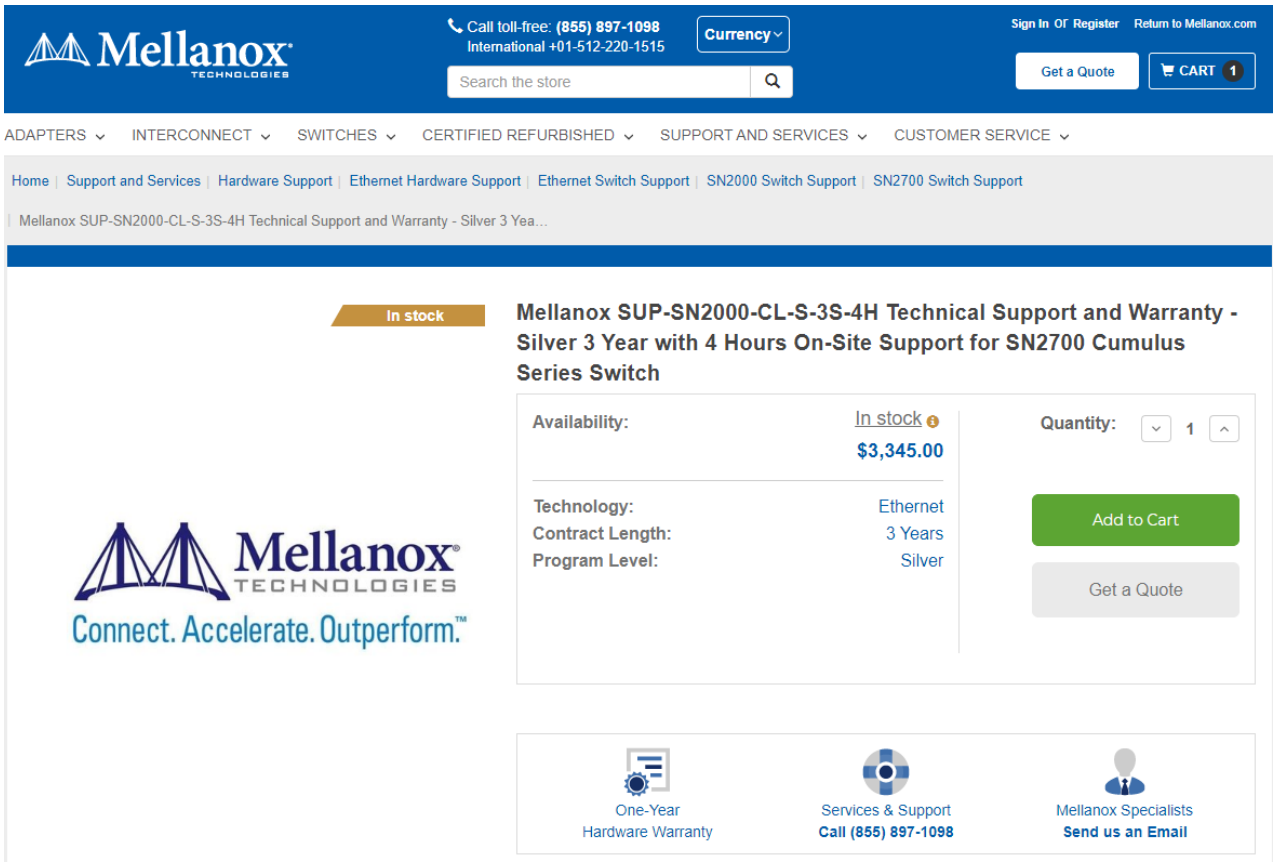
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In stock
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Contract Length:
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Get a Quote CART 1

ADAPTERS INTERCONNECT SWITCHES CERTIFIED REFURBISHED SUPPORT AND SERVICES CUSTOMER SERVICE

Home | Interconnect | InfiniBand Cables | Direct Attach Copper Cables | EDR | Mellanox MCP1600-E002E30 Passive Copper Cable IB EDR up to 100Gb/s QSFP...

Ships same day

Mellanox MCP1600-E002E30 Passive Copper Cable IB EDR up to 100Gb/s QSFP28 2m Black 30AWG

MPN: MCP1600-E002E30 Condition: **New**

Availability:	Ships same day
Price:	**$145.00**
Condition:	New
Technology:	InfiniBand
Max Speed:	EDR
Material:	Copper
Connector Type:	QSFP28
Passive/Active:	Passive
Length:	2.0m and under
ECCN:	EAR99
Product Brief:	Download MCP1600-E002E30

Quantity: 1

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Get a Quote

One-Year Hardware Warranty

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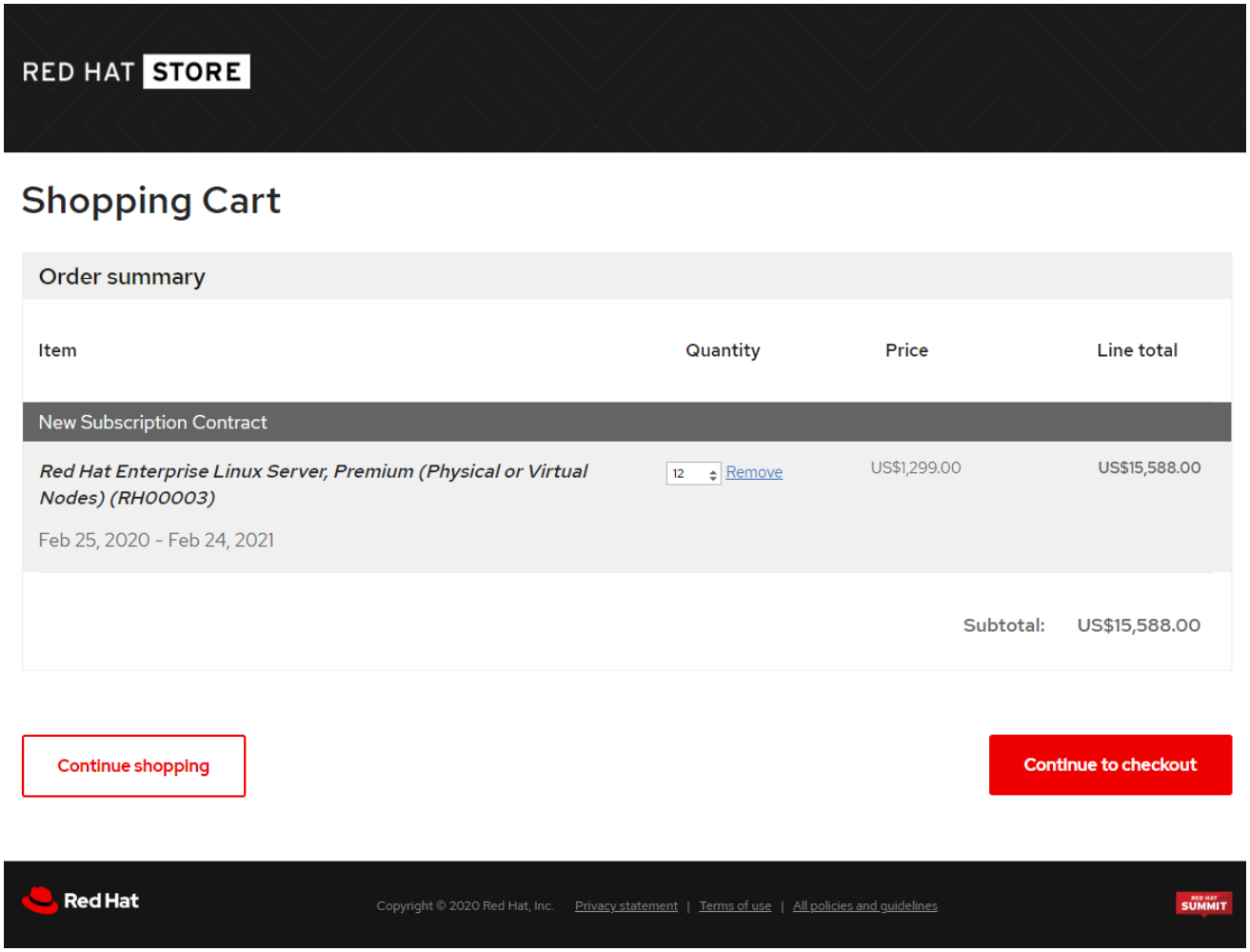
Red Hat Inc.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Machbase Inc.

Quotation

Doc. No.	: MACH-SALES-20200310-01	Business License	120-87-96403		
Date	: 2020-03-10	Company	Machbase Inc.	CEO	Andrew Kim
To	: TTA	BusinessTerritory	Service, Business Service	ProductType	Software
CC	: Mr. Ki Han Choi	Address	Rn. 904, 273 Digital-ro, Guro-gu		
Charge	: Peter Lee (+82-10-7128-6127)		Seoul, Korea		
Here we quote as belows		Tel.	T : 02-2109-5607	F : 02-2038-4607	
Quote	364,364	USD (VAT Incl.)			

No.	Content	List Price (USD/Node)	Proposed Price (USD/Node)	Quantity (Node)	Supply Price (USD)	Tax. Incl. (USD)
1	**Machbase Cluster Edition V5.7.13**	98,000	63,700	4	254,800	280,280
	Machbase Run-Time License					
	Machbase Time Series DBMS					
	Machbase Client Developmet Kit					
	Machbase Coordinator					
	Machbase Broker					
	Machbase Warehouse					
	Machbase Web Admin					
	Machbase Tag Analyzer					

No.	Content	Ref. Price (USD)	Maintenance Rate (%)	Total Period (Year)	Supply Price (USD)	Tax. Incl. (USD)
2	**Maintenance**	254,800	15%	2.00	76,440	84,084
	Support & On-site Guide					
	Fault Handling					
	API Connection					
	Guide for Server & Node Configuration					
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)

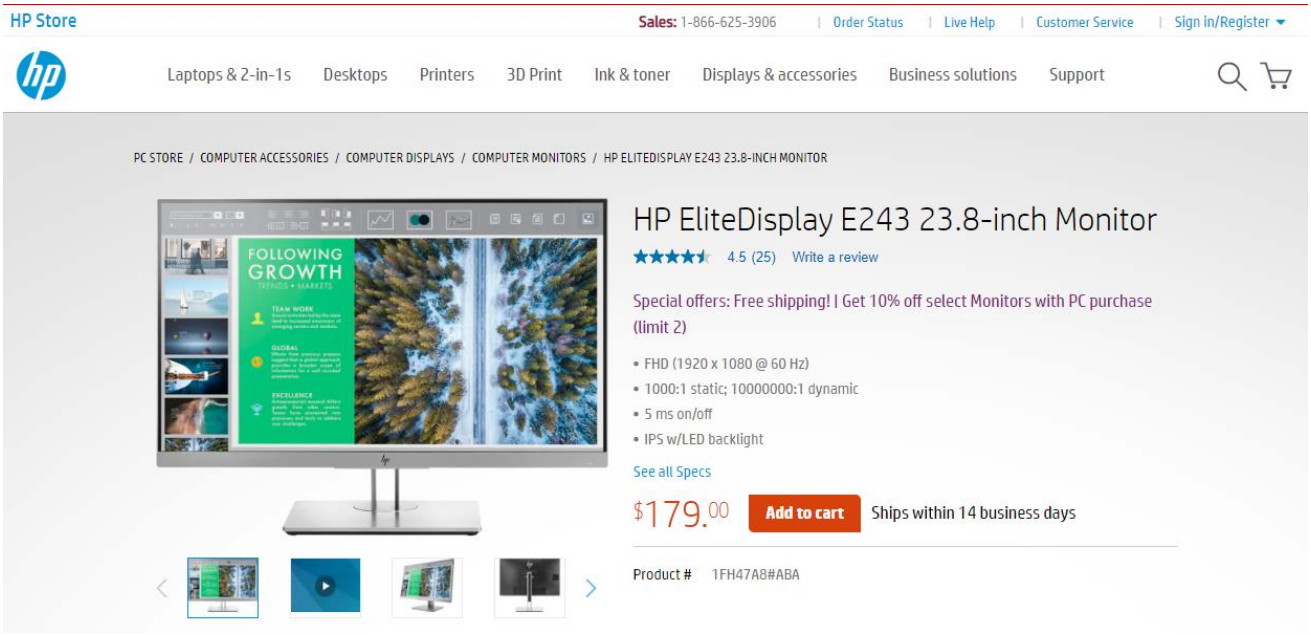
.- Server installation condition: It is recommended to separate DB server and Storage server.

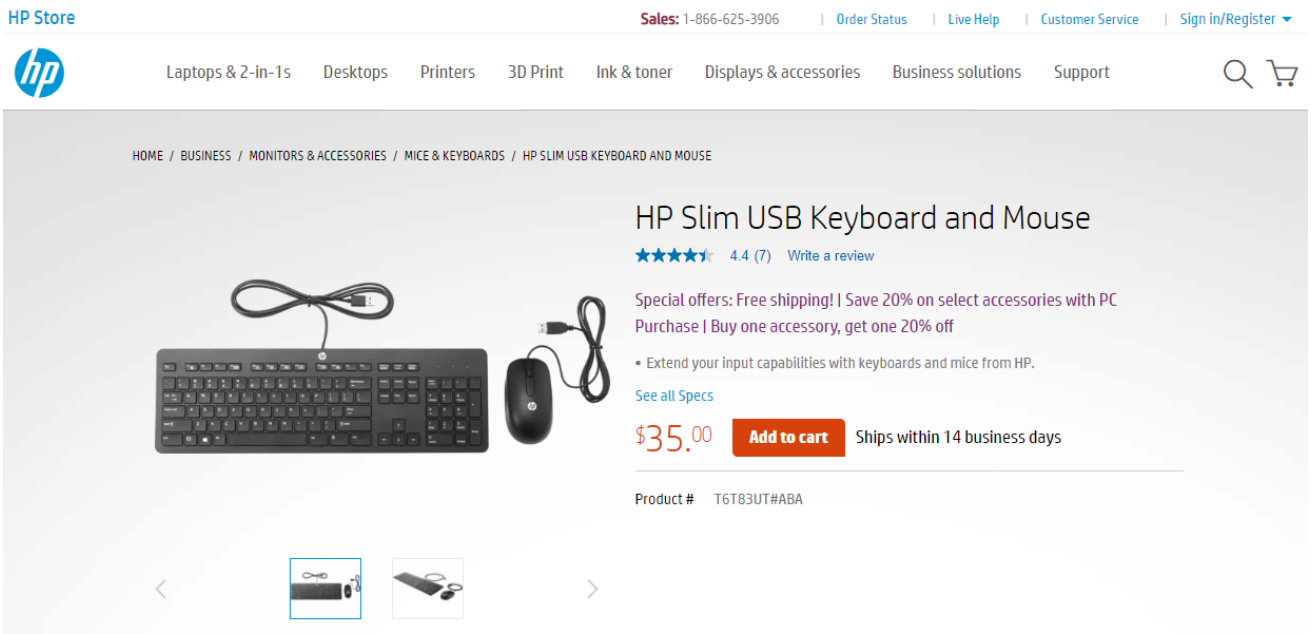
.- Installation : Cluster Edition - 7 Days, DB Table Guide is seperately guided with DB Professional Service.

.- Quotation validity period: 120 days from the date of quotation

MACHBASE

Hewlett Packard Inc.





Supporting File Index

Clause	Description	Archive Pathname
Clause 1	Parameters and options used to configure and tune the SUT	/Clause1
Clause 2	Configuration scripts and Run Report	/Clause2
Clause 3	System configuration details	/Clause3