



TPC Express Benchmark™ IoT
Full Disclosure Report
for
Lenovo® ThinkSystem™ SR655
(With 5x Lenovo SR655 Servers)

Using

HBase 2.1.4 on
Cloudera Distribution for Apache Hadoop
Enterprise Edition 6.3.0
and
Red Hat Enterprise Linux Server Release 7.6

TPCx-IoT Version V1.0.3
Report Edition First
Report Submitted September 05, 2019

First Edition - September 2019

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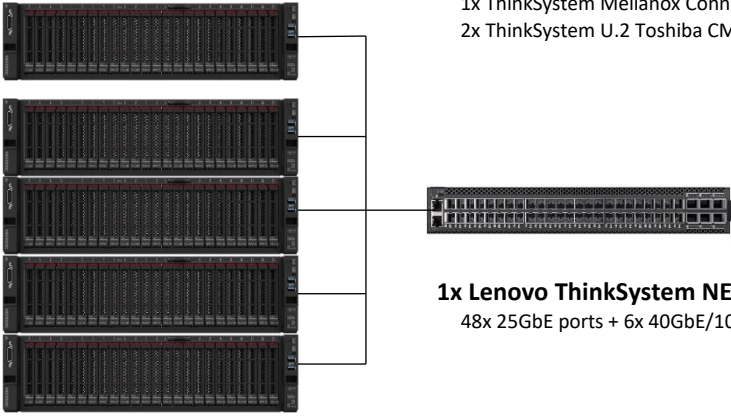
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		Lenovo ThinkSystem SR655		TPCx-IoT: v1.0.3
				TPC-Pricing: v2.4.0
				Report Date: Sep 05, 2019
Total System Cost		TPCx-IoT Performance Metric		Price/Performance
\$193,642 USD		742,256.79 IoTps		0.26 USD \$/IoTps
Number of Records	DBMS Software	Operating System	Other Software	Availability Date
1,224 Million	HBase 2.1.4 on Cloudera Distribution for Apache Hadoop 6.3.0	Red Hat Enterprise Linux Server Release 7.6	None	Dec 18, 2019
System Configuration				
<div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <p>5x Lenovo ThinkSystem SR655</p> <ul style="list-style-type: none"> 1x AMD EPYC™ 7502P 32-Core 2.5GHz Processor 8x ThinkSystem 32GB TruDDR4 3200MHz (2Rx4 1.2V) RDIMM-A (256 GB Total) 1x ThinkSystem M.2 5100 480GB SATA 6Gbps Non-Hot Swap SSD 1x ThinkSystem Mellanox ConnectX-4 Lx 10/25GbE SFP28 2-port PCIe Ethernet Adapter 2x ThinkSystem U.2 Toshiba CM5-V 1.6TB Mainstream NVMe PCIe 3.0 x4 Hot Swap SSD <p>1x Lenovo ThinkSystem NE2572 RackSwitch</p> <p>48x 25GbE ports + 6x 40GbE/100GbE ports</p> </div> </div>				
Total Number of Servers:		5x Lenovo ThinkSystem SR655		
Total Processors/Cores/Threads:		5/160/320		
Server Configuration (each):	Processors	1x AMD EPYC 7502P 2.5GHz 32-Core		
	Memory	256GB		
	Storage Device	1x 480GB M.2 SATA SSD (All Nodes) 2x 1.6TB U.2 NVMe PCIe 3.0 (Data Nodes)		
	Network	1x Mellanox ConnectX-4 Lx 10/25GbE SFP28 2-port NIC		
Connectivity:		Lenovo ThinkSystem NE2572 RackSwitch		
Total Rack Units:		(5xSR655) + (1xNE2572) = (5x2) + (1x1) = 11RU		



Lenovo ThinkSystem SR655

TPCx-IoT: v1.0.3

TPC-Pricing: v2.4.0

Report Date: Sep 05,2019

Description	Part Number	Price Key	Unit Price	Qt y	Extended Price	3-Yr. Maint. Price
Server Hardware						
Lenovo SR655 Server : ThinkSystem SR655 - 3yr Warranty	7Z01CTO1WW	1	\$23,268	5	\$116,340	
-ThinkSystem SR655 24x2.5" Chassis	B5VJ			5		
-ThinkSystem AMD EPYC 7502P 32C 180W 2.5GHz Processor	B6VX			5		
-ThinkSystem 32GB TruDDR4 3200MHz (2Rx4 1.2V) RDIMM-A	B5XE			40		
-ThinkSystem 2U 2.5" NVMe 8-Bay Backplane	B4PC			5		
-ThinkSystem U.2 Toshiba CM5-V 1.6TB Mainstream NVMe PCIe 3.0 x4 Hot Swap SSD	B21X			8		
-ThinkSystem M.2 SATA/NVMe 2-Bay Enablement Kit	B5XJ			5		
-ThinkSystem M.2 5100 480GB SATA 6Gbps Non-Hot Swap SSD	B11V			5		
-ThinkSystem SR655 x16/x8/x8 PCIe Riser2	B5VU			5		
-ThinkSystem Mellanox ConnectX-4 Lx 10/25GbE SFP28 2-port PCIe Ethernet Adapter	B653			5		
-ThinkSystem 1600W (230V) Platinum Hot-Swap Power Supply	AVWG			10		
-2.8m, 13A/100-250V, C13 to C14 Jumper Cord	6400			10		
-ThinkSystem Toolless Slide Rail	AXCA			5		
-ThinkSystem 2U left EIA Latch Standard	AURD			5		
-ThinkSystem SR655 8x PCIE Rear Wall BKT	B5WY			5		
-ThinkSystem SR655 Airduct	B5W5			5		
-ThinkSystem SR655 Riser Filler 1 (3FH)	B5WX			5		
-ThinkSystem SR655 Riser Filler 3 (2FH)	B5WS			5		
-ThinkSystem SR655 Performance Fan Module	B5W3			30		
-ThinkSystem Rome Internal M2 BKT	B5WK			5		
-ThinkSystem SR655 EIA Latch with FIO (Right, 2 USB3.0)	B5WR			5		
-ThinkSystem SR655 MS 2FH+1LP Riser BKT	B5WP			5		
-ThinkSystem OCP3 Filler	B5WJ			5		
-ThinkSystem 2x Supercap BKT	B5WM			5		
-ThinkSystem SR635/SR655 Motherboard	B5VH			5		
Essential Service - 3Yr 24x7 4Hr Response + YourDrive YourData	5PS7A34674	1	\$1,559	5		\$7,795
Subtotal					\$116,340	\$7,795



**Lenovo ThinkSystem
SR655**

TPCx-IoT: v1.0.3

TPC-Pricing: v2.4.0

Report Date: Sep 05,2019

Description	Part Number	Price Key	Unit Price	Qty	Extended Price	3-Yr. Maint. Price
Server Software						
RHEL Server Physical w/up to 1 Virtual Node, 2 Skt Prem RH Sup 3Yr	7S0FCTO1WW	1	\$3,703	5	\$18,515	
Cloudera Enterprise Operational Database Edition, Node License, Gold Support 1yr 24x7	CEODN-GOLD-NK	2	\$6,000	15	\$90,000	
Subtotal					\$108,515	\$0
Network						
Lenovo ThinkSystem NE2572 RackSwitch (Rear to Front)	7159HE3	1	\$23,312	1	\$23,312	
-Lenovo ThinkSystem NE2572 RackSwitch (Rear to Front)	AV19	1		1		
-Adjustable 19" 4 Post Rail Kit	A3KP	1		1		
-2m Passive DAC SFP+ Cable	A51P	1		5		
-2.8m, 10A/100-250V, C13 to C14 Jumper Cord	6311	1		2		
Essential Service - 3Yr 24x7 4Hr Response (Switch)	5WS7A16480	1	\$3,199	1		\$3,199
Subtotal					\$23,312	\$3,199
Infrastructure						
Infrastructure Rack : NetBAY S2 25U Rack Cabinet	9307RC2	1	\$1,330	1	\$1,330	
OU 36 C13/6 C19 24A 1 Phase PDU	00YJ776	1	\$479	1	\$479	
ThinkSystem Pref. Pro II USB Keyboard - US English	AXTL	1	\$29	1	\$29	
ThinkSystem Optical Wheel Mouse - USB	BOLN	1	\$19	1	\$19	
Lenovo D22-10 21.5inch LED Backlit LCD Monitor	61D3KCR6US	1	\$89	1	\$89	
Essential Service - 3Yr 24x7 4Hr Response (Rack)	41L2760	1	\$315	1		\$315
Subtotal					\$1,946	\$315
Total					\$250,113	\$11,309
Dollar Volume Discount (See Note 1)	39.54%	1			\$67,780	
Pricing: 1 - Lenovo 1-877-782-7134; 2 - Cloudera (See the FDR for details); Note 1: Discount applies to all line items where Pricing=1; pricing is for these or similar quantities. Discounts for similarly sized configurations will be similar to what is quoted here, but may vary based on the specific components priced. Audited by Pre-Publication Board.					Three-Year Cost of Ownership USD:	\$193,642
					IoTps:	742,256.79
					\$/IoTps:	\$0.26
<p><i>Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated Line Items. 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 Line Items. For complete details, see the pricing section of the TPC Benchmark Standard. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.</i></p>						

	Lenovo ThinkSystem SR655	TPCx-IoT: v1.0.3
		TPC-Pricing: v2.4.0
Report Date: Sep 05, 2019		
Measurement Results for Performance Run		
Total Number of Records		1,224 Million
Warmup Run - Start Time		2019-09-03 10:34:55
Warmup Run - End Time		2019-09-03 11:10:34
Warmup Run Elapsed Time in Seconds		2,134.338
Measured Run Start Time		2019-09-03 11:10:34
Measured Run End Time		2019-09-03 11:37:51
Total Time In Seconds		1,628.390
Measurement Results for Repeatability Run		
Total Number of Records		1,224 Million
Warmup Run Start Time		2019-09-03 11:56:36
Warmup Run End Time		2019-09-03 12:33:42
Warmup Run Elapsed Time in Seconds		2,225.802
Measured Run Start Time		2019-09-03 12:33:42
Measured Run End Time		2019-09-03 13:01:17
Total Time In Seconds		1,649.025


	Lenovo ThinkSystem SR655	TPCx-IoT: v1.0.3
		TPCx-Pricing: v2.4.0 Report Date: Sep 05, 2019
Run Report for Performance Run		
=====		
TPCx-IoT Performance Metric (IoTps) Report		
Total Time For Warmup Run In Seconds = 2,134.338		
Total Time In Seconds = 1,628.390		
Total Number of Records = 1,224 Million		
TPCx-IoT Performance Metric (IoTps): 751,662.6852		
=====		
Run Report for Repeatability Run		
=====		
TPCx-IoT Performance Metric (IoTps) Report		
Total Time For Warmup Run In Seconds = 2,225.802		
Total Time In Seconds = 1,649.025		
Total Number of Records = 1,224 Million		
TPCx-IoT Performance Metric (IoTps): 742,256.7881		
=====		

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Abstract

This document contains the methodology and results of the TPC Express Benchmark IoT (TPCx-IoT) test conducted in conformance with the requirements of the TPCx-IoT Standard Specification, Revision 1.0.3.

The test was conducted for a Scale Factor of 1,224 million records with Lenovo ThinkSystem SR655 servers running HBase 2.1.4 on Cloudera Distribution for Apache Hadoop Edition 6.3.0 on Red Hat Enterprise Linux Server Release 7.6.

Measured Configuration

Company Name	Cluster Node	Virtualization	Operating System
Lenovo	Lenovo ThinkSystem SR655	Not Used	Red Hat Enterprise Linux Server Release 7.6

TPC Express Benchmark IoT Metrics

Total System Cost	IoTps	Price/Performance	Availability Date
\$193,642 USD	742,256.79	\$0.26 USD / IoTps	Dec 18, 2019

Preface

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. The 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. The 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: TPCx-IoT Specification document, TPCx-IoT Users Guide documentation, 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 Lenovo.

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 contain 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 (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:

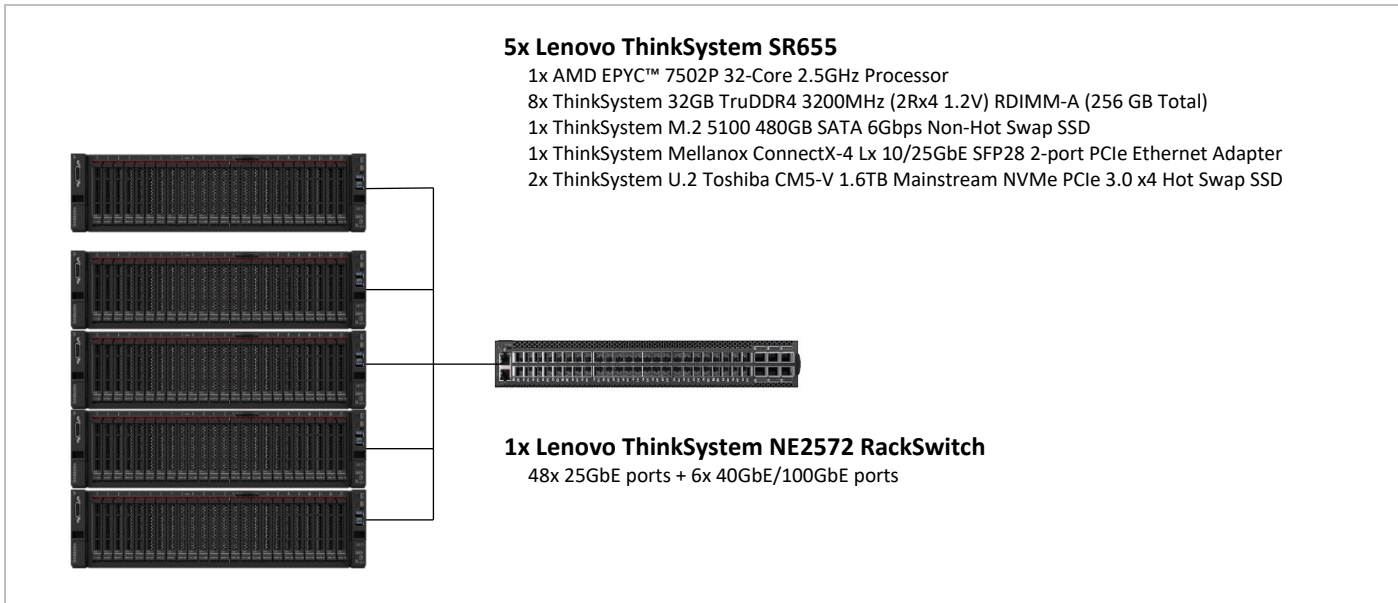


Figure 1-1 Measured Configuration

The measured configuration consisted of:

- Total Nodes: 5
- Total Processor/Cores/Threads: 5/160/320
- L1/L2/L3 Processor Cache (MB): 2/16/128
- Total Memory: 1.28TB
- Total Number of Storage Devices: 13
- Total Storage Capacity: 15.2 TB

Server nodes details:

- Lenovo ThinkSystem SR655 servers, each with:
 - Processors/Cores/Threads: 1/32/64
 - Processor Model: 1x AMD EPYC™ 7502P 2.5GHz 32-core 128MB L3
 - Memory: 256GB (8 x 32GB 2R RDIMM-A 3200MB/s), 8 Channels
 - Drives: 1x 480GB M.2 SATA SSD (for all Servers)
2x 1.6TB U.2 NVMe PCIe Gen3 (for all Data Node Servers)
 - Network: 1x Mellanox ConnectX-4 Lx 10/25GbE SFP28 2-port NIC

Priced Configuration:

There are no differences between the priced and measured configurations.

1.4 Dataset Distribution

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

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

Table 1.4: Dataset Distribution

Server Node	Storage	Disk Drive	Description of Content
1	M.2 SATA	1xSSD	Operating System, Swap, Hadoop Master, Root, Temp
2-4	M.2 SATA U.2 PCIe Gen3	1xSSD NVMe0n1, NVMe1n1	Operating System, Swap, Hadoop Master, Root, Temp Data, Temp

1.5 Software Components Distribution

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

Table 1.5 describes the distribution of the software components across the system.

Table 1.5: Software Component Distribution

Node	HDFS		HBase		YARN		Zoo Keeper
	NameNode	DataNode	Master	Region Server	Resource Manager	Node Manager	
1	X		X		X		X
2-3		X		X		X	X
4-5		X		X		X	

NoSQL Database version must be disclosed.

HBase -2.1.4 on Cloudera Distribution for Apache Hadoop 6.3.0

Clause 2: Workload Related Items

2.1 Hardware & Software Tunable

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

The Supporting File Archive contains all configuration scripts.

2.2 Run Report

The run report generated by TPCx-IoT benchmark kit must be reported.

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

Run Report for Performance Run

```
=====
TPCx-IoT Performance Metric (IoTps) Report

Total Time For Warmup Run In Seconds = 2,134.338
Total Time In Seconds = 1,628.390
Total Number of Records = 1,224 Million

TPCx-IoT Performance Metric (IoTps): 751,662.6852
=====
```

Run Report for Repeatability Run

```
=====
TPCx-IoT Performance Metric (IoTps) Report

Total Time For Warmup Run In Seconds = 2,225.802
Total Time In Seconds = 1,649.025
Total Number of Records = 1,224 Million

TPCx-IoT Performance Metric (IoTps): 742,256.7881
=====
```

2.3 Benchmark Kit Identification

Version number of TPCx-IoT kit and checksum for the jar file and master Programs must be reported.

Table 2.3

Kit Version	1.0.3
0fc49d9c668d22d6a394279fd27474b7	./TPC-IoT-master.sh
68379f9375c7b584fc3253dfe9c4f7a6	./tpcx-iot/lib/core-0.13.0-SNAPSHOT.jar
7bebf1e17d5c2b380df575fad160d7f8	./IoT_cluster_validate_suite.sh

2.4 Benchmark Kit Changes

No modifications were made to the TPC provided kit other than the following fixes made in these three scripts:

- TPC-IoT-master.sh
- TPC-IoT-client.sh
- TPC-IoT-instances.sh

TPCx-IoT kit did not generate tpc_iot_instanceNN_workload files with correct values for benchmark tests that involved multiple client (driver) nodes.

```
# diff org/TPC-IoT-master.sh TPC-IoT-master.sh
130c130
< insertstart=$(echo "$insertstart+$num_records_per_client+1" | bc)
---
> insertstart=$(echo "$insertstart+$num_records_per_client" | bc)

# diff org/TPC-IoT-client.sh TPC-IoT-client.sh
35c35
< DATABASE_RECORDS_COUNT=$(echo $operation_count_string | cut -d=' ' -f2)
---
> OPERATION_COUNT=$(echo $operation_count_string | cut -d=' ' -f2)
38,39c38,39
< echo ">>>>>>>> $PWD/TPC-IoT-instances.sh $DATABASE_RECORDS_COUNT $NUM_INSTANCES
$NUM_THREADS $INSERT_START $clientId $DATABASE_CLIENT $LOGFILE_NAME"
< $PWD/TPC-IoT-instances.sh $DATABASE_RECORDS_COUNT $NUM_INSTANCES $NUM_THREADS
$INSERT_START $clientId $DATABASE_CLIENT $PWD $SUT_PARAMETERS $LOGFILE_NAME
---
> echo ">>>>>>>> $PWD/TPC-IoT-instances.sh $DATABASE_RECORDS_COUNT
$OPERATION_COUNT $NUM_INSTANCES $NUM_THREADS $INSERT_START $clientId
$DATABASE_CLIENT $LOGFILE_NAME"
> $PWD/TPC-IoT-instances.sh $DATABASE_RECORDS_COUNT $OPERATION_COUNT
```

```
$NUM_INSTANCES $NUM_THREADS $INSERT_START $clientId $DATABASE_CLIENT $PWD
$SUT_PARAMETERS $LOGFILE_NAME
```

```
# diff org/TPC-IoT-instances.sh TPC-IoT-instances.sh
10,17c10,20
< numInstances=$2
< threadCount=$3
< start=$4
< clientID=$5
< DATABASE_CLIENT=$6
< PWD=$7
< SUT_PARAMETERS=$8
< RUN_TYPE=$9
---
> totalOperationCount=$2
> numInstances=$3
> threadCount=$4
> start=$5
> clientID=$6
> DATABASE_CLIENT=$7
> PWD=$8
> SUT_PARAMETERS=$9
> RUN_TYPE=${10}
>
> operationCount=$((totalOperationCount / numInstances)) # Improve this to be
total of record count
19d21
< operationCount=$((recordCount / numInstances)) # Improve this to be total of
record count
52c54
< start=$((operationCount * counter))
---
> start=$((operationCount + start))
```

A separate document is provided for the justification and details of the fixes. See details in the **SUPPORTING_FILES_ARCHIVE\clause2\additional-files\IssuesFixed-TPCx-IoT-scripts-documentation.rtf** file.

Clause 3: Scale Factors and Metrics

3.1 Total Run Time

	Run 1	Run 2
Total Run Time	1,628.390	1,649.025

3.2 Performance and Price Performance

The performance metric (IoTps) must be disclosed for Run1 and Run2. The price-performance metric (\$/IoTps) must be disclosed for the performance run.

	Run 1	Run 2
IoTps	751,662.68	742,256.79

\$/IoTps	\$0.26
-----------------	---------------

3.3 System Configuration Information

Storage System Software	Operating System	Other Software	System Availability Date
	Red Hat Enterprise Linux Server Release 7.6		Dec 18, 2019

Cloudera 6.3.0	
Component	Package Version
Apache Hadoop	hadoop-3.0.0+cdh6.3.0
HBase	hbase-2.1.4+cdh6.3.0
YARN	yarn-3.0.0+cdh6.3.0
Zookeeper	zookeeper-3.4.5+cdh6.3.0

Supporting File Index

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

Clause	Contents	Location
Clause 1	Parameters and options used to configure and tune the SUT	Supporting Files Archive/Clause1
Clause 2	Configuration Scripts and Run Report	Supporting Files Archive/Clause2
Clause 3	System Configuration Details	Supporting Files Archive/Clause3

Third-Party Price Quotes

Cloudera Pricing



Quote #: Q-XXXXX
 Date: X-X--20XX
 Offer Expires On: X-X--20XX
 End User: XXXXXXXX
 Subscription Bill Terms:

395 Page Mill Road
 Palo Alto, CA 94306 US
 Phone: +1 (650) 843-0595
 Email: dwilson@cloudera.com

Bill To
 XXXXX

Ship To
 XXXXXX

Product Name	Product Code	Description	List Price	Qty	Start Date	End Date	Discount (%)	Net Total
Cloudera Enterprise Operational Database Edition, Node License, Gold Support	CEODN-GOLD-NK	Subscription (per node) for the Operational Database Edition of the Cloudera Enterprise platform. Includes a commercial license and Gold Support for "Core Hadoop" (i.e. HDFS, YARN/ Mapreduce, Hive, Pig, Hue, Sentry, Flume, Sqoop), Kudu, HBase, Accumulo, Search, Spark, Cloudera Manager, Cloudera Director, and Cloudera Navigator (Audit & Lineage, Encryption & Key Trustee). Gold-Level Support provides technical support 24 hours per day, 7 days per week. The price listed is for an annual (12-month) term.	USD 6,000.00	5	8-20-2019	8-19-2020	0.00	USD 30,000.00
TOTAL:								USD 30,000.00

The resale of the Cloudera Products listed in this Order Form to the End User identified above is governed by the current, valid, mutually executed reseller agreement between Cloudera and the reseller identified above in the Bill To section ("Reseller") dated prior to or on or about the Effective Date of this Order Form ("Reseller Agreement"). Per the terms of the Reseller Agreement, Reseller will ensure that the End User: (i) receives instructions on how to access and accept the applicable Cloudera End Customer Agreement; or (ii) verifies that there is an applicable executed agreement in place with Cloudera for the Cloudera Products provided herein.

The Reseller Agreement shall prevail over any additional, conflicting or inconsistent terms and conditions which may appear on any purchase order furnished by Reseller, and any additional terms and conditions in any such purchase order shall have no force or effect, notwithstanding Cloudera's acceptance or execution of such purchase order.

Cloudera will invoice Reseller upon receipt of this signed Order Form, and fees will be due as set forth in the agreement between Cloudera and Reseller governing the terms of this Order Form.

This Order Form may be executed by exchange of signature by electronic means through facsimile or scanned and emailed signature, or by electronic signature service where legally permitted. For clarity, an electronic, digital, machine-generated or image of a signature will create a valid and binding obligation of Customer.

Signature: _____

Effective Date: _____

Name (Print): _____

Title: _____