TPC Benchmark™ C
Full Disclosure Report

First Edition
15–Feb–2024

Using
Goldilocks v3.1 Standard Edition
on
KTNF KE780S1
TTA, Telecommunications Technology Association, believes that all the information in this document is accurate as of the publication date. The information in this document is subject to change without notice.
TTA, the sponsor of this benchmark test, assumes no responsibility for any errors that may appear in this document. The pricing information in this document is believed to accurately reflect the current prices as of the publication date. However, the sponsor provides no warranty of the pricing information in this document.

Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, the TPC Benchmark™ C 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.

Trademarks
The following terms used in this publication are trademarks of other companies as follows:
- TPC Benchmark, TPC-C, and tpmC are trademarks of the Transaction Processing Performance Council
- TTA is a registered trademark of Telecommunications Technology Association
- Goldilocks is a registered trademark of SUNJESOFT, Inc.
- JBoss is a registered trademark of RedHat, Inc.
- Intel and Intel Xeon are trademarks or registered trademarks of Intel Corporation.
- All other trademarks and copyrights are properties of their respective owners.
# Table of Contents

TABLE OF CONTENTS .................................................................................................................. 3
ABSTRACT ....................................................................................................................................... 5
PREFACE ......................................................................................................................................... 6
GENERAL ITEMS ............................................................................................................................. 11
  0.1 APPLICATION CODE AND DEFINITION STATEMENTS .................................................. 11
  0.2 BENCHMARK SPONSOR ..................................................................................................... 11
  0.3 PARAMETER SETTINGS ....................................................................................................... 11
  0.4 CONFIGURATION DIAGRAMS ........................................................................................... 12
CLAUSE 1: LOGICAL DATABASE DESIGN ..................................................................................... 13
  1.1 TABLE DEFINITIONS ......................................................................................................... 13
  1.2 PHYSICAL ORGANIZATION OF DATABASE .................................................................... 13
  1.3 INSERT AND DELETE OPERATIONS ............................................................................... 13
  1.4 HORIZONTAL OR VERTICAL PARTITIONING ............................................................... 13
  1.5 REPLICATION OR DUPLICATION .................................................................................... 13
CLAUSE 2: TRANSACTION AND TERMINAL PROFILES ............................................................. 14
  2.1 RANDOM NUMBER GENERATION .................................................................................... 14
  2.2 INPUT/OUTPUT SCREENS ................................................................................................ 14
  2.3 PRICED TERMINAL FEATURE ........................................................................................ 14
  2.4 PRESENTATION MANAGERS .......................................................................................... 14
  2.5 TRANSACTION STATISTICS ............................................................................................. 15
  2.6 QUEUING MECHANISM .................................................................................................... 15
CLAUSE 3: TRANSACTION AND SYSTEM PROPERTIES ............................................................ 16
  3.1 ATOMICITY ......................................................................................................................... 16
    3.1.1 Atomicity of Completed Transactions ...................................................................... 16
    3.1.2 Atomicity of Aborted Transactions ......................................................................... 16
  3.2 CONSISTENCY .................................................................................................................... 16
  3.3 ISOLATION .......................................................................................................................... 17
  3.4 DURABILITY ....................................................................................................................... 21
    3.4.1 Durable Media Failure .............................................................................................. 21
    3.4.2 Instantaneous Interruption, Loss of Memory ............................................................ 22
CLAUSE 4: SCALING AND DATABASE POPULATION ................................................................. 23
  4.1 CARDINALITY OF TABLES ................................................................................................ 23
  4.2 DATABASE IMPLEMENTATION ......................................................................................... 23
  4.3 DISTRIBUTION OF DATABASE FILES .............................................................................. 23
  4.4 60-DAY SPACE .................................................................................................................. 25
CLAUSE 5: PERFORMANCE METRICS ....................................................................................... 26
  5.1 TPC BENCHMARK C METRICS ......................................................................................... 26
  5.2 RESPONSE TIMES ............................................................................................................. 26
  5.3 KEYING AND THINK TIMES ............................................................................................. 26
Abstract

This report documents the methodology and results of the TPC Benchmark™ C (TPC-C) test conducted by TTA on the Goldilocks v3.1 Standard Edition on KTNF KE780S1

Goldilocks v3.1 Standard Edition on KTNF KE780S1

<table>
<thead>
<tr>
<th>Company Name</th>
<th>System Name</th>
<th>Database Software</th>
<th>Operating System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommunications Technology Association</td>
<td>KTNF KE780S1</td>
<td>Goldilocks v3.1 Standard Edition</td>
<td>RedHat Enterprise Linux 9.0</td>
</tr>
</tbody>
</table>

TPC Benchmark™ C Metrics

<table>
<thead>
<tr>
<th>Total System Cost</th>
<th>TPC-C Throughput</th>
<th>Price/Performance</th>
<th>Availability Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>₩ 163,820,700 (KRW)</td>
<td>50,768 tpmC</td>
<td>3,227 KRW/tpmC</td>
<td>Available Now</td>
</tr>
</tbody>
</table>
Preface

The Transaction Processing Performance Council (TPC™) is a non-profit corporation founded to define transaction processing and database benchmarks and to disseminate objective, verifiable TPC performance data to the industry. The TPC Benchmark® C is an on-line transaction processing benchmark (OLTP) developed by the TPC.

TPC Benchmark™ C Overview

TPC Benchmark™ C (TPC-C) simulates a complete computing environment where a population of users executes transactions against a database. The benchmark is centered around the principal activities (transactions) of an order-entry environment. These transactions include entering and delivering orders, recording payments, checking the status of orders, and monitoring the level of stock at the warehouses. While the benchmark portrays the activity of a wholesale supplier, TPC-C is not limited to the activity of any particular business segment, but, rather represents any industry that must manage, sell, or distribute a product or service.

TPC-C consists of a mixture of read-only and update intensive transactions that simulate the activities found in complex OLTP application environments. It does so by exercising a breadth of system components associated with such environments, which are characterized by:

- The simultaneous execution of multiple transaction types that span a breadth of complexity
- On-line and deferred transaction execution modes
- Multiple on-line terminal sessions
- Moderate system and application execution time
- Significant disk input/output
- Transaction integrity (ACID properties)
- Non-uniform distribution of data access through primary and secondary keys
- Databases consisting of many tables with a wide variety of sizes, attributes, and relationships
- Contention of data access and update

The performance metric reported by TPC-C is a “business throughput” measuring the number of orders processed per minute. Multiple transactions are used to simulate the business activity of processing an order, and each transaction is subject to a response time constraint. The performance metric for this benchmark is expressed in transactions-per-minute-C (tpmC). To be compliant with the TPC-C standard, all references to tpmC results must include the tpmC rate, the associated price-per-tpmC, and the availability date of the priced configuration.

TPC-C uses terminology and metrics that are similar to other benchmarks, originated by the TPC or others. Such similarity in terminology does not in any way imply that TPC-C results are comparable to other benchmarks. The only benchmark results comparable to TPC-C are other TPC-C results conformant with the same revision.

Despite the fact that this benchmark offers a rich environment that emulates many OLTP applications, this benchmark does not reflect the entire range of OLTP requirements. In addition, the extent to which a customer can achieve the results reported by a vendor is highly dependent on how closely TPC-C approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to other environments are not recommended.

Benchmark results are highly dependent upon workload, specific application requirements, and systems design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC-C should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

Further information is available at www.tpc.org
**Goldilocks v3.1 Standard Edition on KTNF KE780S1**

<table>
<thead>
<tr>
<th>Total System Cost</th>
<th>TPC-C Throughput</th>
<th>Price/Performance</th>
<th>Availability Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>₩163,820,700 (KRW)</td>
<td>50,768 tpmC</td>
<td>3,227 KRW/tpmC</td>
<td>Available Now</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Server Components</th>
<th>Database Manager</th>
<th>Operating System</th>
<th>Other Software</th>
<th>Number of Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processors/Cores/Threads</td>
<td>Goldilocks v3.1 Standard Edition</td>
<td>RHEL 9.0</td>
<td>JBoss Web Server</td>
<td>40,000</td>
</tr>
<tr>
<td>Availability Date</td>
<td>1/12/24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Priced Configuration (KTNF)**

- **[0] 1Gb Ethernet Switch**
- **[1] Database Server**
  - 1x Intel(R) Xeon(R) Silver 4410Y @ 2.00GHz
  - 8x 64GB Memory
  - 1x 2TB SATA HDD
  - 1x 512GB NVMe SSD
  - 1x 1G Ethernet
- **[2] Web Application Server**
  - 1x Intel(R) Core(TM) i7-10700K CPU @ 3.80GHz
  - 16x 32GB Memory
  - 1x 4512GB NVMe SSD (Write Through)
  - 1x 1G Ethernet
- **[3] Storage**
  - 1x GLUESYS Ansible 706E-12
  - 2x Intel(R) Xeon(R) Gold 6238B CPU @ 2.30GHz
  - 8x 32GB Memory
  - 4x 7.68TB NVMe Drive (Write Through)
  - 1x 1TB SATA HDD
  - 1x 512GB NVMe SSD (External, Write Through)
  - 1x NVIDIA RTX A2000 for GPU

### System Components

<table>
<thead>
<tr>
<th>System Components</th>
<th>Quantity</th>
<th>Description</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processors/Cores/Threads</td>
<td>1/12/24</td>
<td>Intel(R) Xeon(R) Silver 4410Y @ 2.00GHz</td>
<td>1/8/16</td>
<td>Intel(R) Core(TM) i7-10700K CPU @ 3.80GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>8</td>
<td>64GB</td>
<td>1</td>
<td>32GB</td>
</tr>
<tr>
<td>Storage Controller</td>
<td>1</td>
<td>None</td>
<td>-</td>
<td>None</td>
</tr>
<tr>
<td>Storage Device</td>
<td>1</td>
<td>512GB NVMe SSD (Write Through)</td>
<td>1</td>
<td>1TB SATA HDD</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>7.68TB NVMe SSD (External, Write Through)</td>
<td>1</td>
<td>512GB SATA SSD</td>
</tr>
<tr>
<td>Total Storage Capacity</td>
<td>31.232 TB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Server Hardware

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Source</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Price</th>
<th>3-Yr. Maint. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DB Server - KTNF(KE780S1)</strong></td>
<td>KE780S1</td>
<td>1</td>
<td>43,000,000</td>
<td>1</td>
<td>43,000,000</td>
<td></td>
</tr>
<tr>
<td>4th Gen intel Xeon Scalable Processor Silver 4410Y</td>
<td>CPU</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64GB DDR5 4800RDIMM</td>
<td>RAM</td>
<td>1</td>
<td>(included)</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual port 100GbE Intel® Ethernet Network Adapter E810</td>
<td>NIC</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>512GB M.2 NVMe SSD</td>
<td>SSD</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3year, 24x7x4hr Onsite Support Service</td>
<td>Maintenance</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WAS Servers - DT-S170G1IV0</strong></td>
<td>DT-S170G1IV0</td>
<td>1</td>
<td>8,000,000</td>
<td>1</td>
<td>8,000,000</td>
<td></td>
</tr>
<tr>
<td>Intel® Core Processor i7-10700K, 3.8GHz</td>
<td>CPU</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDR4 32GB, Samsung, UDIMM PC4-25600U</td>
<td>RAM</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2TB SATA HDD</td>
<td>HDD</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>512 M.2 NVMe SSD</td>
<td>SSD</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2port 10G RJ-45 Adapter</td>
<td>NIC</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1port 1G RJ-45 Adapter</td>
<td>NIC</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3year, 24x7x4hr Onsite Support Service</td>
<td>Maintenance</td>
<td>1</td>
<td>(included)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Server Hardware Sub Total

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>51,000,000</td>
</tr>
</tbody>
</table>

## Storage Hardware

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Source</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Price</th>
<th>3-Yr. Maint. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anystor 700E-12</td>
<td>ASE700E-12</td>
<td>2</td>
<td>97,000,000</td>
<td>1</td>
<td>97,000,000</td>
<td></td>
</tr>
<tr>
<td>Intel® Xeon Gold 6326 Processor (16Core, 2.9GHz, 24MB Cache)</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32GB ECC Registered Memory</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-port 10G RJ45 &amp; 2-port 10G SFP+, Intel X710-TM4</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot-Swappable 12 SAS or SATA Disk Bay</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCIe Gen3x4 x 16 GRAID SupremeRAID Core Software Module License with Full features, supports 32 native NVMe drives and NVMe-oF</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AnyStor-E NAS (480GB SSD X2EA, RAID1)</td>
<td>OS</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAMSUNG PM9A3, 7.68TB U.2 PCIe 4.0 NVMe (SAMSUNG MZQL27T6HBLA-00A07)</td>
<td>Disk Drive</td>
<td>2</td>
<td>1,250,000</td>
<td>4</td>
<td>5,000,000</td>
<td></td>
</tr>
<tr>
<td>Dual-Port QSFP28 100GbE Network Card</td>
<td>NIC Card</td>
<td>2</td>
<td>2,500,000</td>
<td>1</td>
<td>2,500,000</td>
<td></td>
</tr>
<tr>
<td>100G QSFP28 Cable 3M (MCP1600-C003E26N)</td>
<td>NIC Cable</td>
<td>2</td>
<td>300,000</td>
<td>2</td>
<td>600,000</td>
<td></td>
</tr>
<tr>
<td>Premium Package 3-Year Support &amp; Maintenance</td>
<td>Support &amp; Maintenance</td>
<td>2</td>
<td>12,000,000</td>
<td>1</td>
<td>12,000,000</td>
<td></td>
</tr>
</tbody>
</table>

### Storage Hardware Sub Total

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>105,100,000</td>
</tr>
</tbody>
</table>

## Client/Server Software

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Source</th>
<th>Unit Price</th>
<th>Qty</th>
<th>Price</th>
<th>3-Yr. Maint. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat Enterprise Linux Server Standard 3yrs</td>
<td>RH00004F3</td>
<td>3</td>
<td>4,088,000</td>
<td>2</td>
<td>8,178,000</td>
<td></td>
</tr>
<tr>
<td>RHEL Server Standard Maintenance - 3yrs 24x7x4hrs</td>
<td>RP-CPS(OS)</td>
<td>3</td>
<td>8,000,000</td>
<td>2</td>
<td>16,000,000</td>
<td></td>
</tr>
<tr>
<td>Red Hat JBoss Web Server 4-Core Standard 3Year</td>
<td>MW00123F3</td>
<td>3</td>
<td>1,944,000</td>
<td>2</td>
<td>3,888,000</td>
<td></td>
</tr>
<tr>
<td>JBoss Web Server per 4Core 3Year Maintenance</td>
<td>RP-CPS(WAS)</td>
<td>3</td>
<td>12,000,000</td>
<td>2</td>
<td>24,000,000</td>
<td></td>
</tr>
</tbody>
</table>

TPC-C Version 5.11.0
TPC Pricing 2.9.0
Report Date
25-Jan-2024

Available Now

Goldilocks v3.1 Standard Edition on KTNF KE780S1

TPC Pricing 2.9.0
Report Date
25-Jan-2024

Available Now
<table>
<thead>
<tr>
<th>Product Description</th>
<th>Quantity</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldilocks v3.1 Standard Edition</td>
<td></td>
<td></td>
<td>64,000,000</td>
</tr>
<tr>
<td>Goldilocks v3.1 Standard Edition Technical Supports</td>
<td></td>
<td></td>
<td>20,000,000</td>
</tr>
<tr>
<td><strong>Software Sub Total</strong></td>
<td></td>
<td></td>
<td>76,066,000</td>
</tr>
<tr>
<td><strong>Other Hardware</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DASAN Networks access switch - D2224GP, 24port POE</td>
<td>5</td>
<td>1,900,000</td>
<td>5,700,000</td>
</tr>
<tr>
<td>Hansung Computer - HKM1000K Keyboard mouse set</td>
<td>6</td>
<td>19,900</td>
<td>59,700</td>
</tr>
<tr>
<td>Hansung Computer - ULTRON 2235V Freesink real75 Monitor</td>
<td>6</td>
<td>97,000</td>
<td>291,000</td>
</tr>
<tr>
<td><strong>Other Hardware Sub Total</strong></td>
<td></td>
<td></td>
<td>6,050,700</td>
</tr>
<tr>
<td><strong>Discounts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Hardware Discount</td>
<td></td>
<td>-59,230,000</td>
<td>-7,500,000</td>
</tr>
<tr>
<td>Red Hat OS Discount</td>
<td></td>
<td>-2,978,000</td>
<td>-10,000,000</td>
</tr>
<tr>
<td>Red Hat JBoss Discount</td>
<td></td>
<td>-1,288,000</td>
<td>-6,000,000</td>
</tr>
<tr>
<td>SW Discount - Goldilocks</td>
<td></td>
<td>-46,600,000</td>
<td>-52,800,000</td>
</tr>
<tr>
<td><strong>Discounts Sub Total</strong></td>
<td></td>
<td></td>
<td>-110,096,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>128,120,700</td>
</tr>
</tbody>
</table>

**Pricing Notes**

1) KTNF Inc.  
2) Gluesys Co., Ltd.  
3) Rockplace Inc.  
4) Sunjesoft Inc.  
5) DASAN Networks  
6) Hansung Corp.

Three year cost of ownership KRW(₩): 163,820,700  
TPC-C throughput: 50,768 tpmC  
Price/Performance: 3,227 ₩ / tpmC  

Benchmark implementation and results independently audited by Doug Johnson of InfoSizing (www.sizing.com)

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 pricing specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.
### Goldilocks v3.1 Standard Edition on KTNF KE780S1

**MQTh, computed Maximum Qualified Throughput**: 50,768 tpmC

<table>
<thead>
<tr>
<th>Response Times (seconds)</th>
<th>Min</th>
<th>Average</th>
<th>90th</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>New-Order</td>
<td>0.102</td>
<td>0.11</td>
<td>0.103</td>
<td>12.348</td>
</tr>
<tr>
<td>Payment</td>
<td>0.102</td>
<td>0.108</td>
<td>0.103</td>
<td>8.922</td>
</tr>
<tr>
<td>Order-Status</td>
<td>0.102</td>
<td>0.107</td>
<td>0.102</td>
<td>3.882</td>
</tr>
<tr>
<td>Delivery (interactive portion)</td>
<td>0.101</td>
<td>0.104</td>
<td>0.101</td>
<td>3.284</td>
</tr>
<tr>
<td>Delivery (deferred portion)</td>
<td>0.001</td>
<td>0.019</td>
<td>0.005</td>
<td>8.919</td>
</tr>
<tr>
<td>Stock-Level</td>
<td>0.102</td>
<td>0.108</td>
<td>0.103</td>
<td>3.882</td>
</tr>
<tr>
<td>Menu</td>
<td>0.101</td>
<td>0.105</td>
<td>0.102</td>
<td>3.308</td>
</tr>
</tbody>
</table>

Emulated Display Delay: 0.1 sec.

<table>
<thead>
<tr>
<th>Transaction Mix</th>
<th>Percent</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>New-Order</td>
<td>44.980%</td>
<td>21,322,770</td>
</tr>
<tr>
<td>Payment</td>
<td>43.011%</td>
<td>20,389,345</td>
</tr>
<tr>
<td>Order-Status</td>
<td>4.003%</td>
<td>1,897,459</td>
</tr>
<tr>
<td>Delivery</td>
<td>4.003%</td>
<td>1,897,757</td>
</tr>
<tr>
<td>Stock-Level</td>
<td>4.003%</td>
<td>1,897,541</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Keying Times (seconds)</th>
<th>Min</th>
<th>Average</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>New-Order</td>
<td>18.001</td>
<td>18.001</td>
<td>18.002</td>
</tr>
<tr>
<td>Payment</td>
<td>3.001</td>
<td>3.001</td>
<td>3.002</td>
</tr>
<tr>
<td>Order-Status</td>
<td>2.001</td>
<td>2.001</td>
<td>2.002</td>
</tr>
<tr>
<td>Delivery</td>
<td>2.001</td>
<td>2.001</td>
<td>2.002</td>
</tr>
<tr>
<td>Stock-Level</td>
<td>2.001</td>
<td>2.001</td>
<td>2.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Think Times (seconds)</th>
<th>Min</th>
<th>Average</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>New-Order</td>
<td>0.001</td>
<td>12.041</td>
<td>120.501</td>
</tr>
<tr>
<td>Payment</td>
<td>0.001</td>
<td>12.040</td>
<td>120.501</td>
</tr>
<tr>
<td>Order-Status</td>
<td>0.001</td>
<td>10.037</td>
<td>100.501</td>
</tr>
<tr>
<td>Delivery</td>
<td>0.001</td>
<td>5.032</td>
<td>50.301</td>
</tr>
<tr>
<td>Stock-Level</td>
<td>0.001</td>
<td>5.028</td>
<td>50.301</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Duration</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp-up time</td>
<td>65 min</td>
</tr>
<tr>
<td>Measurement Interval (MI)</td>
<td>420 min</td>
</tr>
<tr>
<td>Checkpoints in MI</td>
<td>14</td>
</tr>
<tr>
<td>Checkpoint Interval (Average / Max)</td>
<td>29:21 min / 29:22 min</td>
</tr>
<tr>
<td>Number of Transactions in MI (all types)</td>
<td>47,404,872</td>
</tr>
</tbody>
</table>
General Items

0.1 Application Code and Definition Statements

The application program (as defined in clause 2.1.7) must be disclosed. This includes, but is not limited to, the code implementing the five transactions and the terminal input output functions.

Appendix A contains the application source code for the transactions.

0.2 Benchmark Sponsor

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

This benchmark was sponsored by TTA, Telecommunications Technology Association. The implementation was developed and engineered in partnership with SUNJESOFT Inc. and KTNF Inc.

0.3 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:

- Database options
- Recover/commit options
- Consistency locking options
- Operating system and application configuration parameters

This requirement can be satisfied by providing a full list of all parameters.

Appendix B contains the tunable parameters for the database, the operating system, and the transaction monitor.
0.4 Configuration Diagrams

Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences.

The configuration diagram for both the tested and priced system is depicted in Figure 0.1. There was no difference between the priced and tested configurations.

Figure 0.1: Benchmarked and Priced Configuration
Clause 1: Logical Database Design

1.1 Table Definitions

Listing must be provided for all table definition statements and all other statements used to set up the database.

Appendix A contains the code used to define and load the database tables.

1.2 Physical Organization of Database

The physical organization of tables and indices within the database must be disclosed.

The physical organization of the database is shown in Table 1.2.

<table>
<thead>
<tr>
<th>Controller</th>
<th>Array</th>
<th>RAID Array</th>
<th>Drives</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVMe</td>
<td>Internal</td>
<td>None</td>
<td>1 x 512GB NVMe SSD</td>
<td>OS</td>
</tr>
<tr>
<td>GRAID SupremeRAID</td>
<td>AnySotr 700E-12</td>
<td>RAID 1</td>
<td>2 x 7.68TB NVMe SSD</td>
<td>Database files</td>
</tr>
<tr>
<td></td>
<td>(External)</td>
<td>RAID 1</td>
<td>2 x 7.68TB NVMe SSD</td>
<td>Redo Logs</td>
</tr>
</tbody>
</table>

1.3 Insert and Delete Operations

It must be ascertained that insert and/or delete operations to any of the tables can occur concurrently with the TPC-C transaction mix. Furthermore, any restrictions in the SUT database implementation that precludes inserts beyond the limits defined in Clause 1.4.11 must be disclosed. This includes the maximum number of rows that can be inserted and the minimum key value for these new rows.

All insert and delete functions were verified to be fully operational during the entire benchmark.

1.4 Horizontal or Vertical Partitioning

While there are a few restrictions placed upon horizontal or vertical partitioning of tables and rows in the TPC-C benchmark, any such partitioning must be disclosed.

No horizontal or vertical partitioning was used in this benchmark.

1.5 Replication or Duplication

Replication of tables, if used, must be disclosed. Additional and/or duplicated attributes in any table must be disclosed along with a statement on the impact on performance.

No replications, duplications or additional attributes were used in this benchmark.
Clause 2: Transaction and Terminal Profiles

2.1 Random Number Generation

The method of verification for the random number generation must be described.

Random numbers were generated using ‘SysVr4 rand_r()’ call. The seed value for ‘rand_r()’ was collected and reviewed by the auditor.

2.2 Input/Output Screens

The actual layout of the terminal input/output screens must be disclosed.

All screen layouts were verified by the auditor to validate that they followed the requirements of the specifications.

2.3 Priced Terminal Feature

The method used to verify that the emulated terminals provide all the features described in Clause 2.2.2.4 must be explained. Although not specifically priced, the type and model of the terminals used for the demonstration in 8.1.3.3 must be disclosed and commercially available (including supporting software and maintenance).

The terminal attributes were manually verified by the auditor by verifying that each required feature was implemented.

2.4 Presentation Managers

Any usage of presentation managers or intelligent terminals must be explained.

Application code running on the client systems implemented the TPC-C user interface. No presentation manager software or intelligent terminal features were used. The source code for the user interface is listed in Appendix A.
2.5 Transaction Statistics

Table 2.1 lists the transaction statistics defined in Clauses 8.1.3.5 to 8.1.3.11 and observed during the Measurement Interval.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Order</td>
<td></td>
</tr>
<tr>
<td>Home warehouse order lines</td>
<td>99.00%</td>
</tr>
<tr>
<td>Remote warehouse order lines</td>
<td>1.00%</td>
</tr>
<tr>
<td>Rolled back transactions</td>
<td>1.004%</td>
</tr>
<tr>
<td>Average items per order</td>
<td>10.001</td>
</tr>
<tr>
<td>Payment</td>
<td></td>
</tr>
<tr>
<td>Home warehouse</td>
<td>84.993%</td>
</tr>
<tr>
<td>Remote warehouse</td>
<td>15.007%</td>
</tr>
<tr>
<td>Accessed by last name</td>
<td>59.975%</td>
</tr>
<tr>
<td>Order Status</td>
<td></td>
</tr>
<tr>
<td>Accessed by last name</td>
<td>60.071%</td>
</tr>
<tr>
<td>Delivery</td>
<td></td>
</tr>
<tr>
<td>Skipped transactions</td>
<td>0</td>
</tr>
<tr>
<td>Transaction Mix</td>
<td></td>
</tr>
<tr>
<td>New Order</td>
<td>44.980%</td>
</tr>
<tr>
<td>Payment</td>
<td>43.011%</td>
</tr>
<tr>
<td>Order status</td>
<td>4.003%</td>
</tr>
<tr>
<td>Delivery</td>
<td>4.003%</td>
</tr>
<tr>
<td>Stock level</td>
<td>4.003%</td>
</tr>
</tbody>
</table>

2.6 Queuing Mechanism

The queuing mechanism used to defer the execution of the Delivery transaction must be disclosed.

The queuing mechanism was implemented using ‘BlockingQueue’ provided by Java.
Clause 3: Transaction and System Properties

The results of the ACID tests must be disclosed along with a description of how the ACID requirements were met. This includes disclosing which case was followed for the execution of Isolation Test 7.

All ACID property tests were conducted according to the specification.

3.1 Atomicity

The system under test must guarantee that the database transactions are atomic; the system will either perform all individual operations on the data or will assure that no partially completed operations leave any effects on the data.

3.1.1 Atomicity of Completed Transactions

Perform the Payment transaction for a randomly selected warehouse, district, and customer (by customer number) and verify that the records in the CUSTOMER, DISTRICT, and WAREHOUSE tables have been changed appropriately.

A row was randomly selected from the CUSTOMER, DISTRICT, and WAREHOUSE tables, and the balances noted. A payment transaction was started with the same Customer, District, and Warehouse identifiers and a known amount. The payment transaction was committed and the rows were verified to contain correctly updated balances.

3.1.2 Atomicity of Aborted Transactions

Perform the Payment transaction for a randomly selected warehouse, district, and customer (by customer number) and substitute a ROLLBACK of the transaction for the COMMIT of the transaction. Verify that the records in the CUSTOMER, DISTRICT, and WAREHOUSE tables have NOT been changed.

A row was randomly selected from the CUSTOMER, DISTRICT, and WAREHOUSE tables, and the balances noted. A payment transaction was started with the same Customer, District, and Warehouse identifiers and a known amount. The payment transaction was rolled back and the rows were verified to contain the original balances.

3.2 Consistency

Consistency is the property of the application that requires any execution of a database transaction to take the database from one consistent state to another, assuming that the database is initially in a consistent state.

Verify that the database is initially consistent by verifying that it meets the consistency conditions defined in Clauses 3.3.2.1 to 3.3.2.4. Describe the steps used to do this in sufficient detail so that the steps are independently repeatable.

The specification defines 12 consistency conditions, of which Consistency conditions 1 through 4 were demonstrated as follows:

1. The sum of balances (d_ytd) for all Districts within a specific Warehouse is equal to the balance (w_ytd) of that Warehouse.

2. For each District within a Warehouse, the next available Order ID (d_next_o_id) minus one is equal to the most recent Order ID [max(o_id)] for the ORDER table associated with the preceding District and Warehouse. Additionally, that same relationship exists for the most recent Order ID [max(o_id)] for the NEW-ORDER table associated with the same District and Warehouse. Those relationships can be illustrated as:
   \[ d_{\text{next\_o\_id}} - 1 = \text{max}(o_{\text{id}}) = \text{max}(no_{\text{id}}) \]
   where (d_w_id = o_w_id = no_w_id) and (d_id = o_d_id = no_d_id)
3. For each District within a Warehouse, the value of the most recent Order ID \([\text{max}(\text{no\_o\_id})]\) minus the first Order ID \([\text{min}(\text{no\_o\_id})]\) plus one, for the NEW-ORDER table associated with the District and Warehouse, equals the number of rows in that NEW-ORDER table. That relationship can be illustrated as:
\[
\text{max}(\text{no\_o\_id}) - \text{min}(\text{no\_o\_id}) + 1 = \text{rows in NEW-ORDER}
\]
where \((\text{o\_w\_id} = \text{no\_w\_id})\) and \((\text{o\_d\_id} = \text{no\_d\_id})\)

4. For each District within a Warehouse, the sum of Order-Line counts \([\text{sum}(\text{o\_ol\_cnt})]\) for the Orders associated with the District equals the number of rows in the ORDER-LINE table associated with the same District. That relationship can be illustrated as:
\[
\text{sum}(\text{o\_ol\_cnt}) = \text{rows in the ORDER-LINE table for the Warehouse and District}
\]

To test consistency, the following steps were executed:

1. The consistency conditions 1 through 4 were tested by running queries against the database. All queries showed that the database was in a consistent state.
2. An RTE run was executed at full load for a duration sufficient to include at least one completed checkpoint.
3. The consistency conditions 1 through 4 were tested again. All queries showed that the database was still in a consistent state.

3.3 Isolation

Sufficient conditions must be enabled at either the system or application level to ensure the required isolation defined above (clause 3.4.1) is obtained.

The benchmark specification defines nine tests to demonstrate the property of transaction isolation. The tests, described in Clauses 3.4.2.1 – 3.4.2.9, were all successfully executed using a series of scripts. Each included timestamps to demonstrate the concurrency of operations. The results of the queries were logged. The captured logs were verified to demonstrate the required isolation had been met.

Isolation Test 1

This test demonstrates isolation for read-write conflicts of Order-Status and New-Order transactions when the New-Order transaction is committed.

The test proceeds as follows:

1. An Order-Status transaction \(T_0\) was executed and committed for a randomly selected Customer, and the Order returned was noted.
2. A New-Order transaction \(T_1\) was started for the same Customer used in \(T_0\). \(T_1\) was stopped prior to COMMIT.
3. An Order-Status transaction \(T_2\) was started for the same Customer used in \(T_1\). \(T_2\) completed and was committed without being blocked by \(T_1\). \(T_2\) returned the same Order that \(T_0\) had returned.
4. \(T_1\) was allowed to complete and was committed.
5. An Order-Status transaction \(T_3\) was started for the same Customer used in \(T_1\). \(T_3\) returned the Order inserted by \(T_1\).
Isolation Test 2

This test demonstrates isolation for read-write conflicts of Order-Status and New-Order transactions when the New-Order transaction is rolled back.

The test proceeds as follows:

1. An Order-Status transaction T0 was executed and committed for a randomly selected Customer and the Order returned was noted.
2. A New-Order transaction T1 with an invalid item number was started for the same Customer used in T0. T1 was stopped immediately prior to ROLLBACK.
3. An Order-Status transaction T2 was started for the same Customer used in T1. T2 completed and was committed without being blocked by T1. T2 returned the same Order that T0 had returned.
4. T1 was allowed to ROLLBACK.
5. An Order-Status transaction T3 was started for the same Customer used in T1. T3 returned the same Order that T0 had returned.

Isolation Test 3

This test demonstrates isolation for write-write conflicts of two New-Order transactions when both transactions are committed.

The test proceeds as follows:

1. The D_NEXT_O_ID of a randomly selected district was retrieved.
2. A New-Order transaction T1 was started for a randomly selected customer within the District used in step 1. T1 was stopped immediately prior to COMMIT.
3. Another New-Order transaction T2 was started for the same customer used in T1. T2 waited.
4. T1 was allowed to complete. T2 completed and was committed.
5. The order number returned by T1 was the same as the D_NEXT_O_ID retrieved in step 1. The order number returned by T2 was one greater than the order number returned by T1.
6. The D_NEXT_O_ID of the same District was retrieved again. It had been incremented by two (i.e. it was one greater than the order number returned by T2).

Isolation Test 4

This test demonstrates isolation for write-write conflicts of two New-Order transactions when one transaction is rolled back.

The test proceeds as follows:

1. The D_NEXT_O_ID of a randomly selected District was retrieved.
2. A New-Order transaction T1, with an invalid item number, was started for a randomly selected customer within the district used in step 1. T1 was stopped immediately prior to ROLLBACK.
3. Another New-Order transaction T2 was started for the same customer used in T1. T2 waited.
4. T1 was allowed to roll back, and T2 completed and was committed.
5. The order number returned by T2 was the same as the D_NEXT_O_ID retrieved in step 1.
6. The D_NEXT_O_ID of the same District was retrieved again. It had been incremented by one (i.e. one greater than the order number returned by T2).
Isolation Test 5
This test demonstrates isolation for write-write conflicts of Payment and Delivery transactions when Delivery transaction is committed.

The test proceeds as follows:
1. A query was executed to find out the Customer who is to be updated by the next Delivery transaction for a randomly selected Warehouse and District.
2. The C_BALANCE of the Customer found in step 1 was retrieved.
3. A Delivery transaction T1 was started for the same Warehouse used in step 1. T1 was stopped immediately prior to COMMIT.
4. A Payment transaction T2 was started for the same Customer found in step 1. T2 waited.
5. T1 was allowed to complete. T2 completed and was committed.
6. The C_BALANCE of the Customer found in step 1 was retrieved again. The C_BALANCE reflected the results of both T1 and T2.

Isolation Test 6
This test demonstrates isolation for write-write conflicts of Payment and Delivery transactions when the Delivery transaction is rolled back.

The test proceeds as follows:
1. A query was executed to find out the Customer who is to be updated by the next delivery transaction for a randomly selected Warehouse and District.
2. The C_BALANCE of the Customer found in step 1 was retrieved.
3. A Delivery transaction T1 was started for the same Warehouse used in step 1. T1 was stopped immediately prior to COMMIT.
4. A Payment transaction T2 was started for the same customer found in step 1. T2 waited.
5. T1 was forced to execute a ROLLBACK. T2 completed and was committed. The C_BALANCE of the Customer found in step 1 was retrieved again. The C_BALANCE reflected the results of only T2.

Isolation Test 7
This test demonstrates repeatable reads for the New-Order transaction while an interactive transaction updates the prices of some items.

The test proceeds as follows:
1. The I_PRICE of two randomly selected items X and Y were retrieved.
2. A New-Order transaction T1 with a group of Items including Items X and Y was started. T1 was stopped immediately after retrieving the prices of all items. The prices of Items X and Y retrieved matched those retrieved in step 1.
3. A transaction T2 was started to increase the price of Items X and Y by 10%.
4. T2 did not stall and was committed.
5. T1 was resumed, and the prices of all Items were retrieved again within T1. The prices of Items X and Y matched those retrieved in step 1.

6. T1 was committed.

7. The prices of Items X and Y were retrieved again. The values matched the values set by T2.

The Execution followed Case D, where T3 does not stall and no transaction is rolled back. Query T4 verifies the price change made by T3.

**Isolation Test 8**

*This test demonstrates isolation for phantom protection between New-Order and Delivery transactions.*

The test proceeds as follows:

1. The NO_D_ID of all NEW_ORDER rows for a randomly selected Warehouse and District was changed to 11. The changes were committed.
2. A Delivery transaction T1 was started for the selected Warehouse.
3. T1 was stopped immediately after reading the NEW_ORDER table for the selected Warehouse and District. No qualifying row was found.
4. A New-Order transaction T2 was started for the same Warehouse and District. T2 completed and was committed without being blocked by T1.
5. T1 was resumed and the NEW_ORDER table was read again. No qualifying row was found.
6. T1 completed and was committed.
7. The NO_D_ID of all NEW_ORDER rows for the selected Warehouse and District was restored to the original value. The changes were committed.

**Isolation Test 9**

*This test demonstrates isolation for phantom protection between New-Order and Order-Status transactions.*

The test proceeds as follows:

1. An Order-Status transaction T1 was started for a randomly selected Customer.
2. T1 was stopped immediately after reading the ORDER table for the selected Customer to find the most recent Order for that Customer.
3. A New-Order transaction T2 was started for the same Customer. T2 completed and was committed without being blocked by T1.
4. T1 was resumed and the ORDER table was read again to determine the most recent Order for the same Customer. The Order found was the same as the one found in step 2.
5. T1 completed and was committed.
3.4 Durability

The tested system must guarantee durability: the ability to preserve the effects of committed transactions and ensure database consistency after recovery from any one of the failures listed in Clause 3.5.3

- Permanent irrecoverable failure of any single durable medium containing TPC-C database tables or recovery log data (this test includes failure of all or part of memory)
- Instantaneous interruption (system crash/system hang) in processing that requires system reboot to recover
- Failure of all or part of memory (loss of contents)

3.4.1 Durable Media Failure

3.4.1.1 Loss of Log Media and Data Media

This test was conducted on a fully scaled database. To demonstrate recovery from a permanent failure of durable medium containing TPC-C Log Media and Data Media, the following steps were executed:

1. The total number of Orders is determined by the sum of D_NEXT_O_ID of all rows in the DISTRICT table; giving count-1.
2. The consistency is verified.
3. The RTE is started with full user load.
4. The test is allowed to run for a minimum of 5 minutes after ramp-up.
5. A first checkpoint is initiated and completed.
6. The test is allowed to run for a minimum of 2 more minutes.
7. A second checkpoint is initiated.
8. Before the second checkpoint completes, one data disk is disabled by removing it physically. Since the data disks are configured with redundancy, the transactions continued to run without interruption.
9. The test is allowed to run until the completion of the second checkpoint and for at least 5 minutes
10. A third checkpoint is initiated.
11. Before the third checkpoint completes, one log device is disabled by removing it physically. Since the log devices are configured with redundancy, the transactions continued to run without interruption.
12. The test is allowed to run until the fourth checkpoint has completed, but no less than 5 more minutes.
13. The RTE run is completed.
14. The consistency is verified.
15. Step 1 is repeated, giving count-2.
16. The RTE result file is used to determine the number of New-Order transactions successfully completed during the full run.
17. The difference between the count-1 and count-2 is compared with the number of New-Order transactions successfully completed during the full run. The difference indicated that no committed transactions had been lost.
18. Data from the success file is used to query the database to demonstrate that the last 500 successful New-Orders have corresponding rows in the ORDER table.
3.4.2 Instantaneous Interruption, Loss of Memory

As the loss of power erases the contents of memory, the instantaneous interruption and the loss of memory tests were combined into a single test. This test was executed on a fully scaled database. The following steps were executed:

1. The total number of Orders is determined by the sum of D_NEXT_O_ID of all rows in the DISTRICT table; giving count-1.
2. The consistency is verified.
3. The RTE is started with full user load.
4. The test is allowed to run for a minimum of 5 minutes at full load (after ramp-up).
5. A first checkpoint is initiated and completed.
6. The test is allowed to run for a minimum of 2 more minutes.
7. A second checkpoint is initiated.
8. Before the second checkpoint completes, the primary power to the back-end server is shut off (removing both power cords).
9. The RTE is shutdown.
10. Power is restored to the database server and the system performs an automatic recovery.
11. GOLDILOCKS is restarted and performs an automatic recovery.
12. Step 1 is repeated, giving count-2.
13. The consistency is verified.
14. The RTE result file is used to determine the number of New-Order transactions successfully completed during the full run.
15. The difference between the count-1 and count-2 is compared with the number of New-Order transactions successfully completed during the full run. The difference indicated that all committed transactions had been successfully recovered.
16. Data from the success file is used to query the database to demonstrate that the last 500 successful New-Orders have corresponding rows in the ORDER table.
Clause 4: Scaling and Database Population

4.1 Cardinality of Tables

The cardinality (e.g. number of rows) of each table, as it existed at the start of the benchmark run, must be disclosed. If the database was over-scaled and inactive rows of the WAREHOUSE table were deleted, the cardinality of the WAREHOUSE table as initially configured and the number of rows Table 4.1 shows that number of rows for each table as they were initially populated.

<table>
<thead>
<tr>
<th>Table</th>
<th>Cardinality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehouse</td>
<td>4,000</td>
</tr>
<tr>
<td>District</td>
<td>40,000</td>
</tr>
<tr>
<td>Customer</td>
<td>120,000,000</td>
</tr>
<tr>
<td>History</td>
<td>120,000,000</td>
</tr>
<tr>
<td>Order</td>
<td>120,000,000</td>
</tr>
<tr>
<td>New Order</td>
<td>36,000,000</td>
</tr>
<tr>
<td>Order Line</td>
<td>1,199,731,538</td>
</tr>
<tr>
<td>Stock</td>
<td>400,000,000</td>
</tr>
<tr>
<td>Item</td>
<td>100,000</td>
</tr>
<tr>
<td>Unused Warehouses</td>
<td>0</td>
</tr>
</tbody>
</table>

4.2 Database Implementation

A statement must be provided that describes: The data model implemented by DBMS used (e.g. relational, network, hierarchical). The database interfaces (e.g. embedded, call level) and access language (e.g. SQL, DL/1, COBOL read/write used to implement the TPC-C transaction. If more than one interface/access language is used to implement TPC-C, each interface/access language must be described and a list of which interface/access language is used with which transaction type must be disclosed.

Goldilocks v3.1 is an in-memory DBMS, implementing the relational model.
The transactions are implemented in SQL via JDBC calls to the database engine.
All application code and procedures are listed in Appendix A.

4.3 Distribution of Database Files

The distribution of tables and logs across all media must be explicitly depicted for tested and priced systems.
The database files are stored on a set of two 7.68TB disks configured as RAID1. The database log files are stored on two 7.68TB disks configured as RAID1.

**Table 4.3: Database file locations**

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>system_XXX.dbf</td>
<td>/data/db/db1</td>
<td>System tables and dictionary</td>
</tr>
<tr>
<td>tpcc_data_XX.dbf</td>
<td>/data/db/db1, /data/db/db2, /data/db/db3, /data/db/db4, /data/db/db5</td>
<td>Database data files</td>
</tr>
<tr>
<td>redo_X_X.log</td>
<td>/wal</td>
<td>Database log files</td>
</tr>
</tbody>
</table>

The distribution of tables and logs across storage media is shown in Table 1.2.
4.4 60-Day Space

Details of the 60-day space computations along with proof that the database is configured to sustain 8 hours of growth for the dynamic tables (Order, Order-Line, and History) must be disclosed.

A test run of over 8 hours was executed to demonstrate that the configuration is capable of sustaining 8 hours of growth at the reported throughput. The computation of the 60-day storage requirements is shown in Table 4.4.

Table 4.4: 60-Day Space Calculations

<table>
<thead>
<tr>
<th>Table</th>
<th>Rows</th>
<th>Data</th>
<th>Index</th>
<th>Initial Population</th>
<th>5% Growth</th>
<th>8-Hour Growth</th>
<th>Required Runtime Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAREHOUSE</td>
<td>4,000</td>
<td>32,248</td>
<td>112</td>
<td>32,360</td>
<td>1,618</td>
<td>0</td>
<td>33,978</td>
</tr>
<tr>
<td>DISTRICT</td>
<td>40,000</td>
<td>5,128</td>
<td>1,208</td>
<td>6,336</td>
<td>317</td>
<td>0</td>
<td>6,653</td>
</tr>
<tr>
<td>CUSTOMER</td>
<td>120,000,000</td>
<td>77,141,608</td>
<td>9,820,784</td>
<td>86,962,392</td>
<td>4,348,120</td>
<td>0</td>
<td>91,310,512</td>
</tr>
<tr>
<td>NEW_ORDER</td>
<td>36,000</td>
<td>2,272,744</td>
<td>1,269,076</td>
<td>3,541,760</td>
<td>177,088</td>
<td>0</td>
<td>3,718,848</td>
</tr>
<tr>
<td>ITEM</td>
<td>100,000</td>
<td>10,809</td>
<td>2,784</td>
<td>13,592</td>
<td>680</td>
<td>0</td>
<td>14,272</td>
</tr>
<tr>
<td>STOCK</td>
<td>400,000,000</td>
<td>147,136,256</td>
<td>13,027,736</td>
<td>160,163,992</td>
<td>8,008,200</td>
<td>0</td>
<td>168,172,192</td>
</tr>
<tr>
<td>HISTORY</td>
<td>120,000,000</td>
<td>9,832,488</td>
<td>0</td>
<td>9,832,488</td>
<td>0</td>
<td>1,996,723</td>
<td>11,289,211</td>
</tr>
<tr>
<td>ORDERS</td>
<td>120,000,000</td>
<td>7,612,624</td>
<td>9,045,464</td>
<td>16,658,088</td>
<td>0</td>
<td>1,545,926</td>
<td>18,204,014</td>
</tr>
<tr>
<td>ORDER_LINE</td>
<td>1,199,731,538</td>
<td>112,456,952</td>
<td>46,777,864</td>
<td>159,234,816</td>
<td>0</td>
<td>22,837,083</td>
<td>182,071,899</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>436,445,824</td>
<td>12,536,022</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>475,361,577</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>60-Day Requirements</th>
<th>Memory Requirements</th>
<th>Storage Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic-Space: 129,902,064</td>
<td>Final Allocation: 483,467,376</td>
<td>Total Disk Space: 15,002,570,752</td>
</tr>
<tr>
<td>Free-Space: 482,288</td>
<td>Non-Growing 5%: 12,536,022</td>
<td>Log space used: 73,400,320</td>
</tr>
<tr>
<td>Static-Space: 306,543,760</td>
<td>1-Day Memory: 496,003,398</td>
<td>60-Day Space: 1,889,327,665</td>
</tr>
<tr>
<td>Daily-Growth: 26,379,732</td>
<td></td>
<td>Remaining Space: 13,039,842,767</td>
</tr>
<tr>
<td>Daily-Spread: 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-Day Space: 1,889,327,665</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Base Unit (Kbytes)
tpmC  50,768,500
Clause 5: Performance Metrics

5.1 TPC Benchmark C Metrics
The TPC-C Metrics are reported in the front of this report as part of the executive summary.

5.2 Response Times
*Ninetieth percentile, maximum and average response times must be reported for all transaction types as well as for the menu response time.*

During the performance run transactions are submitted by the RTE in accordance with the required mix, Keying Times and Think Times of the benchmark Specification. Transactions are submitted by emulated users via HTTP. All timings are recorded by the RTE. The response time is measured from the submission of the transaction until the last byte of response is received by the RTE.

The details of the response times are reported in the front of this report as part of the Executive Summary.

5.3 Keying and Think Times
*The minimum, the average, and the maximum keying and think times must be reported for each transaction type.*

The details of the keying and think times are reported in the front of this report as part of the Executive Summary.

5.4 Distribution and Performance Curves

5.4.1 Response Time frequency distribution curves
*Response Time frequency distribution curves must be reported for each transaction type.*

Figure 5.4.1.1 shows the Response Time frequency distribution curves for the New-Order transaction.

Figure 5.4.1.2 shows the Response Time frequency distribution curves for the Payment transaction.

Figure 5.4.1.3 shows the Response Time frequency distribution curves for the Order-Status transaction.

Figure 5.4.1.4 shows the Response Time frequency distribution curves for the interactive portion of the Delivery transaction.

Figure 5.4.1.5 shows the Response Time frequency distribution curves for the Stock-Level transaction.
Figure 5.4.1.1: New-Order RT Frequency Distribution

Figure 5.4.1.2: Payment RT Frequency Distribution
Figure 5.4.1.3: Order-Status RT Frequency Distribution

Figure 5.4.1.4: Delivery (Interactive) RT Frequency Distribution
Figure 5.4.1.5: Stock-Level RT Frequency Distribution

Stock-Level Response Time

- Average Response Time: 0.108
- 90th Percentile Response Time: 0.103
- Maximum Response Time: 3.882

Response Time (sec.)

Response Time Frequency (txn)

- 0.00
- 0.05
- 0.10
- 0.15
- 0.20
- 0.25
- 0.30
- 0.35
- 0.40
- 0.45

- 0
- 200,000
- 400,000
- 600,000
- 800,000
- 1,000,000
- 1,200,000
- 1,400,000

Response Time Frequency (txn) vs. Response Time (sec.)
5.4.2 Response Time versus throughput

The performance curve for response times versus throughput must be reported for the New-Order transaction.

Figure 5.4.2 shows the Response Time versus throughput curves for the New-Order transaction.

![Response Time v Throughput](image)

**Figure 5.4.2: New-Order RT versus Throughput**
5.4.3 Think Time frequency distribution

Think Time frequency distribution curves (see Clause 5.6.3) must be reported for the New-Order transaction.

Figure 5.4.3 shows the Think Time frequency distribution curves for the New-Order transaction.

![New-Order Think Time Frequency Distribution](image_url)

**Figure 5.4.3: New-Order Think Time Frequency Distribution**

Average Think Time: 12.041
Maximum Think Time: 120.501
5.4.4 Throughput versus elapsed time

A graph of throughput versus elapsed time must be reported for the New-Order transaction.

Figure 5.4.4 shows the throughput versus elapsed time for the New-Order transaction. The start and end of the Measurement Interval is included on the figure.

Figure 5.4.4: New-Order Throughput versus Elapsed Time
5.5 Steady State Determination
The method used to determine that the SUT had reached a steady state prior to commencing the measurement interval must be disclosed.

Steady state was determined using real time monitor utilities from the RTE. Steady state was further confirmed by a visual analysis of the throughput graph.

5.6 Work Performed During Steady State
A description of how the work normally performed during a sustained test (for example checkpointing, writing redo/undo log records, etc.) actually occurred during the measurement interval must be reported.

During the test, Goldilocks satisfied all of the ACID properties required by the benchmark specification. Committed transactions write a Redo record in the transaction log, to be used in case of system failure. The Redo records are used for roll-forward recovery during a re-start following a failure. This prevents the system from losing any committed transactions. Checkpoints periodically occurred about every 29.3 min. and are completed in about 3.3 min.

5.7 Measurement Period Duration
A statement of the duration of the measurement interval for the reported Maximum Qualified Throughput (tpmC) must be included.

The duration of the reported measured interval was 7 hours (7hr = 420min = 25,200sec).

5.8 Transaction Statistics
The percentage of the total mix for each transaction type must be disclosed. The percentage of New-Order transactions rolled back as a result of invalid item number must be disclosed. The average number of order-lines entered per New-Order transaction must be disclosed. The percentage of remote order lines per New-Order transaction must be disclosed. The percentage of remote Payment transactions must be disclosed. The percentage of customer selections by customer last name in the Payment and Order-Status transactions must be disclosed. The percentage of skipped Delivery transactions must be disclosed.

The details of the transaction statistics are reported in the front of this report as part of the Executive Summary.

5.9 Checkpoints
The number of checkpoints in the Measurement Interval, the time in seconds from the start of the Measurement Interval to the first checkpoint, and the Checkpoint Interval must be disclosed.

Two full checkpoints occurred before the Measurement Interval. 14 full checkpoints occurred during the Measurement Interval. The checkpoints’ start and end times and durations during the Measurement Interval are listed in table 5.6.
<table>
<thead>
<tr>
<th>Event</th>
<th>Event time</th>
<th>Execution time</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Interval Begin</td>
<td>2023-11-10 17:14:18</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Checkpoint3 Begin</td>
<td>2023-11-10 17:31:01</td>
<td>00:29:21</td>
<td></td>
</tr>
<tr>
<td>Checkpoint3 End</td>
<td>2023-11-10 17:34:08</td>
<td>00:03:07</td>
<td></td>
</tr>
<tr>
<td>Checkpoint4 Begin</td>
<td>2023-11-10 18:00:18</td>
<td>00:29:17</td>
<td></td>
</tr>
<tr>
<td>Checkpoint4 End</td>
<td>2023-11-10 18:03:31</td>
<td>00:03:13</td>
<td></td>
</tr>
<tr>
<td>Checkpoint5 Begin</td>
<td>2023-11-10 18:29:39</td>
<td>00:29:21</td>
<td></td>
</tr>
<tr>
<td>Checkpoint5 End</td>
<td>2023-11-10 18:32:51</td>
<td>00:03:12</td>
<td></td>
</tr>
<tr>
<td>Checkpoint6 Begin</td>
<td>2023-11-10 18:58:59</td>
<td>00:29:20</td>
<td></td>
</tr>
<tr>
<td>Checkpoint6 End</td>
<td>2023-11-10 19:02:11</td>
<td>00:03:12</td>
<td></td>
</tr>
<tr>
<td>Checkpoint7 Begin</td>
<td>2023-11-10 19:28:18</td>
<td>00:29:19</td>
<td></td>
</tr>
<tr>
<td>Checkpoint7 End</td>
<td>2023-11-10 19:31:35</td>
<td>00:03:17</td>
<td></td>
</tr>
<tr>
<td>Checkpoint8 Begin</td>
<td>2023-11-10 19:57:38</td>
<td>00:29:20</td>
<td></td>
</tr>
<tr>
<td>Checkpoint8 End</td>
<td>2023-11-10 20:00:47</td>
<td>00:03:09</td>
<td></td>
</tr>
<tr>
<td>Checkpoint9 Begin</td>
<td>2023-11-10 20:26:59</td>
<td>00:29:21</td>
<td></td>
</tr>
<tr>
<td>Checkpoint9 End</td>
<td>2023-11-10 20:30:02</td>
<td>00:03:03</td>
<td></td>
</tr>
<tr>
<td>Checkpoint10 Begin</td>
<td>2023-11-10 20:56:19</td>
<td>00:29:20</td>
<td></td>
</tr>
<tr>
<td>Checkpoint10 End</td>
<td>2023-11-10 20:59:27</td>
<td>00:03:08</td>
<td></td>
</tr>
<tr>
<td>Checkpoint11 Begin</td>
<td>2023-11-10 21:25:38</td>
<td>00:29:19</td>
<td></td>
</tr>
<tr>
<td>Checkpoint11 End</td>
<td>2023-11-10 21:28:44</td>
<td>00:03:06</td>
<td></td>
</tr>
<tr>
<td>Checkpoint12 Begin</td>
<td>2023-11-10 21:54:57</td>
<td>00:29:19</td>
<td></td>
</tr>
<tr>
<td>Checkpoint12 End</td>
<td>2023-11-10 21:58:06</td>
<td>00:03:09</td>
<td></td>
</tr>
<tr>
<td>Checkpoint13 Begin</td>
<td>2023-11-10 22:24:18</td>
<td>00:29:21</td>
<td></td>
</tr>
<tr>
<td>Checkpoint13 End</td>
<td>2023-11-10 22:27:22</td>
<td>00:03:04</td>
<td></td>
</tr>
<tr>
<td>Checkpoint14 Begin</td>
<td>2023-11-10 22:53:39</td>
<td>00:29:21</td>
<td></td>
</tr>
<tr>
<td>Checkpoint14 End</td>
<td>2023-11-10 22:56:43</td>
<td>00:03:04</td>
<td></td>
</tr>
<tr>
<td>Checkpoint15 Begin</td>
<td>2023-11-10 23:23:00</td>
<td>00:29:21</td>
<td></td>
</tr>
<tr>
<td>Checkpoint15 End</td>
<td>2023-11-10 23:26:04</td>
<td>00:03:04</td>
<td></td>
</tr>
<tr>
<td>Checkpoint16 Begin</td>
<td>2023-11-10 23:52:20</td>
<td>00:29:20</td>
<td></td>
</tr>
<tr>
<td>Checkpoint16 End</td>
<td>2023-11-10 23:55:29</td>
<td>00:03:09</td>
<td></td>
</tr>
<tr>
<td>Measurement Interval End</td>
<td>2023-11-11 00:17:49</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Clause 6: SUT, Driver and Communication

6.1 Remote Terminal Emulator (RTE)

If the RTE is commercially available, then its inputs must be specified. Otherwise, a description must be supplied of what inputs (e.g., scripts) to the RTE had been used.

The RTE software used was internally developed. The RTE simulated web users. It generated random input data based on the benchmark requirements and recorded response times and other statistics for each transaction cycle.

6.2 Emulated Components

It must be demonstrated that the functionality and performance of the components being emulated in the Driver System are equivalent to the priced system. The results of the test described in Clause 6.6.3.4 must be disclosed.

No components were emulated by the driver system.

6.3 Functional Diagrams

A complete functional diagram of both the benchmark configuration and the configuration of the proposed (target) system must be disclosed. A detailed list of all hardware and software functionality being performed on the Driver System and its interface to the SUT must be disclosed.

The diagram in Figure 0.1 shows the tested and priced benchmark configurations.

6.4 Networks

The network configuration of both the tested services and proposed (target) services which are being represented and a thorough explanation of exactly which parts of the proposed configuration are being replaced with the Driver System must be disclosed.

The bandwidth of the networks used in the tested/priced configuration must be disclosed.

The diagram in Figure 0.1 shows the network configuration between the components of the tested configuration. The RTE and the SUT are connected through a 1Gbit switch.

The network bandwidths are listed in Figure 0.1.

6.5 Operator Intervention

If the configuration requires operator intervention (see Clause 6.6.6), the mechanism and the frequency of this intervention must be disclosed.

No operator intervention is required to sustain eight hours at the reported throughput.
Clause 7: Pricing

7.1 Hardware and Software Pricing

A detailed list of hardware and software used in the priced system must be reported. Each separately orderable item must have vendor part number, description, and release/revision level, and either general availability status or committed delivery date. If package-pricing is used, vendor part number of the package and a description uniquely identifying each of the components of the package must be disclosed. Pricing source and effective date(s) of price(s) must also be reported.

The details of the hardware and software are reported in the front of this report as part of the Executive Summary.

7.2 Three Year Price

The total 3-year price of the entire configuration must be reported, including: hardware, software, and maintenance charges. Separate component pricing is recommended. The basis of all discounts used must be disclosed.

The pricing details for this TPC-C result are reported in the front of this report as part of the Executive Summary.

7.3 Availability Dates

The committed delivery date for general availability (availability date) of products used in the price calculations must be reported. When the priced system includes products with different availability dates, the reported availability date for the priced system must be the date at which all components are committed to be available.

All components of the priced system are available as of the date of this publication.
Clause 8: Reporting

8.1 Full Disclosure Report

A Full Disclosure report is required in order for results to be considered compliant with the TPC-C benchmark specification.

This document constitute the Full Disclosure Report for the TPC-C benchmark result describes within.
Clause 9: Auditor Attestation

9.1 Auditor Information

The auditor's agency name, address, phone number, and Attestation letter with a brief audit summary report indicating compliance 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:

InfoSizing
Doug Johnson
63 Lourdes Drive
Leominster, MA, 01453 USA
Phone: +1 (978) 343-6562
www.sizing.com

9.2 Attestation Letter

The auditor’s attestation letter is included in the following pages.
Sejin Hwang  
Senior Research Engineer  
Telecommunications Technology Association (TTA)  
Bundang-ro 47, Bundang-gu, Seongnam-city  
Gyeonggi-do, 13591, Republic of Korea

February 23, 2022

I verified the TPC Benchmark™ C v5.11.0 performance of the following configuration:

- **Platform:** KTNF KE780S1  
- **Operating System:** Red Hat Enterprise Linux 9.0  
- **Database Manager:** Goldilocks v3.1 Standard Edition

The results were:

<table>
<thead>
<tr>
<th>Performance Metric</th>
<th>50,768 tpmC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Users</td>
<td>40,000</td>
</tr>
</tbody>
</table>

**Server:** KTNF KE780S1  
- **CPUs:** 1x Intel® Xeon® Silver 4410Y @ 2.00 GHz, 12-core, 30 MB L3  
- **Memory:** 512 GB  
- **Storage:**  
<table>
<thead>
<tr>
<th>Qty</th>
<th>Size</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>512 GB</td>
<td>NVMe</td>
</tr>
<tr>
<td>4</td>
<td>7.68 TB</td>
<td>NVMe (External)</td>
</tr>
</tbody>
</table>

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:

- The transactions were correctly implemented.
- The database records were the proper size.
- The database was properly scaled and populated.
- The ACID properties were met.
- Input data was generated according to the specified percentages.
- The transaction cycle times included the required keying and think times.
- The reported response times were correctly measured.
- At least 90% of all delivery transactions met the 80 Second completion time limit.
- All 90% response times were under the specified maximums.
• The measurement interval was representative of steady state conditions.
• The reported measurement interval was over 120 minutes.
• Checkpoint intervals were under 30 minutes.
• The 60-day storage requirement was correctly computed.
• The system pricing was verified for major components and maintenance.

Additional Audit Notes:

None.

Respectfully Yours,

[Signature]

Doug Johnson, Certified TPC Auditor
Appendix A: Source Code

The source code and scripts used to implement the benchmark is provided as a soft appendix. This soft appendix includes the following files:

\ACID\include
\ACID\src
\ACID\src\atom.c
\ACID\src\compare.c
\ACID\src\consist.c
\ACID\src\Delivery.c
\ACID\src\isol1.c
\ACID\src\isol2.c
\ACID\src\isol3.c
\ACID\src\isol4.c
\ACID\src\isol5.c
\ACID\src\isol6.c
\ACID\src\isol7.c
\ACID\src\isol8.c
\ACID\src\isol9.c
\ACID\src\Makefile
\ACID\src\NewOrder.c
\ACID\src\OrderStatus.c
\ACID\src\Payment.c
\ACID\src\support.c
\bin
\bin\load.sh
\html
  \html\DeliveryInput.html
  \html\MainMenu.html
  \html\NewOrderInput.html
  \html\OrderStatusInput.html
  \html\PaymentInput.html
  \html\StockLevelInput.html
\include
  \include\spt_proc.h
  \include\support.h
\java
  \java\Common.java
  \java\Delivery.java
  \java\NewOrder.java
  \java\OrderStatus.java
  \java\Payment.java
  \java\StockLevel.java
\scripts
  \scripts\analyze_system.sql
  \scripts\analyze_table.sql
  \scripts\analyze_table_district.sql
  \scripts\analyze_table_item.sql
  \scripts\analyze_table_new_order.sql
  \scripts\analyze_table_orders.sql
  \scripts\analyze_table_order_line.sql
\scripts\analyze_table_stock.sql
\scripts\analyze_table_warehouse.sql
\scripts\audit.sql
\scripts\checkpoint.py
\scripts\count.sql
\scripts\create_audit_table.sql
\scripts\create_index.sql
\scripts\create_procedure.sql
\scripts\create_table.sql
\scripts\create_tablespace.sql
\scripts\dbcheck.sql
\scripts\dbtables.sql
\scripts\runcheck.sql
\scripts\sys
   \scripts\sys\be
      \scripts\sys\be\part_info.sh
      \scripts\sys\be\reboot_info.sh
      \scripts\sys\be\sw_info.sh
      \scripts\sys\be\sys_info.sh
\src
   \src\free_space.c
   \src\load.c
   \src\load_new.c
   \src\Makefile
   \src\support.c
Appendix B: Tunable Parameters

goldilocks.properties.conf

TRANSACTION_COMMIT_WRITE_MODE = 1
TRANSACTION_TABLE_SIZE = 1024
UNDO_RELATION_COUNT = 1024
LOG_BUFFER_SIZE = 3G
LOG_FILE_SIZE = 14G
LOG_GROUP_COUNT = 5
PENDING_LOG_BUFFER_COUNT = 8
SPIN_COUNT = 1
BUSY_WAIT_COUNT = 1000
SYSTEM_TABLESPACE_DIR = '/data/db/db1'
SYSTEM_MEMORY_UNDO_TABLESPACE_SIZE = 2G
SYSTEM_MEMORY_TEMP_TABLESPACE_SIZE = 1G
SHARED_MEMORY_STATIC_SIZE = 4G
PARALLEL_IO_FACTOR = 1
PARALLEL_IO_GROUP_1 = '/data/db/db1'
LOG_DIR = '/wal'
CLIENT_MAX_COUNT = 1024
PROCSS_MAX_COUNT = 1024
PARALLEL_LOAD_FACTOR = 16
SHARED_SESSION = NO
CONTROL_FILE_COUNT = 2
CONTROL_FILE_0 = '/wal/control_0.ctl'
CONTROL_FILE_1 = '/wal/control_1.ctl'
DATABASE_FILE_IO = 1
SYSTEM_FILE_IO = 1
LOG_FILE_IO = 1

limit.conf

# /etc/security/limits.conf
#
# This file sets the resource limits for the users logged in via PAM. #
# Also note that configuration files in /etc/security/limits.d directory, #
# which are read in alphabetical order, override the settings in this #
# file in case the domain is the same or more specific. #
# That means for example that setting a limit for wildcard domain here #
# can be overridden with a wildcard setting in a config file in the #
# subdirectory, but a user specific setting here can be overridden only #
# with a user specific setting in the subdirectory. #
# Each line describes a limit for a user in the form: #
#   <domain>  <type>  <item>  <value> #
# A domain is a host followed by a netmask, or a wildcard, or a user. #
# A type is one of: hard, max, soft. #
# An item is one of: core, data, cpu, fsize, nice, nproc, as, mem, memsw, c荡, real, stack, time, user, vsz, nice, nproc, unlimited. #
# Example 1: #
#   user  soft core 1000000 #
# Example 2: #
#   user  hard mem 1G #
# Example 3: #
#   user  soft nproc unlimited #
#

server.xml

<Context>
    <Resource name="jdbc/goldilocks" auth="Container" type="javax.sql.DataSource" driverClassName='sunje.goldilocks.jdbc.GoldilocksDriver' url='jdbc:goldilocks://10.100.250.139:22581/test' username='test' password='test' maxActive='10' maxIdle='10' maxWait='10000' connectionTimeout='120000'事务模式='1'事务表大小='1024'undo关系数='1024'undo缓冲区数='8'spinning='1'busy等待数='1000'系统表空间='data/db/db1'系统内存未使用的表空间='2G'系统内存临时表空间='1G'共享内存静态大小='4G'并行io因子='1'并行io组1='data/db/db1'日志目录='wal'客户端连接数='1024'进程最大数='1024'并行加载因子='16'共享会话='否'控制文件数='2'控制文件0='wal/control_0.ctl'控制文件1='wal/control_1.ctl'数据库文件io='1'系统文件io='1'日志文件io='1'/>
</Context>
## Appendix C: Price Quotations

### DB&WAS Server

<table>
<thead>
<tr>
<th>Model</th>
<th>Specification</th>
<th>Quantity</th>
<th>Price (IDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KET8001 (12C 2.0GHz x1P / 512GB DDR4 / 512GB M.2 SSD x1)</td>
<td></td>
<td>1</td>
<td>43,000,000</td>
</tr>
<tr>
<td>KET8001 (12C 2.0GHz x1P / 512GB DDR4 / 512GB M.2 SSD x1)</td>
<td></td>
<td>1</td>
<td>43,000,000</td>
</tr>
<tr>
<td>RAM</td>
<td>4Gb DDR5 4800 RDIMM</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>NIC</td>
<td>10000 Q2 Network Card</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>HDD</td>
<td>1TB SATA 7200rpm</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SSD</td>
<td>512GB M.2 NVMe SSD</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desktop (Windows)</td>
<td></td>
<td>1</td>
<td>8,000,000</td>
</tr>
<tr>
<td>RAM</td>
<td>32GB DDR4 Memory</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>HDD</td>
<td>2TB SATA HDD</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SSD</td>
<td>512GB M.2 NVMe SSD</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>NIC</td>
<td>2port 10G &amp; 45 Adapter</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:****

1. The server is equipped with the latest software and hardware, ensuring optimal performance.
2. The specifications are subject to change without notice.
3. VAT is included in the price.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Price (IDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAT</td>
<td>Additional tax</td>
<td>5,000,000</td>
</tr>
<tr>
<td>VAT</td>
<td>Additional tax (Total)</td>
<td>56,000,000</td>
</tr>
</tbody>
</table>
## 견적서

장 소: TTA

코드: 통신허가전(접수)원

1. 납품일자: 협의 후 지정
2. 결제조건: 협의
3. 견적일자: 2024년 2월 14일
4. 견적유효일자: 견적일로부터 90일

제공사: Gluesys

경기도 안양시 동안구 시민대로327번길 11-31

주소: R&D센터 5F 러글루시스

대표 이사: 박 성 순

담 당 자: 김용상 부당

연락처: 010-2353-2325

이메일: yskim@Gluesys.com

### 구상의무공개전달주문

유형: V.A.T 포함

<table>
<thead>
<tr>
<th>번호</th>
<th>구분</th>
<th>설명</th>
<th>수량</th>
<th>소매가</th>
<th>소매가 할부</th>
<th>공급단가</th>
<th>공급액</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Anystor 700i-E12 (7.68Tb NVMe SSD *2)</td>
<td></td>
<td>1</td>
<td>117,100,000</td>
<td>50,370,000</td>
<td>50,370,000</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ASE700i-E12</td>
<td>Intel® Xeon Gold 6226 Processor (16 Core, 2.9GHz, 24MB Cache) X2ea</td>
<td>1</td>
<td>97,000,000</td>
<td>97,000,000</td>
<td>40,000,000</td>
<td>40,000,000</td>
</tr>
<tr>
<td></td>
<td>OS</td>
<td>AnySector-6 NAS 전용 O/S (480GB SSD X2ea, RAID1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>지원프로그램</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- NFS, CIFS, SNMP, FTP, NVMeNF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- AnyManager</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 웹 기반의 NAS 관리도구</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Clustering Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Volume Manager &amp; Monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Auto / Manual recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Parallel / distributed recovery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data Replication Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Online Scale-Out Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- PD550 F5 AP Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Monitoring Tool on WEB (WMS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data Distributed I/O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data Replication &amp; NetworkRAID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Support &amp; Maintenance</td>
<td>Premium Package 3-Year Support &amp; Maintenance</td>
<td>1</td>
<td>12,000,000</td>
<td>12,000,000</td>
<td>4,500,000</td>
<td>4,500,000</td>
</tr>
<tr>
<td>3</td>
<td>Disk Drive</td>
<td>SAMSUNG PM9A3, 7.68TB U.2 PCIe 4.0 NVMe (SAMSUNG MZQL2776HBLW-004D40)</td>
<td>4</td>
<td>1,250,000</td>
<td>5,000,000</td>
<td>1,000,000</td>
<td>4,000,000</td>
</tr>
<tr>
<td>4</td>
<td>NIC Card</td>
<td>Dual-Port QSFP28 100GGe Network Card</td>
<td>1</td>
<td>2,500,000</td>
<td>2,500,000</td>
<td>1,500,000</td>
<td>1,500,000</td>
</tr>
<tr>
<td>5</td>
<td>NIC Cable</td>
<td>100G QSFP28 Cable 3M (MCP1600-C03826N)</td>
<td>2</td>
<td>300,000</td>
<td>600,000</td>
<td>185,000</td>
<td>370,000</td>
</tr>
</tbody>
</table>

공 급 가: 50,370,000
부 가 값 차: 5,037,000
총 합 결: 55,407,000

비고

1. 무상 유지보수 기간: 납품 및 설치 후 3년

TPC-C Full Disclosure Report
© 2021 Telecommunications Technology Association. All rights reserved.
## 태블릿에서 제공하는 고정وصم الاستثنائي

<table>
<thead>
<tr>
<th>구분</th>
<th>Description</th>
<th>가격정보</th>
</tr>
</thead>
</table>
1. | OX 작업 | perpetuity subscription |
2. | OX 계정 유형 | subscription |
## Network Switch

**상품상세정보**

네트워크스위치

### 약정정보

- **업체명:** 주식회사 에스비정보기술(주)
- **계약자:** 농금자 정보조회
- **계약방법:** 다수공급자계약
- **규제법령:** 네트워크스위치, 다산네트워스, (CNI)20213GP, 24포트 POE (유형)

#### 가격
- 1,900,000원

### 주요부품
- **원산지:** 중국
- **주요부품**
  - 소스 [중국]
  - 메모리 [중국]
    - 제조사: (주)다산네트웍스
    - 납품장소: 허브기기 저장장소
    - 안도조건: 현장설치도
    - 공급지역: 전지역
  - 부가세부담: 부가가치세포함
  - 계약기간: 2023/11/15 ~ 2024/11/14
  - 납품기한: 60일 (납품요구일로부터)
  - 조달수수료부담: 조달수수료 별도

### 첨부파일
- 2023/11/01_003C053100-(계약서)용품구매계약서(처)계약일반조건(기획재정부계약예규583호20211201).hwp
- 2023/11/02_003C053100-용품디자인협의계약서(수신조항).hwp
- 2023/11/03_003C053100-용품구매계약서관리관리특수조건(210101).hwp
- 2023/11/04_003C053100-규격서.zip

### 대분류
- 09 - 전자/정보/통신/영상

### 중분류
- 07 - 응용장비 및 신호장치

### 재고관리
- 물품관리번호: 03220121
- 세부품명번호: 43220121
- 물품상태번호: 24567061
- 계약번호: 003C053100-6
- 장수구분: 추정수

### 감추기

### 구매의사결정을 위한 구매정보

<table>
<thead>
<tr>
<th>목적</th>
<th>구매대상</th>
<th>해당 없음</th>
</tr>
</thead>
<tbody>
<tr>
<td>평균배송일/납품기한</td>
<td>관리정보입력 / 60일 (납품요구일로부터)</td>
<td></td>
</tr>
<tr>
<td>통합보증조달용품여부</td>
<td>해당없이</td>
<td></td>
</tr>
<tr>
<td>본사소재지</td>
<td>경기도 의왕시 싱고로53, 10층 A동 1016호(포일동, 에스플랜드타워)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>분류</td>
<td>상품명</td>
</tr>
<tr>
<td>----</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>1</td>
<td>[9926]</td>
<td>한성 컴퓨터 HKM1000K 키보드마우스 세트</td>
</tr>
<tr>
<td></td>
<td>[키보드/키ypad] HKM1000K 키보드마우스 세트</td>
<td>0원</td>
</tr>
<tr>
<td>2</td>
<td>[24623]</td>
<td>ULTRON 2235V 프리싱크 리얼75</td>
</tr>
<tr>
<td></td>
<td>[22형] ULTRON 2235V 프리싱크 리얼75(일반-무결점보증품)</td>
<td>0원</td>
</tr>
<tr>
<td>3</td>
<td>배송비</td>
<td>배송비(무료배송)</td>
</tr>
</tbody>
</table>

합계금액: 350,700 원
(무가배포포함)

1. 한성컴퓨터 경매는 경매 당일만 유효합니다.
2. 제품 납품(출고)은 결제 완료 후 가능합니다.
3. 제주, 도서/산간 지역은 추가 비용이 발생할 수 있습니다.
4. 가격정보는 수시로 변경될 수 있으며,
   최종 금액은 주문/결제 화면에서 확인할 수 있습니다.

입금계좌 안내
예금주: (주)한성
우리은행: 1005-301-076521

Copyright® 2003 HANSUNG Corp All Rights Reserved
**TTA 貴中**

Title: TPC-C Performance & Quality Authentication

- 수 신: 황세진 선임연구원님 (010-5110-4883, hsejin314@tta.or.kr)
- 건적일자: 2024년 1월 16일
- 유효기간: 건적일로부터 4개월

※ **Goldilocks Standard Edition for LINUX 1식**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Unit Price</th>
<th>Q’ty</th>
<th>Total Price</th>
<th>Offer Price</th>
<th>비고</th>
</tr>
</thead>
<tbody>
<tr>
<td>[24Core]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Goldilocks Ver 3.1 DBMS Standard Edition</td>
<td>64,000,000</td>
<td>1 Set(s)</td>
<td>64,000,000</td>
<td>17,400,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Query Processes Module</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Storage Management Module</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>소 계 (부가세 별도)</td>
<td>64,000,000</td>
<td></td>
<td></td>
<td>17,400,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DBMS Implementaion &amp; Supports</td>
<td>20,000,000</td>
<td>3 Set(s)</td>
<td>60,000,000</td>
<td>7,200,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>소 계 (부가세 별도)</td>
<td>60,000,000</td>
<td></td>
<td></td>
<td>7,200,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>합 계 (부가세 별도)</td>
<td>124,000,000</td>
<td></td>
<td></td>
<td>24,600,000</td>
<td></td>
</tr>
</tbody>
</table>

총 합 계 (부가세 별도) | 24,600,000 |

* Remarks
- For Technical supports, it indicates 24 x 7 x 4 hours of support