SPC BENCHMARK 1™

FULL DISCLOSURE REPORT

TELECOMMUNICATIONS TECHNOLOGY ASSOCIATION
GLUESYS ANYSTOR-700EK

SPC-1 V3.8

SUBMISSION IDENTIFIER: A31023

SUBMITTED FOR REVIEW: NOVEMBER 4, 2019
First Edition – November 2019

THE INFORMATION CONTAINED IN THIS DOCUMENT IS DISTRIBUTED ON AN AS IS BASIS WITHOUT ANY WARRANTY EITHER EXPRESS OR IMPLIED. The use of this information or the implementation of any of these techniques is the customer’s responsibility and depends on the customer’s ability to evaluate and integrate them into the customer’s operational environment. While each item has been reviewed by TTA for accuracy, in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environment do so at their own risk.

This publication was produced in Korea. TTA may not offer the products, services, or features discussed in this document in other countries, and the information is subject to change with notice. Consult your local TTA representative for information on products and services available in your area.

© Copyright TTA 2019. All rights reserved.

Permission is hereby granted to publicly disclose and reproduce this document, in whole or in part, provided the copyright notice as printed above is set forth in full text on the title page of each item reproduced.

Trademarks

SPC Benchmark 1, SPC-1, SPC-1 IOPS, SPC-1 LRT and SPC-1 Price-Performance are trademarks of the Storage Performance Council.

TTA and the TTA logo are trademarks or registered trademarks of the Telecommunications Technology Association in Korea and other countries. AnyStor™ is a trademark or registered trademark of Gluesys Co., Ltd. in Korea and other countries. All other brands, trademarks, and product names are the property of their respective owners.

Benchmark Specification and Glossary

The official SPC Benchmark 1™ (SPC-1™) specification is available on the website of the Storage Performance Council (SPC) at www.spcresults.org.

The SPC-1™ specification contains a glossary of the SPC-1™ terms used in this publication.
Table of Contents

Audit Certification .............................................................................................................................................. 4
Letter Of Good Faith ........................................................................................................................................ 6
Executive Summary .......................................................................................................................................... 7
Configuration Information ................................................................................................................................. 12
  Benchmark Configuration and Tested Storage Configuration ........................................................................ 12
  Benchmark Configuration Creation Process ................................................................................................. 14
Benchmark Execution Results .......................................................................................................................... 15
  Benchmark Execution Overview .................................................................................................................... 15
  SUSTAIN Test Phase .................................................................................................................................... 16
  RAMPD_100 Test Phase ................................................................................................................................. 19
  Response Time Ramp Test ............................................................................................................................... 22
  Repeatability Test ......................................................................................................................................... 24
  Space Optimization Reporting ....................................................................................................................... 27
  Data Persistence Test .................................................................................................................................... 28
Appendix A: Supporting Files ......................................................................................................................... 29
Appendix B: Third Party Quotation ................................................................................................................ 30
  Korean Version ........................................................................................................................................... 30
  English Version .......................................................................................................................................... 31
Appendix C: Tuning Parameters and Options .................................................................................................. 32
Appendix D: Storage Configuration Creation ................................................................................................ 33
Appendix E: Configuration Inventory ............................................................................................................. 38
Appendix F: Workload Generator ................................................................................................................ 39
AUDIT CERTIFICATION

Hyo-Sil Kim
Telecommunications Technology Association
47, Bundang-ro, Bundang-gu, Seongnam-city,
Gyeonggi-do, 13591
Republic of Korea

October 25, 2018

I verified the SPC Benchmark 1™ (SPC-1™ Revision3.8) test execution and performance results of the following Tested Storage Product:

GLUESYS ANYSTOR-700EK

The results were:

<table>
<thead>
<tr>
<th>SPC-1 IOPS™</th>
<th>310,509</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$84.06/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.470 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.260 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>4,073 GB</td>
</tr>
<tr>
<td>SPC-1 Space Effectiveness Ratio</td>
<td>NA</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$6.41/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$26,100.00</td>
</tr>
</tbody>
</table>

In my opinion, these performance results were produced in compliance with the SPC requirements for the benchmark.

The testing was executed using the SPC-1 Toolkit Version 0x1dc3e88v3.0.2. The audit process was conducted in accordance with the SPC Policies and met the requirements for the benchmark.

A Letter of Good Faith was issued by the Test Sponsor, stating the accuracy and completeness of the documentation and testing data provided in support of the audit of this result.

A Full Disclosure Report for this result was prepared by InfoSizing, reviewed and approved by the Test Sponsor, and can be found at www.spcresults.org under the Submission Identifier A31023.
The independent audit process conducted by InfoSizing included the verifications of the following items:

- The physical capacity of the data repository;
- The total capacity of the Application Storage Unit (ASU);
- The accuracy of the Benchmark Configuration diagram;
- The tuning parameters used to configure the Benchmark Configuration;
- The Workload Generator commands used to execute the testing;
- The validity and integrity of the test result files;
- The compliance of the results from each performance test;
- The compliance of the results from the persistence test;
- The compliance of the submitted pricing model; and
- The differences between the tested and the priced configuration, if any.

The Full Disclosure Report for this result was prepared in accordance with the disclosure requirements set forth in the specification for the benchmark.

The following benchmark requirements, if any, were waived according to the SPC Policies:

- None.

Respectfully Yours,

François Raab, Certified SPC Auditor
LETTER OF GOOD FAITH

October 21, 2019

From: Telecommunications Technology Association
To: Mr. Francois Raab, Certified SPC Auditor
   InfoSizing
   20 Kreg Lane
   Manitou Springs, CO 80829

Subject: SPC-1 Letter of Good Faith for GLUESYS AnyStor-700EK

Telecommunications Technology Association is the SPC-1 Test Sponsor for the above listed project. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V3.8 of the SPC-1 benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark that affected the reported results even if the items are not explicitly required to be disclosed by the SPC-1 benchmark specification.

Signed:

[Signature]

Date: Oct. 21, 2019

Cheol-Soon Park
Vice President,
Telecommunications Technology Association
SPC Benchmark 1™

EXECUTIVE SUMMARY

TELECOMMUNICATIONS TECHNOLOGY ASSOCIATION
GLUESYS ANYSTOR-700EK

<table>
<thead>
<tr>
<th>SPC-1 IOPS™</th>
<th>310,509</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$84.06/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.470 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.260 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>4,073 GB</td>
</tr>
<tr>
<td>SPC-1 Space Effectiveness Ratio</td>
<td>NA</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$6.41/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$26,100.00</td>
</tr>
</tbody>
</table>

Data Protection Level: Protected 1 (RAID 1+0)
Physical Storage Capacity: 11,520.00 GB
Pricing Currency / Target Country: U.S. Dollars / Korea

SPC-1 V3.8

Submission Identifier: A31023
Submitted For Review: November 4, 2019
Benchmark Configuration Diagram

Host System

KTNF KRS580S1 Server

1 x 100Gb/s IB HBA MCX556A-ECAT (dual-port)

1 x 100Gb Infiniband

Gluesys AnyStor-700EK

AnyStor-700EK, with:
1 x Controller, with:
1 x Intel® Xeon® E5-2690 v3 (or better)
32 GB main memory
1 x 100Gb/s IB HBA MCX556A-ECAT (dual-port)
3 x MegaRAID SAS 9361-8i (8 x 12 Gb/s SAS EXP ports)
24 x 480GB Samsung 2.5” SATA 6 Gb/s SSD

Tested Storage Configuration (TSC)
Tested Storage Product Description

Gluesys AnyStor-700EK (AS700EK) is an all-flash storage system that is designed and optimized to deliver outstanding response speed and performance for a wide range of enterprise environments.

Due to its flexibility, AS700EK has the storage gateway capability depending on the backbone infrastructure of the business, as well as the storage expansion and data tiering in heterogeneous storage devices. Furthermore, as the AS700EK block storage is derived from its previous scale-out NAS products, it supports iSER protocol for InfiniBand, and also with iSCSI and file-based protocols.

For more details, visit:


Priced Storage Configuration Components

<table>
<thead>
<tr>
<th>1 x 100Gb/s IB HBA MCX556A-ECAT (dual port)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x AnyStor-700EK, with:</td>
</tr>
<tr>
<td>1 x Controller, with:</td>
</tr>
<tr>
<td>1 x Intel® Xeon® E5-2690 v3 (or better)</td>
</tr>
<tr>
<td>32 GB main memory</td>
</tr>
<tr>
<td>1 x 100Gb/s IB HBA MCX556A-ECAT (dual-port)</td>
</tr>
<tr>
<td>3 x MegaRAID SAS 9361-8i (8 x 12 Gb/s SAS EXP ports)</td>
</tr>
<tr>
<td>24 x 480GB Samsung 2.5” SATA 6 Gb/s SSD</td>
</tr>
</tbody>
</table>
## Storage Configuration Pricing

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty</th>
<th>Unit Price</th>
<th>Ext. Price</th>
<th>Disc.</th>
<th>Disc. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hardware &amp; Software</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANYSTOR700EK</td>
<td>1</td>
<td>32,989.34</td>
<td>32,989.34</td>
<td>50%</td>
<td>16,494.67</td>
</tr>
<tr>
<td>HD-SD00480G</td>
<td>24</td>
<td>110.00</td>
<td>2,640.00</td>
<td>0%</td>
<td>2,640.00</td>
</tr>
<tr>
<td>IB-C100G0002</td>
<td>1</td>
<td>183.33</td>
<td>183.33</td>
<td>0%</td>
<td>183.33</td>
</tr>
<tr>
<td>IB-H100G002</td>
<td>2</td>
<td>1,100.00</td>
<td>2,200.00</td>
<td>0%</td>
<td>2,200.00</td>
</tr>
<tr>
<td>NC-10G0002</td>
<td>1</td>
<td>458.33</td>
<td>458.33</td>
<td>0%</td>
<td>458.33</td>
</tr>
<tr>
<td><strong>Hardware &amp; Software Subtotal</strong></td>
<td></td>
<td>21,976.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GLS-N-Support-3Y</td>
<td>1</td>
<td>8,247.34</td>
<td>8,247.34</td>
<td>50%</td>
<td>4,123.67</td>
</tr>
<tr>
<td><strong>Support &amp; Maintenance Subtotal</strong></td>
<td></td>
<td>4,123.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 Total System Price</strong></td>
<td></td>
<td>26,100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPC-1 IOPS™</td>
<td></td>
<td>310,509.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 Price-Performance™ ($/SPC-1 KIOPS™)</strong></td>
<td></td>
<td>84.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPC-1 ASU Capacity (GB)</td>
<td></td>
<td>4,073</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 ASU Price ($/GB)</strong></td>
<td></td>
<td>6.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Third-Party Reseller**: TTA is the sponsor of this result but does not directly sell the products and components of the Priced Storage Configuration (PSC). The above reflects the pricing quoted by the vendor and third-party reseller Gluesys Co., Ltd. See Appendix B of the Full Disclosure Report for a copy of the third-party reseller’s quotation.

**Discount Details**: The discounts shown are based on the storage capacity purchased and are generally available.

**Warranty**: The 3-year maintenance and support included in the above pricing meets or exceeds a 24x7 coverage with a 4-hour response time.

**Availability Date**: Currently available.
Response Time and Throughput Graph

Contact Information

| Test Sponsor Primary Contact | TTA – http://tta.or.kr/eng/index.jsp  
|                             | Hyo-Sil Kim – hyosil.kim@tta.or.kr |
| SPC Auditor                | InfoSizing – www.sizing.com  
|                            | Francois Raab – francois@sizing.com |

Revision Information

<table>
<thead>
<tr>
<th>SPC Benchmark 1™ Revision</th>
<th>V3.8.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Workload Generator Revision</td>
<td>0x18ade88v3.0.2</td>
</tr>
<tr>
<td>Publication Revision History</td>
<td>First Edition</td>
</tr>
</tbody>
</table>
## Configuration Information

### Benchmark Configuration and Tested Storage Configuration

The following diagram illustrates the Benchmark Configuration (BC), including the Tested Storage Configuration (TSC) and the Host System(s).

**Storage Network Configuration**

The Tested Storage Configuration (TSC) involved a single storage subsystem (Gluesys AnyStor-700K), driven by a single KTNF KRS580S1 host system. The host had a single InfiniBand (IB) connection to the storage subsystem (one connection from the dual-port HBA was unused). The connection operated at 100Gbps.
Host System and Tested Storage Configuration Components

The following table lists the components of the Host System(s) and the Tested Storage Configuration (TSC).

<table>
<thead>
<tr>
<th>Host Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – KTNF KRS580S1, which includes:</td>
</tr>
<tr>
<td>2 x Intel® Xeon® Gold 6140 (2.30GHz, 25MB L3)</td>
</tr>
<tr>
<td>768 GB main memory</td>
</tr>
<tr>
<td>2 x 600 GB HDD (RAID 1)</td>
</tr>
<tr>
<td>CentOS 7.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Priced Storage Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 100Gb/s IB HBA MCX556A-ECAT (dual port)</td>
</tr>
<tr>
<td>1 x AnyStor-700EK, with:</td>
</tr>
<tr>
<td>1 x Controller, with:</td>
</tr>
<tr>
<td>1 x Intel® Xeon® E5-2690 v3 (or better)</td>
</tr>
<tr>
<td>32 GB main memory</td>
</tr>
<tr>
<td>1 x 100Gb/s IB HBA MCX556A-ECAT (dual-port)</td>
</tr>
<tr>
<td>3 x MegaRAID SAS 9361-8i (8 x 12 Gb/s SAS EXP ports)</td>
</tr>
<tr>
<td>24 x 480GB Samsung 2.5” SATA 6 Gb/s SSD</td>
</tr>
</tbody>
</table>

Differences Between Tested and Priced Storage Configurations

There were no differences between the Tested Storage Configuration and the Priced Storage Configuration.

Component Changes in Revised Full Disclosure Report

The following table outlines component changes that were made in revisions to this Full Disclosure Report.

<table>
<thead>
<tr>
<th>Original Component</th>
<th>Revised Component</th>
<th>Description of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>n/a</td>
<td>Initial submission</td>
</tr>
</tbody>
</table>
Benchmark Configuration Creation Process

Customer Tuning Parameters and Options

All the customer tuning parameters and options that have been altered from their default values for this benchmark are included in Appendix C and in the Supporting Files (see Appendix A).

Tested Storage Configuration Creation

A detailed description of how the logical representation of the TSC was created is included in Appendix D and in the Supporting Files (see Appendix A).

Tested Storage Configuration Inventory

An inventory of the components in the TSC, as seen by the Benchmark Configuration, is included in Appendix E and in the Supporting Files (see Appendix A).

Workload Generator Storage Configuration

The SPC-1 Workload Generator storage configuration commands and parameters used to invoke the execution of the tests are included in Appendix F and in the Supporting Files (see Appendix A).

Logical Volume Capacity and ASU Mapping

The following table details the capacity of each ASU and how they are mapped to logical volumes (LV).

<table>
<thead>
<tr>
<th>LV per ASU</th>
<th>LV Capacity</th>
<th>Used per LV</th>
<th>Total per ASU</th>
<th>% ASU Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASU-1</td>
<td>9</td>
<td>203.70</td>
<td>203.70</td>
<td>1,833.30</td>
</tr>
<tr>
<td>ASU-2</td>
<td>9</td>
<td>203.70</td>
<td>203.70</td>
<td>1,833.30</td>
</tr>
<tr>
<td>ASU-3</td>
<td>1</td>
<td>407.00</td>
<td>407.00</td>
<td>407.00</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td></td>
<td></td>
<td></td>
<td>4,073.60</td>
</tr>
</tbody>
</table>

Physical Storage Capacity and Utilization

The following table details the Physical Capacity of the storage devices and the Physical Capacity Utilization (percentage of Total Physical Capacity used) in support of hosting the ASUs.

<table>
<thead>
<tr>
<th>Devices</th>
<th>Count</th>
<th>Physical Capacity</th>
<th>Total Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>480GB SSD (system)</td>
<td>24</td>
<td>480.00</td>
<td>11,520.00</td>
</tr>
<tr>
<td>Total Physical Storage Capacity</td>
<td></td>
<td></td>
<td>11,520.00</td>
</tr>
<tr>
<td>Physical Capacity Utilization</td>
<td></td>
<td></td>
<td>35.36%</td>
</tr>
</tbody>
</table>

Data Protection

The data protection level used for all logical volumes was Protected 1, which was accomplished by creating a RAID 0 volume over the RAID 1 volumes.
**BENCHMARK EXECUTION RESULTS**
This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs.

**Benchmark Execution Overview**

**Workload Generator Input Parameters**

The SPC-1 Workload Generator commands and input parameters for the Test Phases are presented in the Supporting Files (see Appendix A).

**Primary Metrics Test Phases**

The benchmark execution consists of the Primary Metrics Test Phases, including the Test Phases SUSTAIN, RAMPD_100 to RAMPD_10, RAMPU_50 to RAMPU_100, RAMP_0, REPEAT_1 and REPEAT_2.

Each Test Phase starts with a transition period followed by a Measurement Interval.

**Measurement Intervals by Test Phase Graph**

The following graph presents the average IOPS and the average Response Times measured over the Measurement Interval (MI) of each Test Phase.

![Measurement Intervals by Test Phase Graph](image)

**Exception and Waiver**

None.
SUSTAIN Test Phase

SUSTAIN – Results File

The results file generated during the execution of the SUSTAIN Test Phase is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

SUSTAIN – Execution Times

<table>
<thead>
<tr>
<th>Interval</th>
<th>Start Time</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
</table>

SUSTAIN – Throughput Graph

![Throughput Graph (SUSTAIN @ 310,500 IOPS)](image-url)
SUSTAIN – Response Time Graph

SUSTAIN – Data Rate Graph
**SUSTAIN – Response Time Frequency Graph**

The following table lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O STREAM, its coefficient of variation (Variation) and the percentage of difference (Difference) between Target and Measured.

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0012</td>
<td>0.0004</td>
<td>0.0009</td>
<td>0.0004</td>
<td>0.0017</td>
<td>0.0009</td>
<td>0.0012</td>
<td>0.0004</td>
</tr>
<tr>
<td>Difference</td>
<td>0.005%</td>
<td>0.000%</td>
<td>0.002%</td>
<td>0.000%</td>
<td>0.008%</td>
<td>0.003%</td>
<td>0.004%</td>
<td>0.001%</td>
</tr>
</tbody>
</table>
RAMPD_100 Test Phase

**RAMPD_100 – Results File**

The results file generated during the execution of the RAMPD_100 Test Phase is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

**RAMPD_100 – Execution Times**

<table>
<thead>
<tr>
<th>Interval</th>
<th>Start Time</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>24-Oct-19 05:25:42</td>
<td>24-Oct-19 05:28:42</td>
<td>0:03:00</td>
</tr>
</tbody>
</table>

**RAMPD_100 – Throughput Graph**

![Throughput Graph (RAMPD_100 @ 310,500 IOPS)](image-url)
RAMPD_100 – Response Time Graph

RAMPD_100 – Data Rate Graph
### RAMPD_100 – Intensity Multiplier

The following table lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O STREAM, its coefficient of variation (Variation) and the percentage of difference (Difference) between Target and Measured.

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0009</td>
<td>0.0004</td>
<td>0.0006</td>
<td>0.0004</td>
<td>0.0011</td>
<td>0.0009</td>
<td>0.0014</td>
<td>0.0005</td>
</tr>
<tr>
<td>Difference</td>
<td>0.043%</td>
<td>0.012%</td>
<td>0.018%</td>
<td>0.012%</td>
<td>0.050%</td>
<td>0.014%</td>
<td>0.037%</td>
<td>0.000%</td>
</tr>
</tbody>
</table>

### RAMPD_100 – I/O Request Summary

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O Requests Completed in the Measurement Interval</td>
<td>186,301,956</td>
</tr>
<tr>
<td>I/O Requests Completed with Response Time &lt;= 30 ms</td>
<td>186,301,956</td>
</tr>
<tr>
<td>I/O Requests Completed with Response Time &gt; 30 ms</td>
<td>0</td>
</tr>
</tbody>
</table>
Response Time Ramp Test

Response Time Ramp Test – Results File

The results file generated during the execution of the Response Time Ramp Test is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

Response Time Ramp Test – Phases

The Response Time Ramp Test is comprised of 11 Test Phases, including six Ramp-Down Phases (executed at 100%, 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit) and five Ramp-Up Phases (executed at 50%, 80%, 90%, 95%, and 100% of the Business Scaling Unit).

Response Time Ramp Test – Average Throughput Graph
Response Time Ramp Test – Average Response Time Graph

![Average Response Time Graph (Response Time Ramp Test)]

Response Time Ramp Test – RAMPD_10 Response Time Graph

![Response Time Graph (RAMPD_10 @ 31,050 IOPS)]
Repeatability Test

**Repeatability Test Results File**

The results file generated during the execution of the Repeatability Test is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

**Repeatability Test Results**

The throughput measurements for the Response Time Ramp Test (RAMPD) and the Repeatability Test Phases (REPEAT_1 and REPEAT_2) are listed in the tables below.

<table>
<thead>
<tr>
<th>Test Phase</th>
<th>100% IOPS</th>
<th>10% IOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAMPD</td>
<td>310,509.7</td>
<td>31,058.9</td>
</tr>
<tr>
<td>REPEAT_1</td>
<td>310,523.7</td>
<td>31,038.6</td>
</tr>
<tr>
<td>REPEAT_2</td>
<td>310,515.4</td>
<td>31,057.4</td>
</tr>
</tbody>
</table>

**REPEAT_1_100 – Throughput Graph**

![Throughput Graph (REPEAT_1_100 @ 310,500 IOPS)](image-url)
REPEAT_1_100 – Response Time Graph

![Response Time Graph](image)

REPEAT_2_100 – Throughput Graph

![Throughput Graph](image)
Repeatability Test – Intensity Multiplier

The following tables lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O STREAM, its coefficient of variation (Variation) and the percent of difference (Difference) between Target and Measured.

**REPEAT_1_100 Test Phase**

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2101</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0019</td>
<td>0.0002</td>
<td>0.0007</td>
<td>0.0004</td>
<td>0.0015</td>
<td>0.0008</td>
<td>0.0015</td>
<td>0.0003</td>
</tr>
<tr>
<td>Difference</td>
<td>0.101%</td>
<td>0.007%</td>
<td>0.038%</td>
<td>0.025%</td>
<td>0.079%</td>
<td>0.007%</td>
<td>0.056%</td>
<td>0.011%</td>
</tr>
</tbody>
</table>

**REPEAT_2_100 Test Phase**

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0015</td>
<td>0.0004</td>
<td>0.0009</td>
<td>0.0005</td>
<td>0.0013</td>
<td>0.0011</td>
<td>0.0014</td>
<td>0.0004</td>
</tr>
<tr>
<td>Difference</td>
<td>0.041%</td>
<td>0.004%</td>
<td>0.028%</td>
<td>0.005%</td>
<td>0.156%</td>
<td>0.007%</td>
<td>0.047%</td>
<td>0.006%</td>
</tr>
</tbody>
</table>
Space Optimization Reporting

Description of Techniques Used

No space optimization was used for this SPC-1 result.

Physical Free Space Measurements

The following table lists the Physical Free Space as measured at each of the required points during test execution. If space optimization techniques were not used, “NA” is reported.

<table>
<thead>
<tr>
<th>Physical Free Space Measurement</th>
<th>Free Space (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Logical Volume Creation</td>
<td>NA</td>
</tr>
<tr>
<td>After ASU Pre-Fill</td>
<td>NA</td>
</tr>
<tr>
<td>After Repeatability Test Phase</td>
<td>NA</td>
</tr>
</tbody>
</table>

Space Optimization Metrics

The following table lists the required space optimization metrics. If space optimization techniques were not used, “NA” is reported.

<table>
<thead>
<tr>
<th>Space Optimization Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Space Optimization Ratio</td>
<td>NA</td>
</tr>
<tr>
<td>SPC-1 Space Effectiveness Ratio</td>
<td>NA</td>
</tr>
</tbody>
</table>
Data Persistence Test

Data Persistence Test Results file

The results files generated during the execution of the Data Persistence Test is included in the Supporting Files (see Appendix A) as follows:

- SPC1_PERSIST_1_0_Raw_Results.xlsx
- SPC1_PERSIST_2_0_Raw_Results.xlsx

Data Persistence Test Execution

The Data Persistence Test was executed using the following sequence of steps:

- The PERSIST_1_0 Test Phase was executed to completion.
- The Benchmark Configuration was taken through an orderly shutdown process and powered off.
- The Benchmark Configuration was powered on and taken through an orderly startup process.
- The PERSIST_2_0 Test Phase was executed to completion.

Data Persistence Test Results

<table>
<thead>
<tr>
<th>Data Persistence Test Phase: Persist1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Logical Blocks Written</td>
<td>38,594,479</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Verified</td>
<td>20,773,904</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Overwritten</td>
<td>17,820,575</td>
</tr>
<tr>
<td>Total Number of Logical Blocks that Failed Verification</td>
<td>0</td>
</tr>
<tr>
<td>Time Duration for Writing Test Logical Blocks (sec.)</td>
<td>301</td>
</tr>
<tr>
<td>Size in bytes of each Logical Block</td>
<td>8,192</td>
</tr>
<tr>
<td>Number of Failed I/O Requests in the process of the Test</td>
<td>0</td>
</tr>
</tbody>
</table>

Committed Data Persistence Implementation

The persistency of committed data is implemented at the disk level, where data loss is prevented through the use of RAID 1 arrays. At the controller level, the cache is set-up in write-through mode and needs not to be protected to ensure persistence of committed data.
## APPENDIX A: SUPPORTING FILES

The following table details the content of the Supporting Files provided as part of this Full Disclosure Report.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>/SPC1_RESULTS</td>
<td>Data reduction worksheets</td>
<td>root</td>
</tr>
<tr>
<td>SPC1_INIT_0_Raw_Results.xlsx</td>
<td>Raw results for INIT Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_METRICS_0_Quick_Look.xlsx</td>
<td>Quick Look Test Run Overview</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_METRICS_0_Raw_Results.xlsx</td>
<td>Raw results for Primary Metrics Test</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_METRICS_0_Summary_Results.xlsx</td>
<td>Primary Metrics Summary</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_PERSIST_1_0_Raw_Results.xlsx</td>
<td>Raw results for PERSIST1 Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_PERSIST_2_0_Raw_Results.xlsx</td>
<td>Raw results for PERSIST2 Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_Run_Set_Overview.xlsx</td>
<td>Run Set Overview Worksheet</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_VERIFY_0_Raw_Results.xlsx</td>
<td>Raw results for first VERIFY Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_VERIFY_1_Raw_Results.xlsx</td>
<td>Raw results for second VERIFY Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>/C_Tuning</td>
<td>Tuning parameters and options</td>
<td>root</td>
</tr>
<tr>
<td>set_host_kernel_parameters.sh</td>
<td>Set host tuning parameters</td>
<td>/C_Tuning</td>
</tr>
<tr>
<td>/D_Creation</td>
<td>Storage configuration creation</td>
<td>root</td>
</tr>
<tr>
<td>login.sh</td>
<td>Connect to the ISER target</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>lvcreate.sh</td>
<td>Create logical volumes</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>mkln.sh</td>
<td>Create SSD alignment and target LUNs</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>raid1_set.sh</td>
<td>Create RAID volumes</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>set_storage_kernel_parameters.sh</td>
<td>Set storage controller kernel parameters</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>/E_Inventory</td>
<td>Configuration inventory</td>
<td>root</td>
</tr>
<tr>
<td>get_tsc_config.sh</td>
<td>Collect configuration inventory</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>inventory_start.out</td>
<td>Storage inventory before INIT</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>inventory_end.out</td>
<td>Storage inventory after restart</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>/F_Generator</td>
<td>Workload generator</td>
<td>root</td>
</tr>
<tr>
<td>SPC1.asu</td>
<td>Defining LUNs hosting the ASUs</td>
<td>/F_generator</td>
</tr>
<tr>
<td>1host.HST</td>
<td>Host configuration file</td>
<td>/F_generator</td>
</tr>
<tr>
<td>spc1_run.sh</td>
<td>Executing test phases up to Persist-1</td>
<td>/F_generator</td>
</tr>
<tr>
<td>spc1_run_persist2.sh</td>
<td>Executing Persist-2 test phase</td>
<td>/F_generator</td>
</tr>
</tbody>
</table>
APPENDIX B: THIRD PARTY QUOTATION

Korean Version

감사의 우수한 발전을 기원하며, 아래와 같이 견적합니다.

<table>
<thead>
<tr>
<th>번호</th>
<th>모델</th>
<th>상세내역</th>
<th>수량</th>
<th>소비자단가</th>
<th>공급단가</th>
<th>공급금액</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A570DEK</td>
<td>2x Intel® Xeon® Gold 6126 Processor 12 Cores, 24 Threads, 2.10GHz 11.25MB L3</td>
<td>1</td>
<td>32,989.34</td>
<td>16,494.67</td>
<td>16,494.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12GB Memory(Max. 2TB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NAS 0/5 Mirroring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10/100/1000 Gigabit Ethernet 2Port (LTP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hot-Swapable 24 SAS or SATA Disk Bay</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Redundant Power Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AnyStar Enterprise 전용 OS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Raid 지원: 0, 1, 10, 5, 6 Support</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>
</tr>
<tr>
<td></td>
<td></td>
<td>- NFS, CIFS, FTP, iSCSI/GER</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>
</tr>
<tr>
<td></td>
<td></td>
<td>- 웹 기반의 NAS 관리도구</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cluster Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Volume Management &amp; Monitoring</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>
</tr>
<tr>
<td></td>
<td></td>
<td>- Parallel &amp; distributed recovery</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>
</tr>
<tr>
<td></td>
<td></td>
<td>- Online Scale-Out Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- POSIX F5 API Support</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>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data Distributed (D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Data Replication &amp; Network RAID</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>8,247.24</td>
<td>4,223.67</td>
<td>4,223.67</td>
</tr>
<tr>
<td>3</td>
<td>DATA Disk</td>
<td>SAMSUNG PM883 480G TLC</td>
<td>24</td>
<td>110.00</td>
<td>2,040.00</td>
<td>2,040.00</td>
</tr>
<tr>
<td>4</td>
<td>I/B Cable</td>
<td>MCR1600-EO02 IB EDR Cable</td>
<td>1</td>
<td>183.25</td>
<td>183.33</td>
<td>183.33</td>
</tr>
<tr>
<td>5</td>
<td>I/B Card</td>
<td>ConnectX®-5 VPI adapter card, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, PCIe3.0 x16, tall bracket, ROHS 6</td>
<td>2</td>
<td>2,200.00</td>
<td>2,200.00</td>
<td>2,200.00</td>
</tr>
<tr>
<td>6</td>
<td>NEC</td>
<td>2 Port 10G Network Interface</td>
<td>1</td>
<td>458.23</td>
<td>458.33</td>
<td>458.33</td>
</tr>
</tbody>
</table>

비고
1. 무상유지보수 기간은 납품 설치 후 H/W 3년(36개월) 입니다.
2. 견적조건 별도 협의.
3. 위 견적은 견적을 만하여 적용 됩니다.

견적번호 GLS-1910230100-5376

대표이사 박성순
## Gluesys AnyStor-700EK

**Model No.:** AS700EK  
**Description:** 2x Intel® Xeon® Gold 6136 Processor 12Cores, 24Threads, 2,030GHz 24.75MB L3  
**NAS O/S Mirroring(240GB SSD Hot Swappable Disk)**  
**10/100/1000 Gigabit Ethernet 2Port (UTP)**  
**Hot-Swappable 24 SAS or SATA Disk Bay**  
**Redundant Power Supply**  
**AnyStor Enterprise O/S**  
**- Raid : 0, 1, 10, 5, 6 Support**  
**- Parallel & distributed recovery**  
**- Data Replication Management**  
**- Online Scale-Out Support**  
**- POSIX FS API Support**  
**- Monitoring Tool on WEB (WMS)**  
**- Data Distributed I/O**  
**- Data Replication & NetworkRAID Support & Maintenance**  
**Premium Package 3-Year Support & Maintenance**  

### Gluesys AnyStor® V3.8 FULL DISCLOSURE REPORT

<table>
<thead>
<tr>
<th>No.</th>
<th>Part No.</th>
<th>Name</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
<th>Discount</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AS700EK</td>
<td>Gluesys AnyStor-700EK</td>
<td>1</td>
<td>32,989.34</td>
<td>31,100.00</td>
<td>50%</td>
<td>16,494.67</td>
</tr>
<tr>
<td>2</td>
<td>I/O Cable</td>
<td>MCP1600-E002 IB EDR Cable</td>
<td>1</td>
<td>183.33</td>
<td>183.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I/O Card</td>
<td>ConnectX®-5 VPI adapter card, EDR IB (100Gb/s) and QDR (40Gb/s) dual-port QSFP28, PCIe4.0 x16, tall bracket, SFF-8644 RI</td>
<td>1</td>
<td>1,090.00</td>
<td>1,090.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>SSD</td>
<td>Samsung PM883 480G TLC</td>
<td>24</td>
<td>110.00</td>
<td>2,640.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SFP+</td>
<td>MCX556A-ECAT ConnectX®-5 VPI adapter card, EDR IB (100Gb/s) and QDR (40Gb/s) dual-port QSFP28, PCIe4.0 x16, tall bracket, SFF-8644 RI</td>
<td>2</td>
<td>545.33</td>
<td>1,090.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NIC</td>
<td>2 Port 10G Network Interface</td>
<td>1</td>
<td>458.33</td>
<td>458.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Remarks
1. Discount based on the storage capacity purchased.  
2. Shipment and handling is not included in quotation.  
3. Pricing is in U.S. dollars for product availability, sales, and support in Republic of Korea.
APPENDIX C: TUNING PARAMETERS AND OPTIONS

The following scripts, listed below, were used to set tuning parameters and options:

- The script `set_host_kernel_parameters.sh` was used to configure the operating system parameters on the host.

The script described above is included in the Supporting Files (see Appendix A) and listed below.

```
#!/bin/sh

# OS configuration setup (SPC-1 Users' Guide)
cat /proc/sys/fs/epoll/max_user_watches >> /proc/sys/fs/aio-max-nr
ulimit -n 1000

# Disable hyper-threading in the BIOS (Core & Thread Count must be the same)
dmidecode | grep Count

# Melanox OFED Install (--add-kernel-support --enable-mlnx_tune --enable-affinity)
mlnx_tune -p HIGH_THROUGHPUT

# systemctl stop irqbalance
# systemctl disable irqbalance

# CPU Governor setup (Melanox recommandation)
for i in `seq 0 35`
do
echo performance > /sys/devices/system/cpu/cpu$i/cpufreq/scaling_governor
done

# Queue setup (Melanox Block layer staging)
devs=$(egrep "iser" /sys/block/sd?/device/model | awk -F '/' '{print $4}')

for dev in $devs;
do
  #devices configuration setup
  echo 1024 > /sys/block/$dev/queue.nr_requests
  echo 'noop' > /sys/block/$dev/queue/scheduler
  echo 2 > /sys/block/$dev/queue.nomerges
  echo 0 > /sys/block/$dev/queue/add_random
  echo 1 > /sys/block/$dev/queue/rq_affinity

  cat /sys/block/$dev/queue.nr_requests
  cat /sys/block/$dev/queue/scheduler
  cat /sys/block/$dev/queue.nomerges
  cat /sys/block/$dev/queue/add_random
  cat /sys/block/$dev/queue/rq_affinity

done
```
APPENDIX D: STORAGE CONFIGURATION CREATION

Step 1 - Create RAID volumes

The `raid1_set.sh` script listed below was used to create the RAID 1+0 volumes.

The script described above is included in the Supporting Files (see Appendix A) and listed below.

```bash
#!/bin/bash

# jbond unconfig
storcli /c0 set jbond=off
storcli /c1 set jbond=off
storcli /c2 set jbond=off

# create raid1 vd
storcli /c0 add vd type=raid1 drives=252:0-1
storcli /c0 add vd type=raid1 drives=252:2-3
storcli /c0 add vd type=raid1 drives=252:4-5
storcli /c0 add vd type=raid1 drives=252:6-7
storcli /c1 add vd type=raid1 drives=252:0-1
storcli /c1 add vd type=raid1 drives=252:2-3
storcli /c1 add vd type=raid1 drives=252:4-5
storcli /c1 add vd type=raid1 drives=252:6-7
storcli /c2 add vd type=raid1 drives=252:0-1
storcli /c2 add vd type=raid1 drives=252:2-3
storcli /c2 add vd type=raid1 drives=252:4-5
storcli /c2 add vd type=raid1 drives=252:6-7
```

Step 2 - Set-Up iSER on the Storage Subsystem

The `mklun.sh` script listed below includes all the CLI commands to perform the following actions.

- Set SSD Alignment
- Create Target LUN (using targetcli)
- Set the storage controller's kernel parameters, by invoking the script `set_storage_kernel_parameters.sh` listed below.

The script described above is included in the Supporting Files (see Appendix A) and listed below.

```bash
#!/bin/sh

ib0="10.10.2.82"
devel=$(egrep "MR9361-8i" /sys/block/sd?/device/model | awk -F '/' '{print $4}')
dev_num=$(egrep "MR9361-8i" /sys/block/sd?/device/model | wc -l)
tgt_num=12
```
blk_num=`expr $dev_num / $tgt_num`
dev_cnt=1
blk_cnt=1

## Set SSD alignment
for dev in $devs
do
  parted -a optimal -s /dev/$dev mklabel gpt mkpart primary 512s 100%;
  parted -s /dev/$dev unit s print
done
sleep 3

## Create Target LUN (Using targetcli)
# clear target configure
targetcli clearconfig confirm=true
sleep 3

# create backstores
uuids=$(ls /dev/disk/by-path/pci-0000:0000:00.0-scsi-0:2:?:0-part1)
for uuid in $uuids;
do
  echo " /backstores/block create iser_disk$dev_cnt $uuid" | targetcli
dev_cnt=`expr $dev_cnt + 1`
done
sleep 3
tgts=$(ls /sys/kernel/config/target/iscsi/ | grep gluesys)
for tgt in $tgts;
do
  echo "/iscsi delete $tgt" | targetcli
done
for ((i=1; i<=tgt_num; i++));
do
  # create iqn
  echo "/iscsi create iqn.2019-08.gluesys.com:iser$i" | targetcli
  # add blocks to iqn
  for ((k=1; k<=blk_num; k++));
do
    echo "/iscsi/iqn.2019-08.gluesys.com:iser$i/tpg1/luns create /backstores/block/iser_disk$blk_cnt" | targetcli
    blk_cnt=`expr $blk_cnt + 1`
done
  # delete the IP address 0.0.0.0 assigned automatically
  ls /sys/kernel/config/target/iscsi/iqn.2019-08.gluesys.com:iser$i/tpg1/lun 0.0.0.0:3260 > /dev/null 2>&1
  if [ 0 -eq $? ]; then
echo "/iscsi/iqn.2019-08.gluesys.com:iser$i/tpg1/portals delete 0.0.0.0 3260" | targetcli
fi

# Assign IP addresses to iqn and ISER
echo "/iscsi/iqn.2019-08.gluesys.com:iser$i/tpg1/portals create $ib0" | targetcli
echo "/iscsi/iqn.2019-08.gluesys.com:iser$i/tpg1/portals/$ib0:3260 enable_iser boolean=true" | targetcli

# change the configure of each iqn
echo ""/iscsi/ign.2019-08.gluesys.com:iser$i/tpg1 set attribute authentication=0 demo_mode_write_protect=0 generate_node_acls=1 cache_dynamic_acls=1" | targetcli done
sleep 3

# restart target systemd
systemctl restart target
sleep 3

## Set the storage kernel parameters
$PWD/set_storage_kernel_parameters.sh

**set_storage_kernel_parameters.sh**

```bash
#!/bin/sh

# OS configuration setup (SPC-1 Users' Guide)
cat /proc/sys/fs/epoll/max_user_watches >> /proc/sys/fs/aio-max-nr
ulimit -n 1000

# Disable hyper-threading in the BIOS (Core & Thread Count must be the same)
dmidecode | grep Count

# systemctl stop irqbalance
# systemctl disable irqbalance

mlnx_tune -p HIGH_THROUGHPUT

# CPU Governor setup (Melanox recommandation)
for i in `seq 0 23`
do
    echo performance > /sys/devices/system/cpu/cpu$i/cpufreq/scaling_governor
done

# Queue setup (Melanox Block layer staging)
devs=$(egrep "MR9361-8i" /sys/block/sd?/device/model | awk -F '/' '{print $4}')
for dev in $devs;
do
    echo ""/dev/$dev tuning parameters"
    # devices configuration setup
    echo 1024 > /sys/block/$dev/queue.nr_requests
    echo 'noop' > /sys/block/$dev/queue.scheduler
    echo 2 > /sys/block/$dev/queue.nomerges
    echo 0 > /sys/block/$dev/queue.add_random
    echo 1 > /sys/block/$dev/queue.rq_affinity

    cat /sys/block/$dev/queue.nr_requests
    cat /sys/block/$dev/queue.scheduler
    cat /sys/block/$dev/queue.nomerges
    cat /sys/block/$dev/queue.add_random
    cat /sys/block/$dev/queue.rq_affinity
done
```
Step 3 – Connect and Set Parameters

The `login.sh` command file, listed below, includes the CLI commands to perform the following actions:

- Connect to the ISER Target (Using iscsiadm)
- Set the host's kernel parameters, by invoking the script `set_host_kernel_parameters.sh` detailed in Appendix C.

The command file described above is included in the Supporting Files (see Appendix A) and listed below.

```
#!/bin/sh

## Connect to the ISER Target
tgt_ib0="10.10.2.82"
tgt_num=$(iscsiadm -m discovery -t st -p $tgt_ib0 | awk '{print $2}' | wc -l)
i=1
tgts=$(iscsiadm -m discovery -t st -p $tgt_ib0 | awk '{print $2}')
if [ 0 -eq $(echo $?)]; then
  for tgt in $tgts;
    do
      iscsiadm -m node -T"$tgt" -o update -n iface.transport_name -v iser
      iscsiadm -m node -T"$tgt" -p $tgt_ib0 -l
      echo "$tgt is connected $tgt_ib0"
    done
fi

sleep 3

## Set the host kernel parameters
$PWD/set_host_kernel_parameters.sh
```
Step 4 - Create Volumes on the Host Systems

The `lvcreate.sh` shell script listed below, is invoked to perform the following actions:

- Create physical volumes for each RAID volume
- Create 1 volume group
- Create 9 logical volume for ASU1
- Create 9 logical volume for ASU2
- Create 1 logical volume for ASU3

The shell script described above is included in the Supporting Files (see Appendix A) and listed below.

```bash
#!/bin/sh
dev='/dev/sd[b-m]'

pvcreate $dev
sleep 1
pvs --units G

vgcreate vg1 $dev
sleep 1
vgs --units G

num=$(ls $dev | wc -l)
#asu-1
lvcreate -i$num -15%VG -I512 vg1 -n asu1_1 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_2 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_3 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_4 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_5 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_6 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_7 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_8 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu1_9 $dev

#asu-2
lvcreate -i$num -15%VG -I512 vg1 -n asu2_1 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_2 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_3 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_4 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_5 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_6 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_7 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_8 $dev
lvcreate -i$num -15%VG -I512 vg1 -n asu2_9 $dev

#asu-3
lvcreate -i$num -110%VG -I512 vg1 -n asu3_1 $dev

sleep 1
lvs --units G -v --segment
```
APPENDIX E: CONFIGURATION INVENTORY

An inventory of the Tested Storage Configuration (TSC) was collected during the execution the `spci_run.sh` and `spci_runPersist2.sh` scripts. The following log files were generated:

- `inventory_start.out` lists the configured volumes before the INIT Phase.
- `inventory_end.out` lists the configured volumes after the PERSIST_2 Phase.

The above log files are included in the Supporting Files (see Appendix A).
**APPENDIX F: WORKLOAD GENERATOR**

The ASUs accessed by the SPC-1 workload generator, are defined using the script *SPC1.asu*.

The phases of the benchmark are executed using the script *spc1_run.sh*. The script ends after the PERSIST_1 test phase. Once the TSC has been restarted, the PERSIST_2 test phase is executed using the script *spc1_run_persist2.sh*.

The above scripts are included in the Supporting Files (see Appendix A) and listed below.

**SPC1.asu**

```plaintext
-- SPC-1 ASU definition file
-- $:id:
-- Offset = 0
--
ASU=1
device=/dev/vg1/asu1_1
device=/dev/vg1/asu1_2
device=/dev/vg1/asu1_3
device=/dev/vg1/asu1_4
device=/dev/vg1/asu1_5
device=/dev/vg1/asu1_6
device=/dev/vg1/asu1_7
device=/dev/vg1/asu1_8
device=/dev/vg1/asu1_9
--
ASU=2
device=/dev/vg1/asu2_1
device=/dev/vg1/asu2_2
device=/dev/vg1/asu2_3
device=/dev/vg1/asu2_4
device=/dev/vg1/asu2_5
device=/dev/vg1/asu2_6
device=/dev/vg1/asu2_7
device=/dev/vg1/asu2_8
device=/dev/vg1/asu2_9
--
ASU=3
device=/dev/vg1/asu3_1
```

**spc1_run.sh**

```bash
#!/bin/sh

log_dir=/root/Logs/AnyStor-700EK-24
host="/root/spc/1host.HST"

mkdir -p $log_dir
$PWD/get_tsc_config.sh $log_dir "inventory_start.out"
$PWD/mon.sh start $log_dir

sleep 5
## running spc1
```
/root/spc/spc1 -run SPC1_INIT -iops 500 -master $host -output $log_dir
/root/spc/spc1 -run SPC1_VERIFY -iops 100 -master $host -output $log_dir
/root/spc/spc1 -run SPC1_METRICS -iops 310500 -master $host -output $log_dir
/root/spc/spc1 -run SPC1_VERIFY -iops 100 -master $host -output $log_dir

echo "Persist_1"
/root/spc/spc1 -run SPC1_PERSIST_1 -iops 78000 -master $host -output $log_dir

# logout from ISER target
$PWD/mon.sh end $log_dir
sh logout.sh

echo "Ready for Persist_2. Please Reboot!"

spc1_run_persist2.sh

#!/bin/sh

log_dir=/root/Logs/AnyStor-700EK-24
host="/root/spc/1host.HST"

# login for the ISER target and activate vg1
sh login.sh
#vgchange -ay vg1
lvdisplay vg1
read

echo "Persist_2"
/root/spc/spc1 -run SPC1_PERSIST_2 -iops 78000 -master $host -output $log_dir

$PWD/get_tsc_config.sh $log_dir "inventory_end.out"