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.

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.

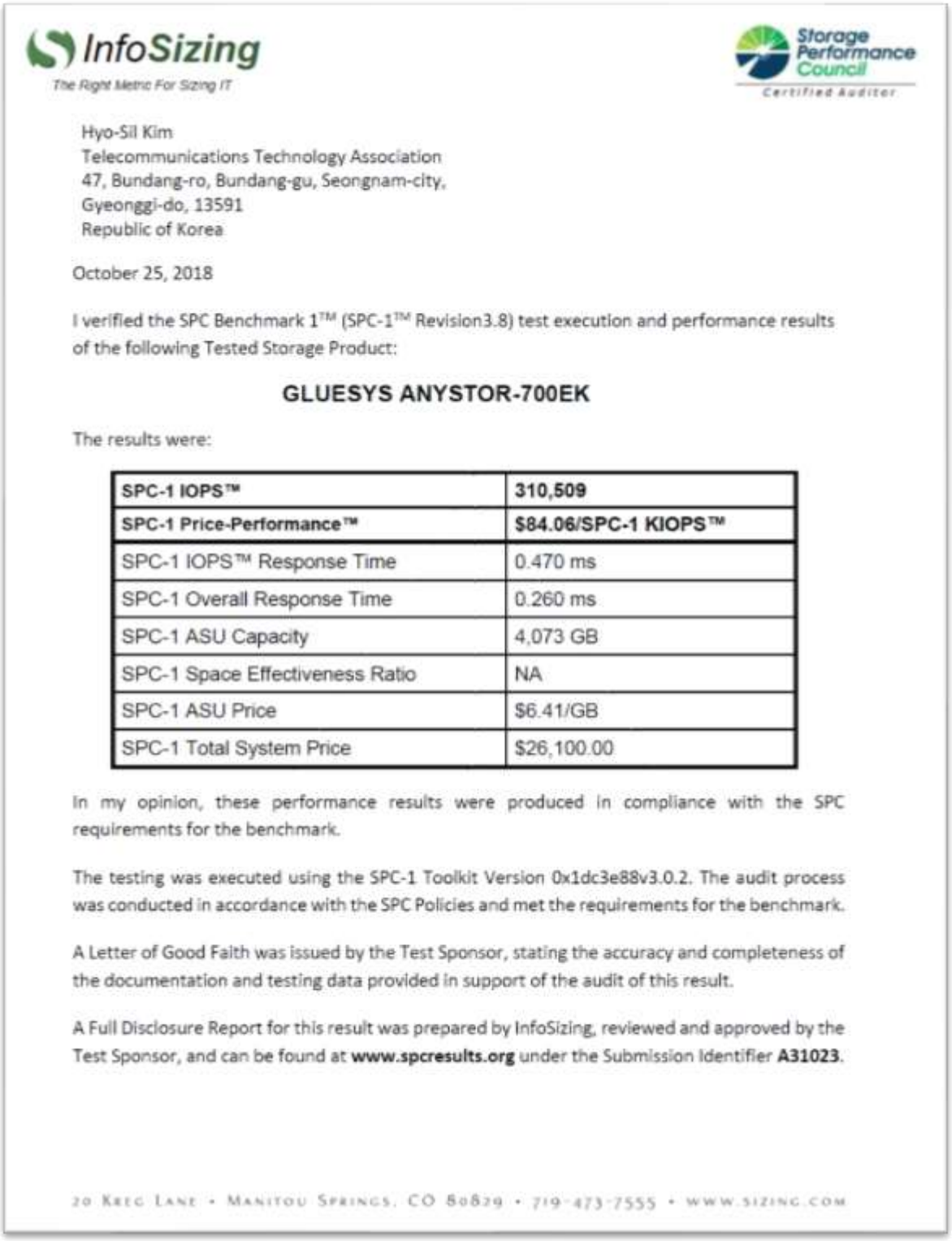
Benchmark Specification and Glossary

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



InfoSizing
The Right Metric For Sizing IT

Storage Performance Council
Certified Auditor

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:

SPC-1 IOPS™	**310,509**
SPC-1 Price-Performance™	**$84.06/SPC-1 KIOPS™**
SPC-1 IOPS™ Response Time	0.470 ms
SPC-1 Overall Response Time	0.260 ms
SPC-1 ASU Capacity	4,073 GB
SPC-1 Space Effectiveness Ratio	NA
SPC-1 ASU Price	$6.41/GB
SPC-1 Total System Price	$26,100.00

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**.

20 Kree Lane • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

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

20 Keeg Lane • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

LETTER OF GOOD FAITH

TTA 한국정보통신기술협회
Telecommunications Technology Association

47, Bundang-ro, Bundang-gu, Seongnam-city,
Gyeonggi-do, 13591, Republic of Korea
TEL: 82-31-724-0114

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: Park. C. S. Date: Oct. 21. 2019

Cheol-Soon Park
Vice President,
Telecommunications Technology Association

SPC BENCHMARK 1™

EXECUTIVE SUMMARY

TELECOMMUNICATIONS TECHNOLOGY ASSOCIATION GLUESYS ANYSTOR-700EK

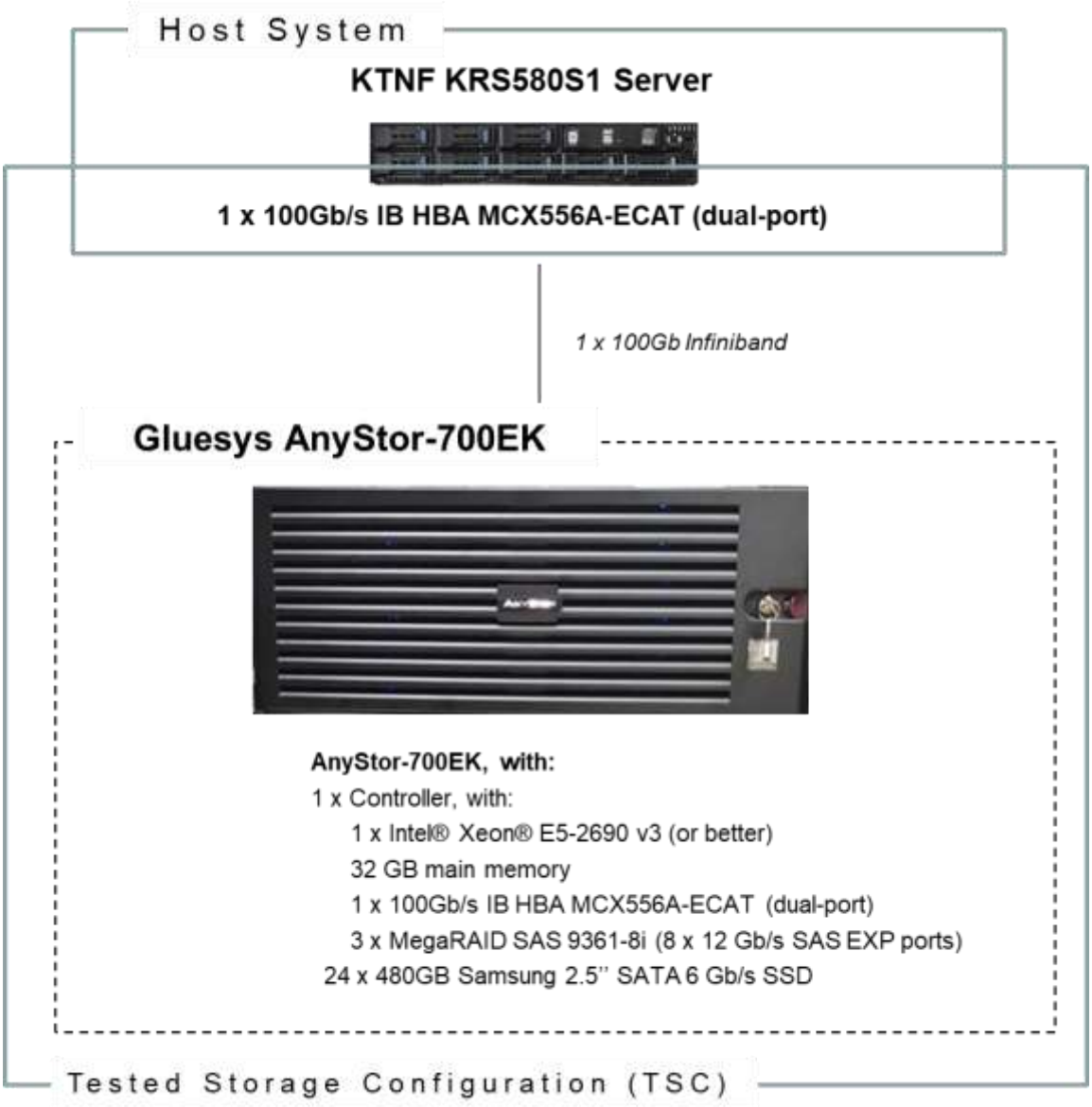
SPC-1 IOPS™	**310,509**
SPC-1 Price-Performance™	**$84.06/SPC-1 KIOPS™**
SPC-1 IOPS™ Response Time	0.470 ms
SPC-1 Overall Response Time	0.260 ms
SPC-1 ASU Capacity	4,073 GB
SPC-1 Space Effectiveness Ratio	NA
SPC-1 ASU Price	$6.41/GB
SPC-1 Total System Price	$26,100.00
Data Protection Level	Protected 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



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:

http://gluesys.com/product-2/scale-out-nas/?lang=en#

Priced Storage Configuration Components

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

Storage Configuration Pricing

	Description	Qty	Unit Price	Ext. Price	Disc.	Disc. Price
Hardware & Software						
ANYSTOR700EK	AS700EK 2U/24bay, 32GB Memory, System OS Mirroring(240GB SSD Hot Swappable Disk), Hot-Swappable 24 SAS or SATA Disk Bay, Redundant Power Supply, 10/100/1000 Gigabit Ethernet 2Port (UTP) AnyManager(Storage OS Solution, RAID 0/1/10/5/6, Protocol NFS/CIFS/FTP/iSCSI/iSER, Support Web Based Management)	1	32,989.34	32,989.34	50%	16,494.67
HD-SD00480G	SAMSUNG PM883 480G TLC	24	110.00	2,640.00	0%	2,640.00
IB-C100G0002	MCP1600-E002 IB EDR Cable	1	183.33	183.33	0%	183.33
IB-H100G002	100G IB EDR HBA CARD MCX556A-ECAT (ConnectX®-5 VPI adapter card, EDR IB and 100GbE, dual-port QSFP28, PCIe3.0 x16, tall bracket, ROHS R6)	2	1,100.00	2,200.00	0%	2,200.00
NC-10G0002	2 Port 10G Network Interface	1	458.33	458.33	0%	458.33
				Hardware & Software Subtotal		**21,976.33**
Support & Maintenance						
GLS-N-Support-3Y	Premium Package 3-Year Support & Maintenance	1	8,247.34	8,247.34	50%	4,123.67
				Support & Maintenance Subtotal		**4,123.67**

SPC-1 Total System Price	**26,100.00**
SPC-1 IOPS™	310,509.74
SPC-1 Price-Performance™ ($/SPC-1 KIOPS™)	**84.06**
SPC-1 ASU Capacity (GB)	4,073
SPC-1 ASU Price ($/GB)	**6.41**

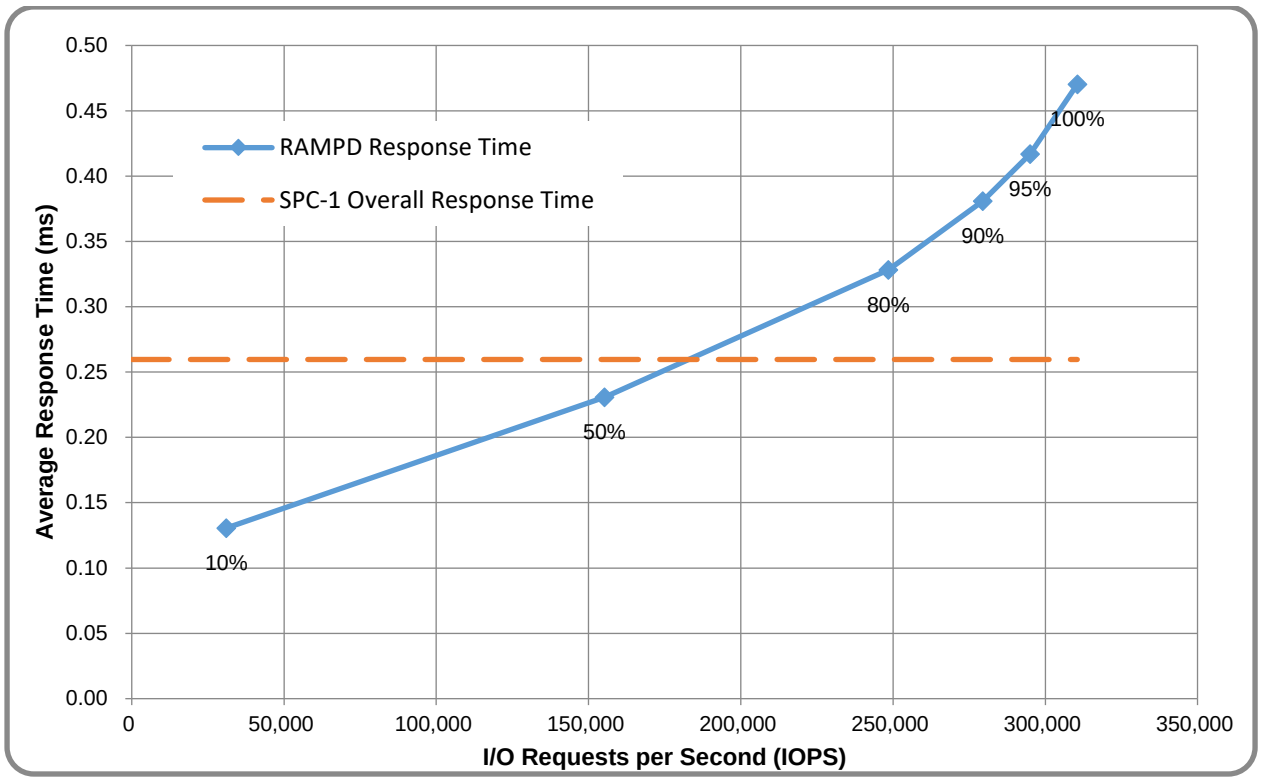
Third-Party Reseller: TTA is the sponsor of this result but does not directly sell the products and components of the Priced Storage Configuration (PSC). The above reflects the pricing quoted by the vendor and third-party reseller Gluesys Co., Ltd. See Appendix B of the Full Disclosure Report for a copy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



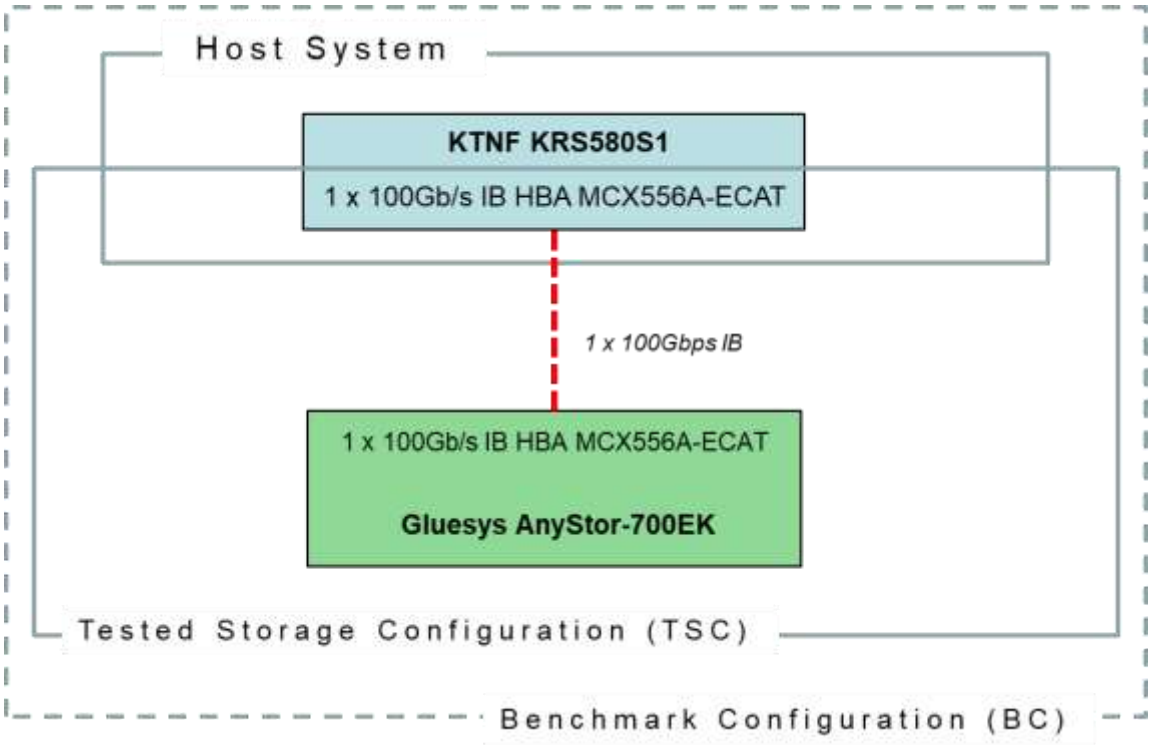
Contact Information	
Test Sponsor Primary Contact	TTA – http://tta.or.kr/eng/index.jsp Hyo-Sil Kim – hyosil.kim@tta.or.kr
SPC Auditor	InfoSizing – www.sizing.com Francois Raab – francois@sizing.com

Revision Information	
SPC Benchmark 1™ Revision	V3.8.0
SPC-1 Workload Generator Revision	0x18ade88v3.0.2
Publication Revision History	First Edition

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).

Host Systems
1 – KTNF KRS580S1, which includes: 2 x Intel® Xeon® Gold 6140 (2.30GHz, 25MB L3) 768 GB main memory 2 x 600 GB HDD (RAID 1) CentOS 7.6
Priced Storage Configuration
1 x 100Gb/s IB HBA MCX556A-ECAT (dual port)
1 x 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

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.

Original Component	Revised Component	Description of Change
n/a	n/a	Initial submission

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).

	LV per ASU	LV Capacity	Used per LV	Total per ASU	% ASU Capacity
ASU-1	9	203.70	203.70	1,833.30	45.00%
ASU-2	9	203.70	203.70	1,833.30	45.00%
ASU-3	1	407.00	407.00	407.00	10.00%
			SPC-1 ASU Capacity	**4,073.60**	

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.

Devices	Count	Physical Capacity	Total Capacity
480GB SSD (system)	24	480.00	11,520.00
		Total Physical Storage Capacity	**11,520.00**
		Physical Capacity Utilization	**35.36%**

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).

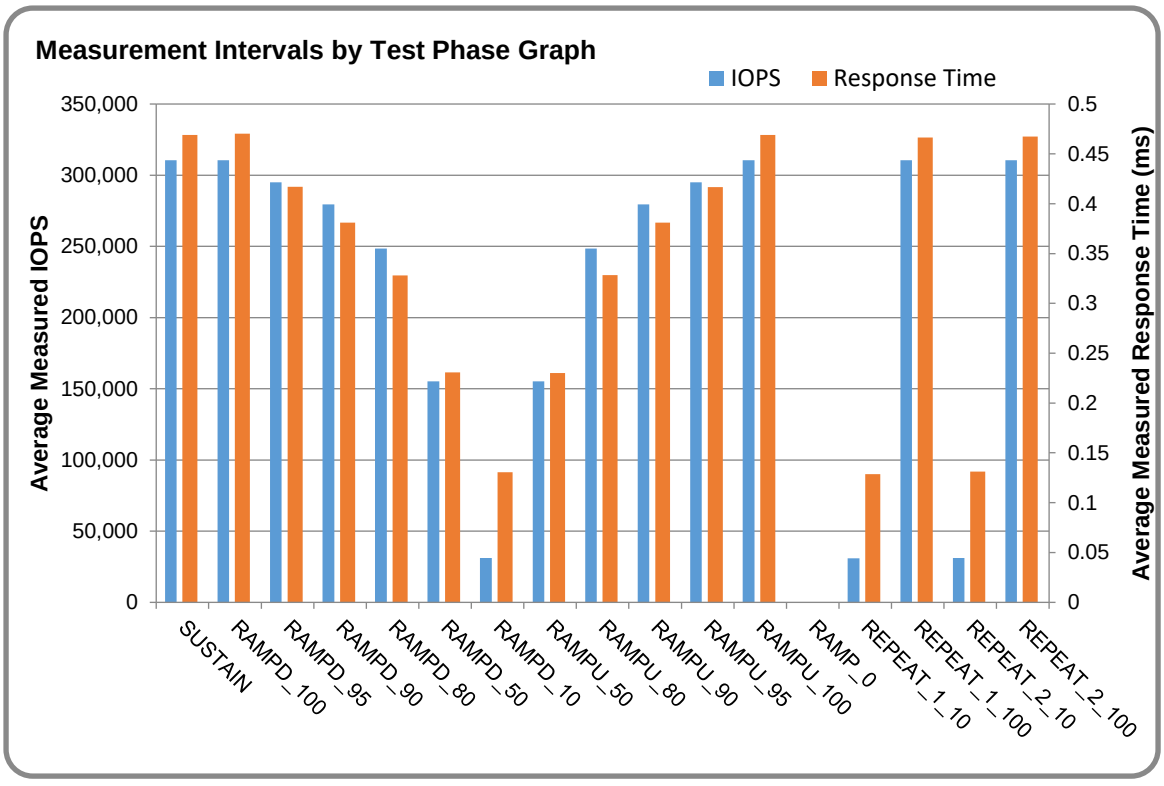
Primary Metrics Test Phases

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.



Exception and Waiver

None.

SUSTAIN Test Phase

SUSTAIN – Results File

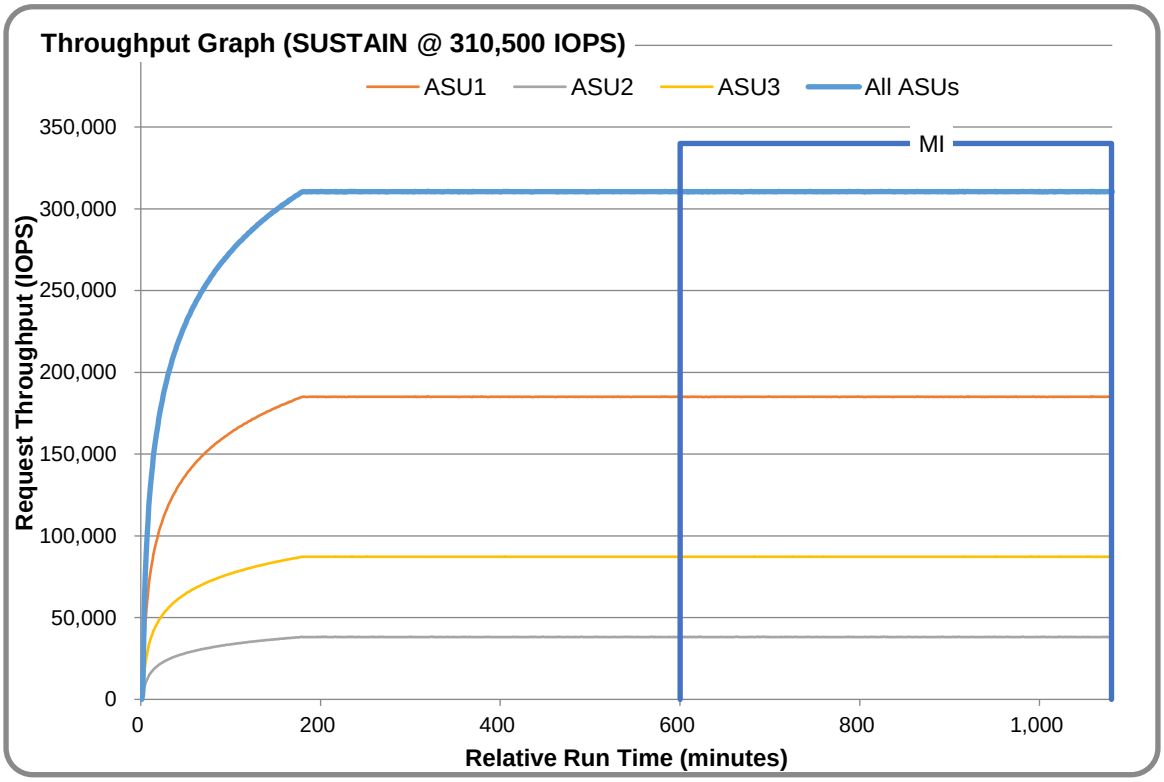
The results file generated during the execution of the SUSTAIN Test Phase is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

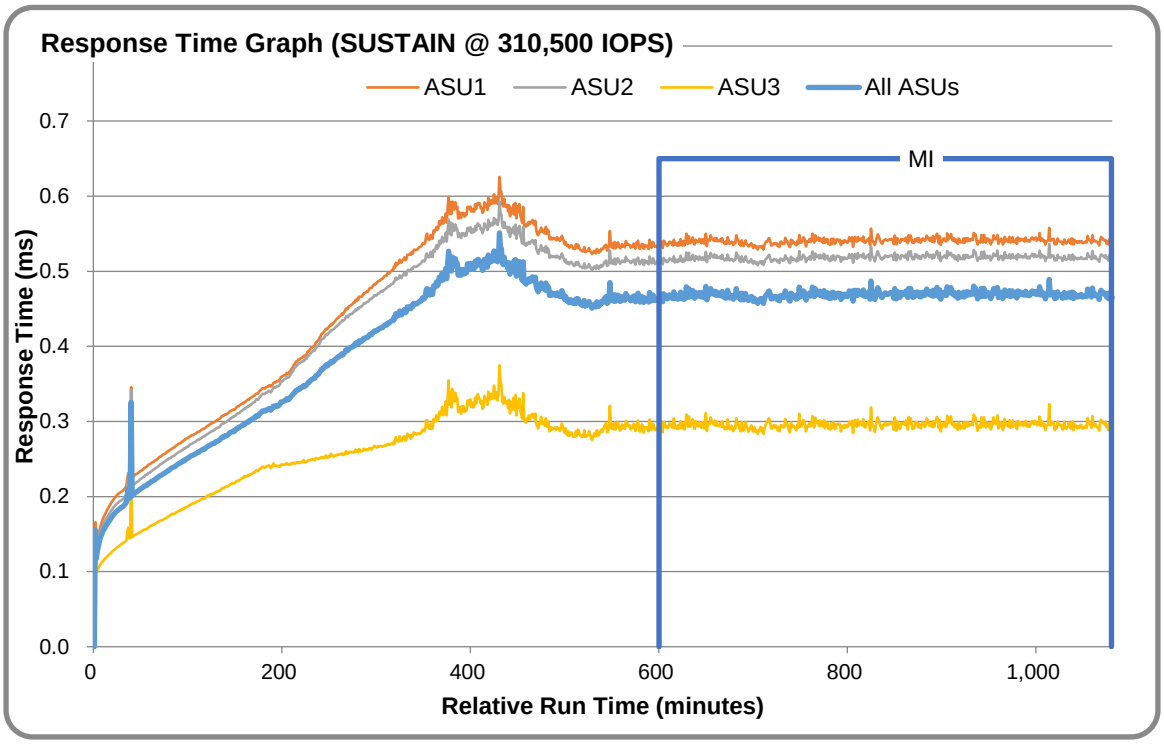
SUSTAIN – Execution Times

Interval	Start Time	End Time	Duration
Transition Period	23-Oct-19 11:24:41	23-Oct-19 21:24:41	10:00:00
Measurement Interval	23-Oct-19 21:24:41	24-Oct-19 05:24:42	8:00:01

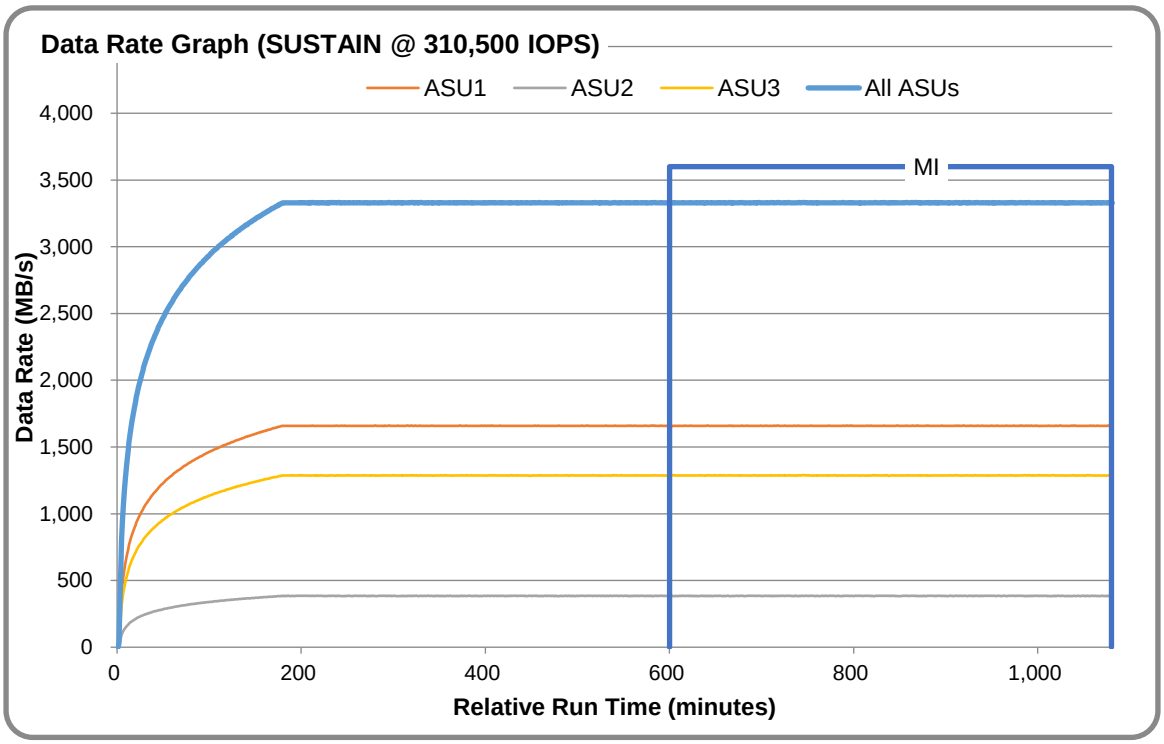
SUSTAIN – Throughput Graph



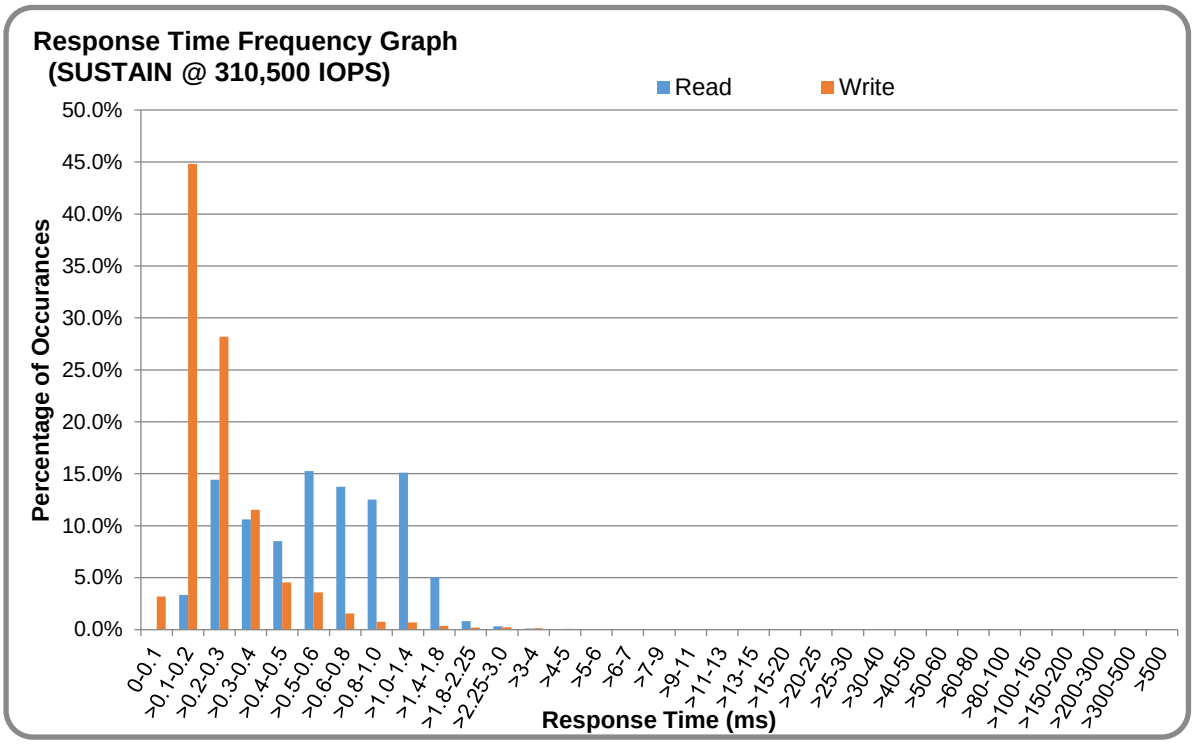
SUSTAIN – Response Time Graph



SUSTAIN – Data Rate Graph



SUSTAIN – Response Time Frequency Graph



SUSTAIN – 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.

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0012	0.0004	0.0009	0.0004	0.0017	0.0009	0.0012	0.0004
Difference	0.005%	0.000%	0.002%	0.000%	0.008%	0.003%	0.004%	0.001%

RAMPD_100 Test Phase

RAMPD_100 – Results File

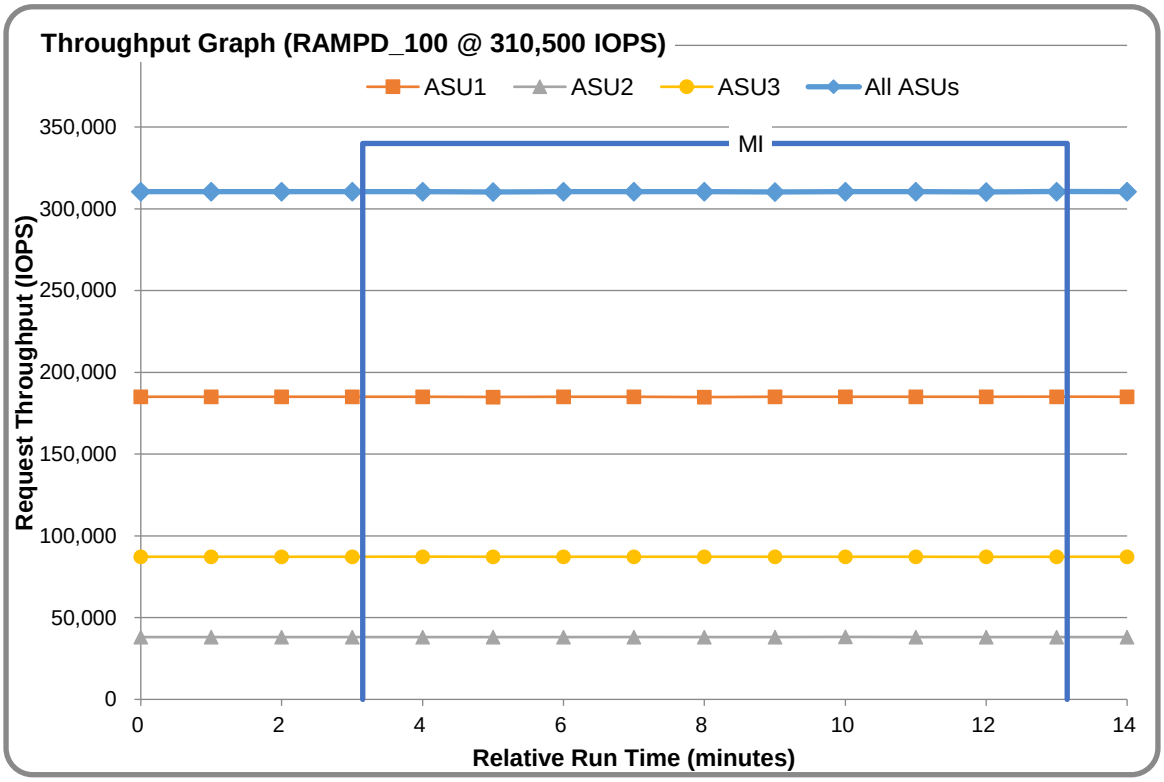
The results file generated during the execution of the RAMPD_100 Test Phase is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

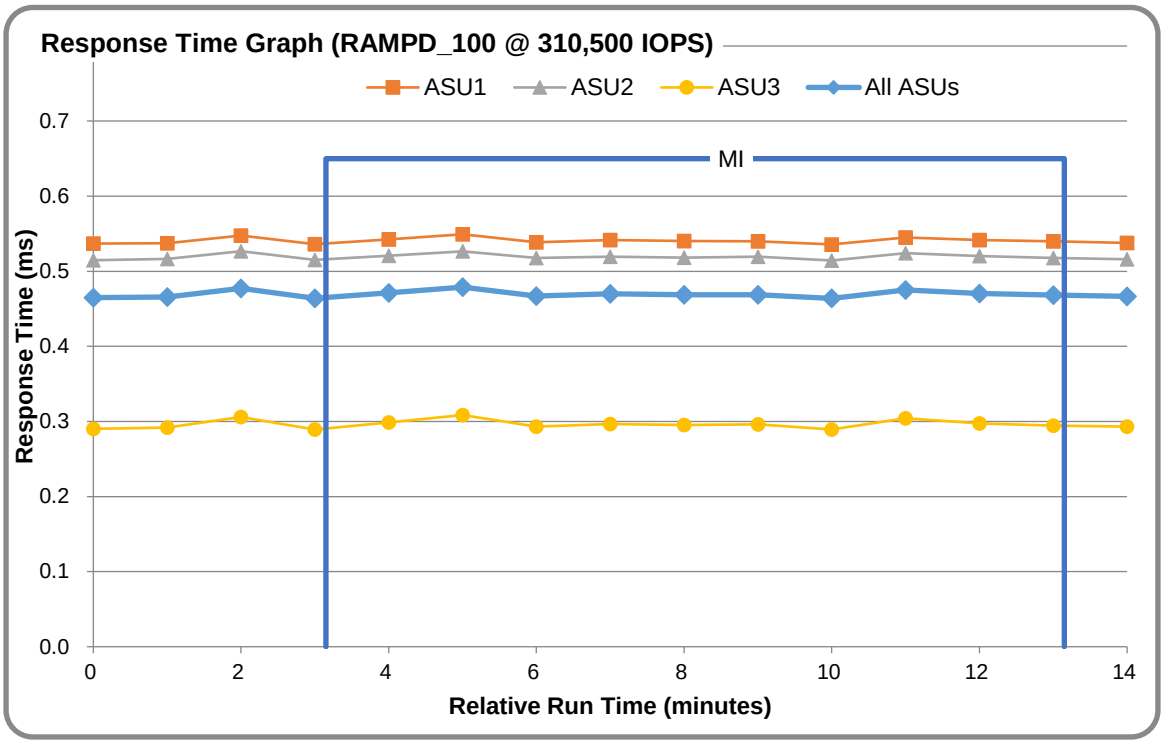
RAMPD_100 – Execution Times

Interval	Start Time	End Time	Duration
Transition Period	24-Oct-19 05:25:42	24-Oct-19 05:28:42	0:03:00
Measurement Interval	24-Oct-19 05:28:42	24-Oct-19 05:38:43	0:10:01

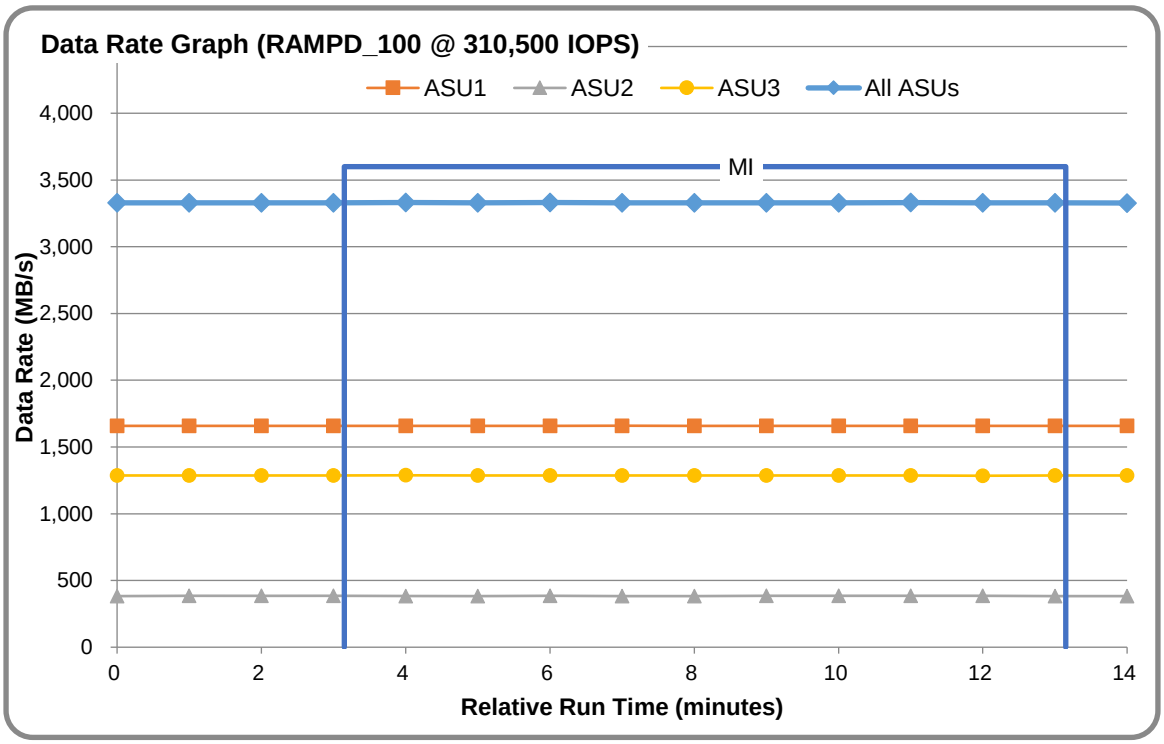
RAMPD_100 – Throughput Graph



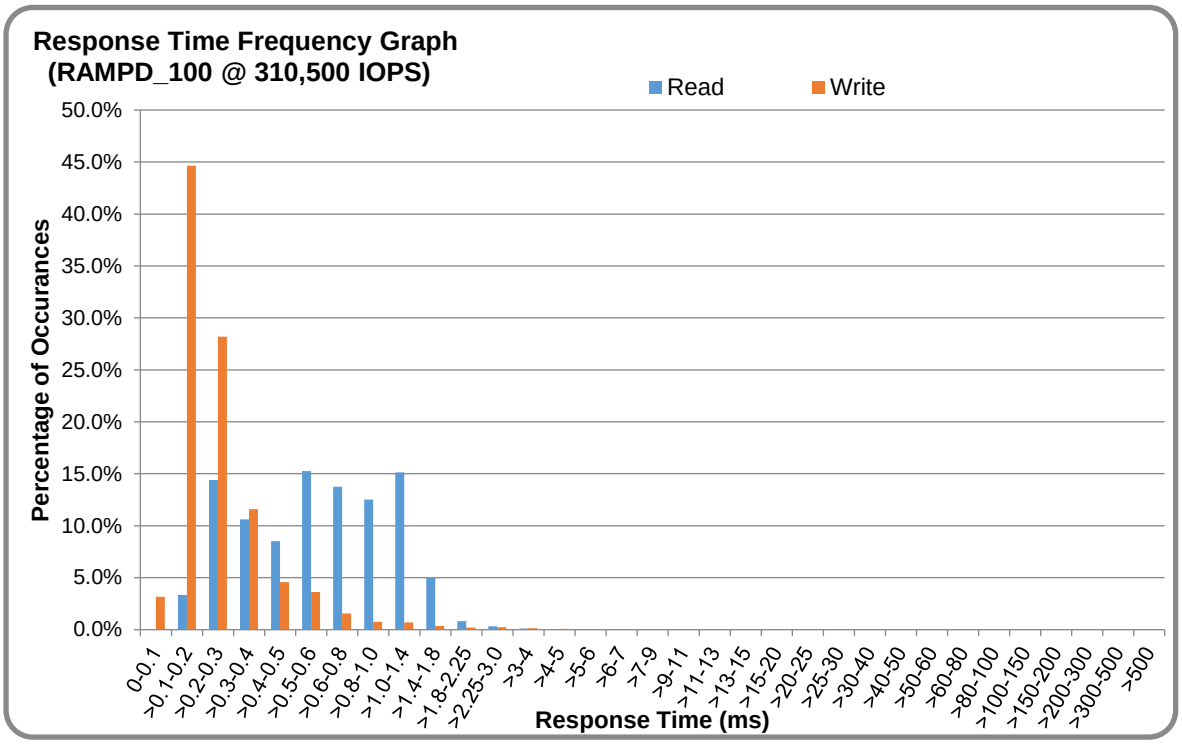
RAMPD_100 – Response Time Graph



RAMPD_100 – Data Rate Graph



RAMPD_100 – Response Time Frequency 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.

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0009	0.0004	0.0006	0.0004	0.0011	0.0009	0.0014	0.0005
Difference	0.043%	0.012%	0.018%	0.012%	0.050%	0.014%	0.037%	0.000%

RAMPD_100 – I/O Request Summary

I/O Requests Completed in the Measurement Interval	186,301,956
I/O Requests Completed with Response Time <= 30 ms	186,301,956
I/O Requests Completed with Response Time > 30 ms	0

Response Time Ramp Test

Response Time Ramp Test – Results File

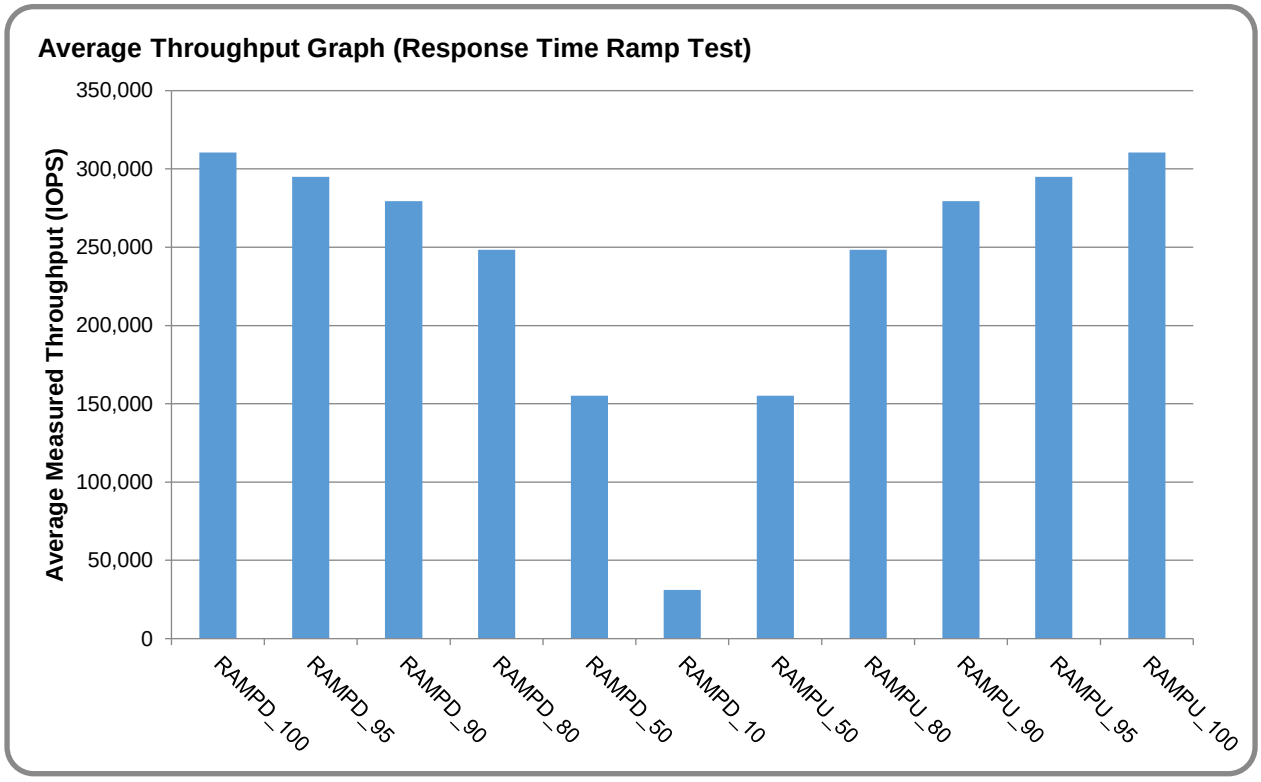
The results file generated during the execution of the Response Time Ramp Test is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

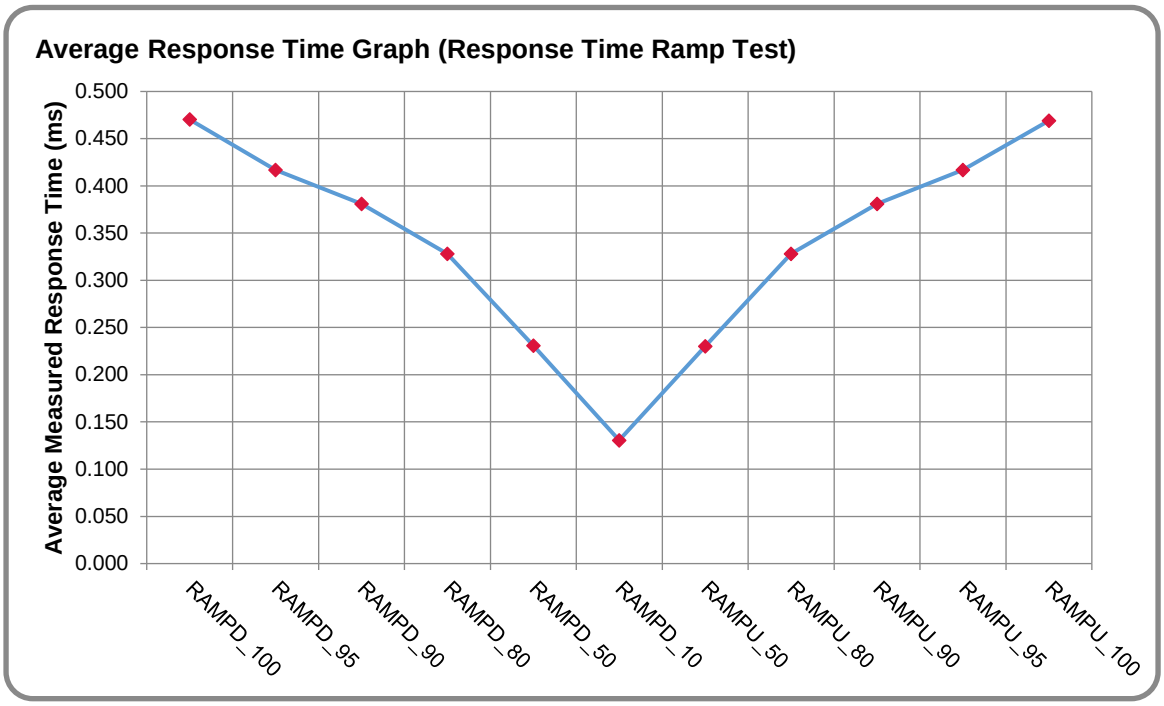
Response Time Ramp Test – Phases

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).

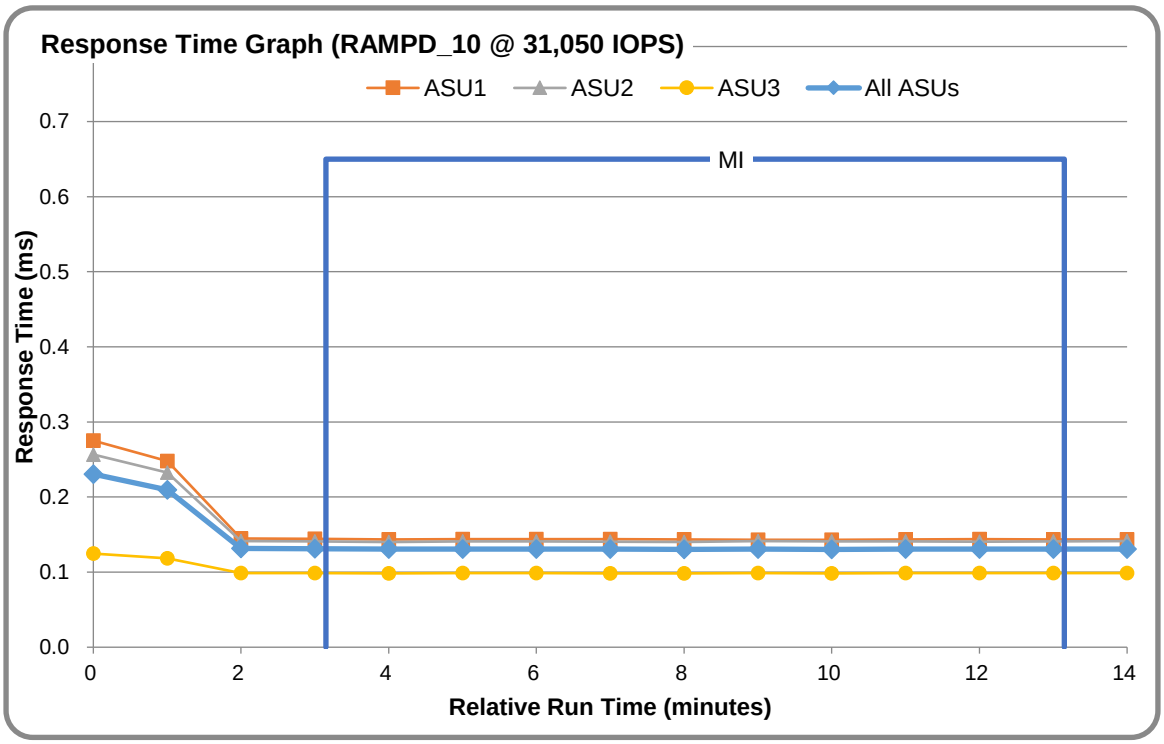
Response Time Ramp Test – Average Throughput Graph



Response Time Ramp Test – Average Response Time Graph



Response Time Ramp Test – RAMPD_10 Response Time Graph



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:

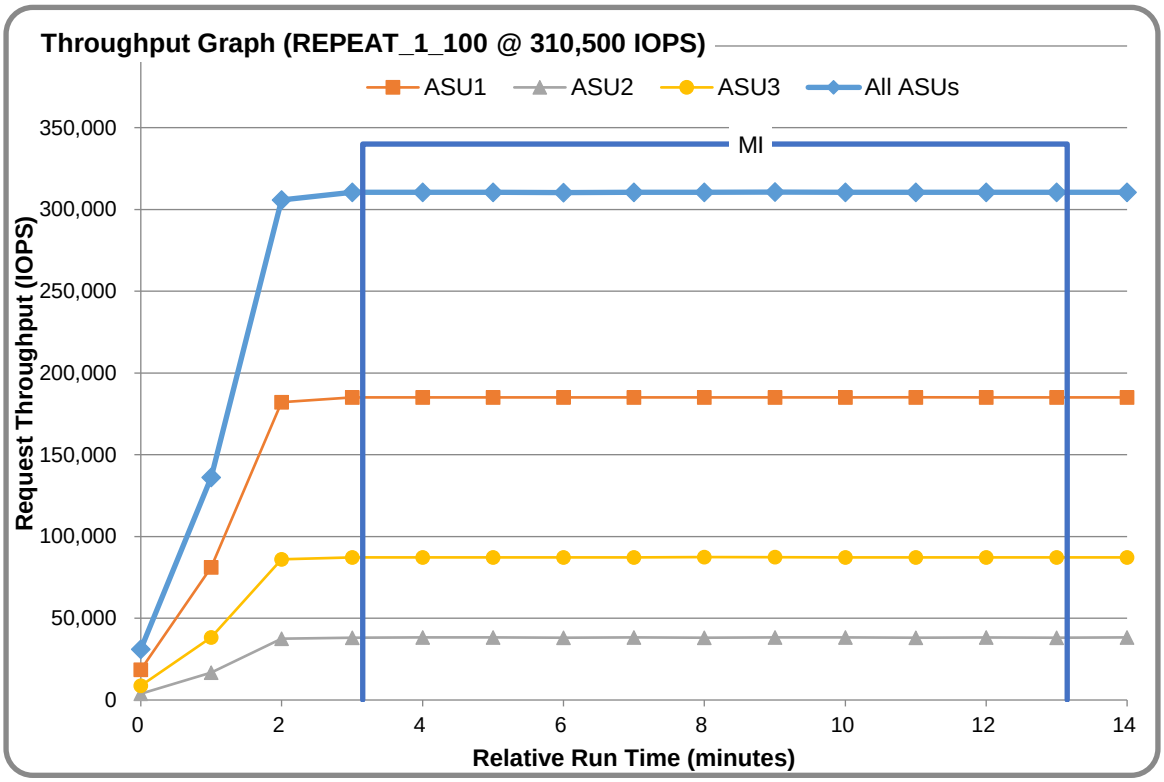
- **SPC1_METRICS_0_Raw_Results.xlsx**

Repeatability Test Results

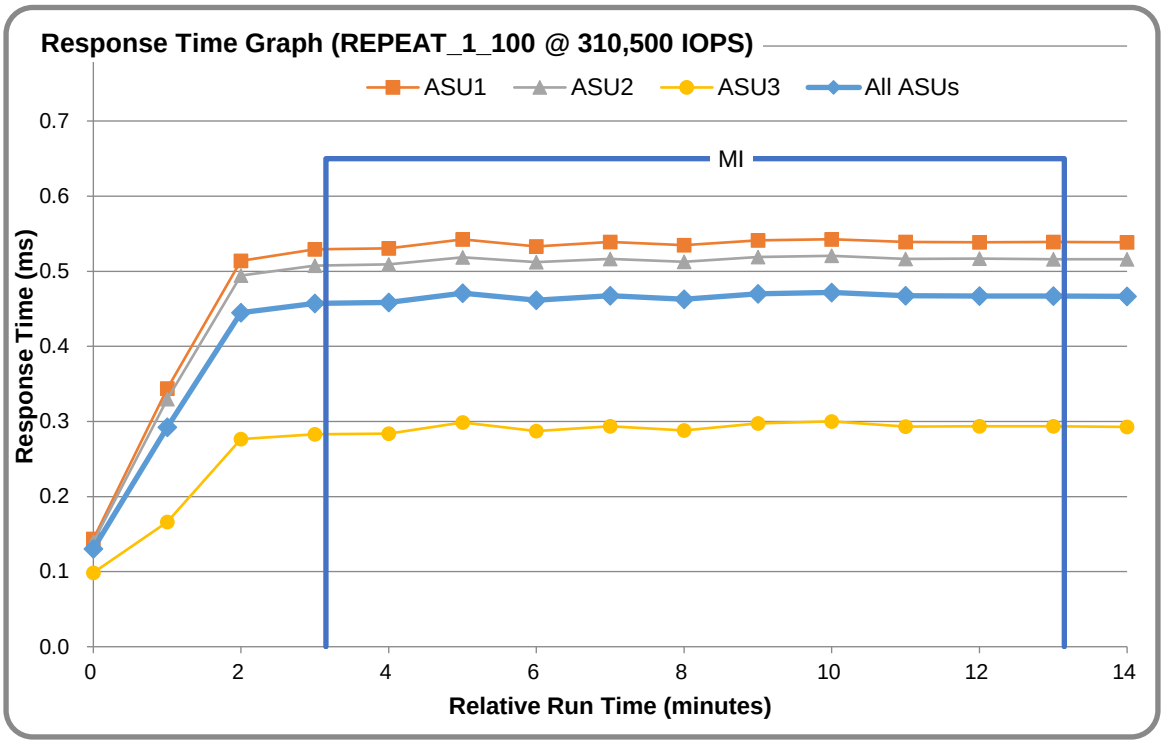
The throughput measurements for the Response Time Ramp Test (RAMPD) and the Repeatability Test Phases (REPEAT_1 and REPEAT_2) are listed in the tables below.

Test Phase	100% IOPS	10% IOPS
RAMPD	310,509.7	31,058.9
REPEAT_1	310,523.7	31,038.6
REPEAT_2	310,515.4	31,057.4

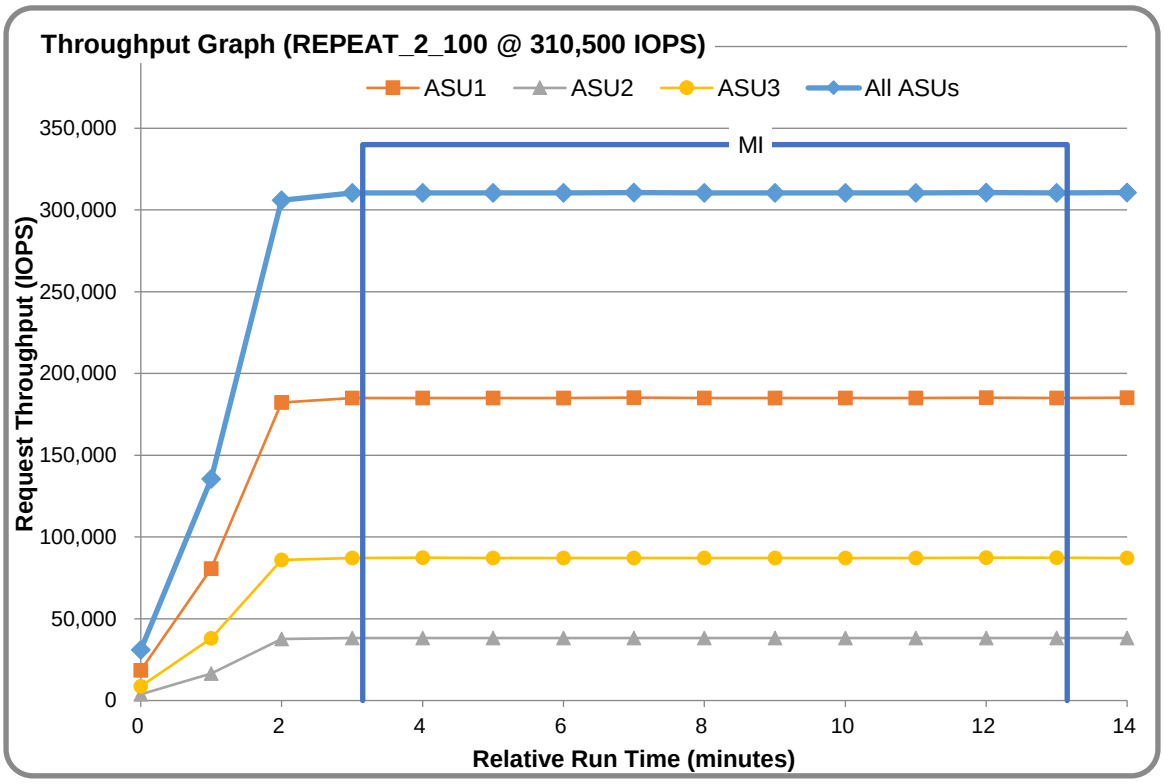
REPEAT_1_100 – Throughput Graph



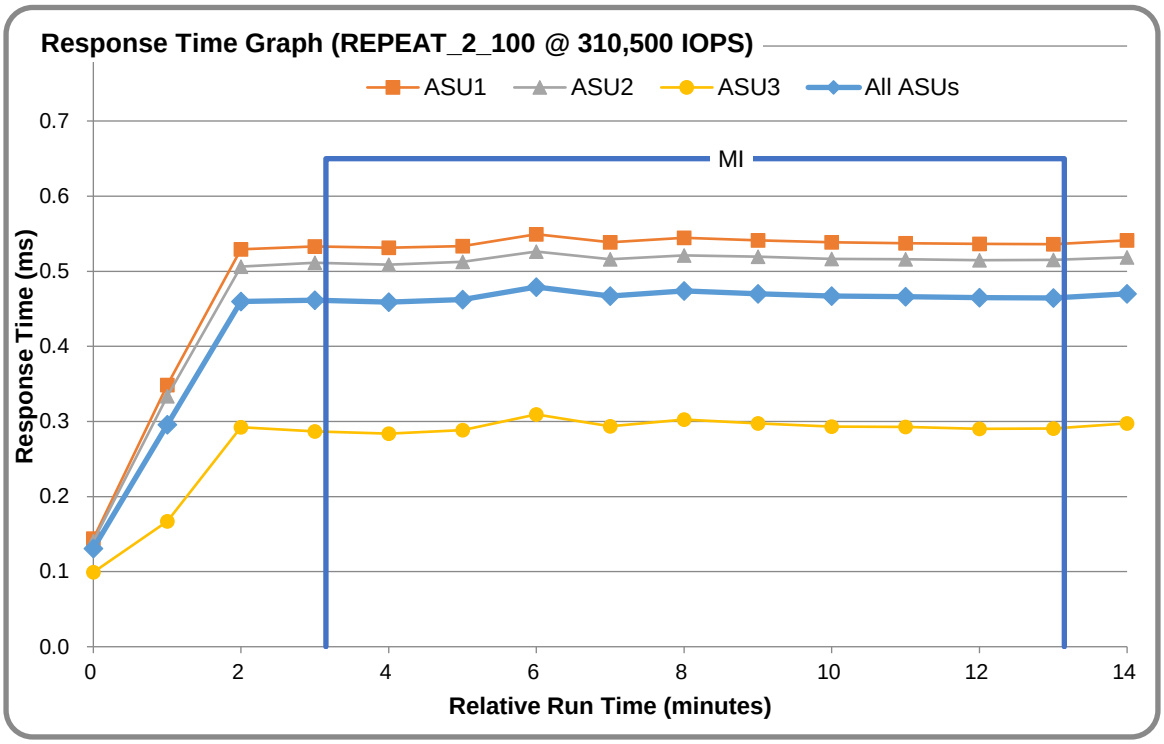
REPEAT_1_100 – Response Time Graph



REPEAT_2_100 – Throughput Graph



REPEAT_2_100 – Response Time Graph



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

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2101	0.0180	0.0700	0.0350	0.2810
Variation	0.0019	0.0002	0.0007	0.0004	0.0015	0.0008	0.0015	0.0003
Difference	0.101%	0.007%	0.038%	0.025%	0.079%	0.007%	0.056%	0.011%

REPEAT_2_100 Test Phase

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
Defined	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Measured	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0015	0.0004	0.0009	0.0005	0.0013	0.0011	0.0014	0.0004
Difference	0.041%	0.004%	0.028%	0.005%	0.156%	0.007%	0.047%	0.006%

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.

Physical Free Space Measurement	Free Space (GB)
After Logical Volume Creation	NA
After ASU Pre-Fill	NA
After Repeatability Test Phase	NA

Space Optimization Metrics

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

Space Optimization Metric	Value
SPC-1 Space Optimization Ratio	NA
SPC-1 Space Effectiveness Ratio	NA

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

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

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.

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

APPENDIX B: THIRD PARTY QUOTATION

Korean Version

gluesys
(14055) 경기도 안양시 동안구 시민대로327번길 11-31 파낙스R&D센터 5층
TEL : 070-8787-5376 FAX : 031-388-3261 http://www.gluesys.com

見 積 書

견적번호	GLS-1910230100-5376
수신	귀중
참조	hyosil.kim@tta.or.kr
연 락 처	010-5110-1847
견적일	2019년 10월 23일
유효기간	2019년 11월 7일
납품 가능일	발주일로부터 4주 이내

담당자	김유상 과장
전화번호	010-2353-2325
E-mail	yskim@gluesys.com
상호	㈜ 글 루 시 스
대표이사	박 성 순

견적 금액 : **一金이만육천일백달러整(VAT포함)**
건 명 :

귀사의 무궁한 발전을 기원하오며, 아래와 같이 견적합니다. 단위. 달러(V.A.T 포함)

번호	모델	상세내역	수량	소비자단가	공급단가	공급금액
		AnyStor-700EK				
1	AS700EK	2x Intel® Xeon® Gold 6126 Processor 12Cores, 24Threads, 2.60GHz 19.25MB L3 32GB Memory(Max. 2TB) 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 전용 O/S - Raid 지원 : 0, 1, 10, 5, 6 Support 지원프로토콜 - NFS, CIFS, FTP, iSCSI/iSER AnyManager - 웹 기반의 NAS 관리도구 - Cluster Management - Volume Managent & Monitoring - Auto / Manual recovery - 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	1	32,989.34	16,494.67	16,494.67
2	Support & Maintenance	Premium Package 3-Year Support & Maintenance	1	8,247.34	4,123.67	4,123.67
3	DATA Disk	SAMSUNG PM883 480G TLC	24	110.00	2,640.00	2,640.00
4	I/B Cable	MCP1600-E002 IB EDR Cable	1	183.33	183.33	183.33
5	I/B Card	MCX556A-ECAT ConnectX®-5 VPI adapter card, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, PCIe3.0 x16, tall bracket, ROHS R6	2	1,100.00	2,200.00	2,200.00
6	NIC	2 Port 10G Network Interface	1	458.33	458.33	458.33
				공급가		26,100.00
				부가가치세		
				총합계		26,100.00

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

English Version

gluesys
(14055) 경기도 안양시 동안구 시민대로327번길 11-31 파낙스R&D센터 5층
TEL : 070-8787-5376 FAX : 031-388-3261 http://www.gluesys.com

見 積 書

견적번호 (Q.No.)	GLS-1910230100-5376
수신(To.)	TTA
참조(ATTN.)	hyosil.kim@tta.or.kr
연 락 처 ☎	010-5110-1847
견적일(Date)	10/23/2019
유효기간 (Effective Date)	11/7/2019
납품 가능일 (Delivery Date)	발주일로부터 4주 이내 In 4 weeks from the order

담당자 (Personal Contact)	김유상 과장 (Yu-Sang Kim)
전화번호☎	010-2353-2325
E-mail	yskim@gluesys.com
상호 (Vendor)	㈜ 글 루 시 스 (GLUESYS Co., Ltd.)
대표이사 (CEO)	박 성 순 (Sung-Soon Park)

견적 금액($) (Total Price) : **26100.00**

귀사의 무궁한 발전을 기원하오며, 아래와 같이 견적합니다.

Unit. ($)

번호 (No.)	모델 (Model No.)	상세내역 (Description)	수량 (Quantity)	소비자단가 (MSRP)	할인 (Discount)	공급금액 (Extended Price)
Gluesys AnyStor-700EK						
1	AS700EK	2x Intel® Xeon® Gold 6126 Processor 12Cores, 24Threads, 2.60GHz 19.25MB L3 32GB Memory(Max. 2TB) 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 전용 O/S - Raid : 0, 1, 10, 5, 6 Support Supported Protocol - NFS, CIFS, FTP, iSCSI/iSER AnyManager - NAS Management System based on Web - Cluster Management - Volume Managent & Monitoring - Auto / Manual recovery - 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	1	32,989.34	50%	16,494.67
2	Support & Maintenance	Premium Package 3-Year Support & Maintenance	1	8,247.34	50%	4,123.67
3	DATA Disk	SAMSUNG PM883 480G TLC	24	110.00	-	2,640.00
4	I/B Cable	MCP1600-E002 IB EDR Cable	1	183.33	-	183.33
5	I/B Card	MCX556A-ECAT ConnectX®-5 VPI adapter card, EDR IB (100Gb/s) and 100GbE, dual-port QSFP28, PCIe3.0 x16, tall bracket, ROHS R6	2	1,100.00	-	2,200.00
6	NIC	2 Port 10G Network Interface	1	458.33	-	458.33
				공급가 (Extended Price)		26,100.00
				VAT		Included
				총합계 (Total Price)		26,100.00

Remarks

1. Discount based on the storage capacity perchased
2. Shipping 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.

set_host_kernel_parameters.sh

```
#!/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.

raid1_set.sh

```
#!/bin/bash

# jbod unconfig
storcli /c0 set jbod=off
storcli /c1 set jbod=off
storcli /c2 set jbod=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.

mklun.sh

```
#!/bin/sh

ib0="10.10.2.82"
devs=$(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\:0[1-3]: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 addresse 0.0.0.0 assigned automatically
   ls                                /sys/kernel/config/target/iscsi/iqn.2019-
   08.gluesys.com:iser$i/tpgt_1/np/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

   # Asssign 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/iqn.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

```
#!/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.

login.sh

```
#!/bin/sh

## Connect to the ISER Target
tgt_ib0="10.10.2.82"
tgt_num=$(iscsiadm -m discovery -t st -p $tgt_ib0 | awk -F ' ' '{print $2}' | wc
   -l)
i=1

tgts=$(iscsiadm -m discovery -t st -p $tgt_ib0 | awk -F ' ' '{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.

lvcreate.sh

```
#!/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 -l5%VG -I512 vg1 -n asu1_1 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_2 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_3 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_4 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_5 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_6 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_7 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_8 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu1_9 $dev

#asu-2
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_1 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_2 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_3 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_4 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_5 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_6 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_7 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_8 $dev
lvcreate -i$num -l5%VG -I512 vg1 -n asu2_9 $dev

#asu-3
lvcreate -i$num -l10%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 ***spc1_run.sh*** and ***spc1_run_persist2.sh*** scripts. *T*he 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

```
-- 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

```
#!/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"
```