SPC BENCHMARK 1™

FULL DISCLOSURE REPORT

IBM
IBM® DS8888

SPC-1 V3.2

SUBMISSION IDENTIFIER: A31002

SUBMITTED FOR REVIEW: NOVEMBER 1, 2016

Second Edition – February 2018

Trademarks

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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.storageperformance.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

Bruce McNutt
IBM ARC
IBM Corporation
650 Harry Road
San Jose, CA 95120

October 24, 2016

I verified the SPC Benchmark 1™ (SPC-1™ Revision3.2) test execution and performance results of the following Tested Storage Product:

IBM® DS8888

The results were:

SPC-1 IOPS™	**1,500,187**
SPC-1 Price-Performance™	**$1.32/SPC-1 IOPS™**
SPC-1 IOPS™ Response Time	0.60 ms
SPC-1 Overall Response Time	0.336 ms
SPC-1 ASU Capacity	34,360 GB
SPC-1 ASU Price	$57.35/GB
SPC-1 Total System Price	$1,970,396

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 3.0 Build 2565. 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.storageperformance.org** under the Submission Identifier **A31002**.

20 Kreg 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:

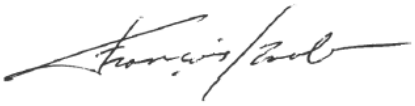
- The physical capacity of the data repository;
- The total capacity of the Application Storage Unit (ASU);
- The accuracy of the Benchmark Configuration diagram;
- The tuning parameters used to configure the Benchmark Configuration;
- The Workload Generator commands used to execute the testing;
- The 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 Kreg Lane • Manitou Springs, CO 80829 • 719-473-7555 • www.sizing.com

LETTER OF GOOD FAITH

Vice President, IBM Enterprise System Storage

IBM Systems and Technology Group
9000 South Rita Road
Tucson, AZ 85744-0002

Phone 1-520-799-2602

September 20, 2016

Mr. Francois Raab, Certified SPC Auditor
InfoSizing, Inc.
20 Kreg Lane
Manitou Springs, CO 80829

Subject: SPC-1 Letter of Good Faith for the IBM DS8888.

IBM Corporation is the SPC-1 Test Sponsor for the above listed product. 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 Version 3.2 of the SPC-1 benchmark specification.

Our disclosure of the Benchmark configuration and execution of the benchmark includes all items that, to the best of our knowledge and belief, materially affect the reported results, regardless of whether such items are explicitly required to be disclosed by the SPC-1 benchmark specification.

Sincerely,

Calline Sanchez
Vice President, IBM Enterprise Systems Storage
IBM Systems and Technology Group

SPC BENCHMARK 1™

EXECUTIVE SUMMARY

IBM
IBM® DS8888

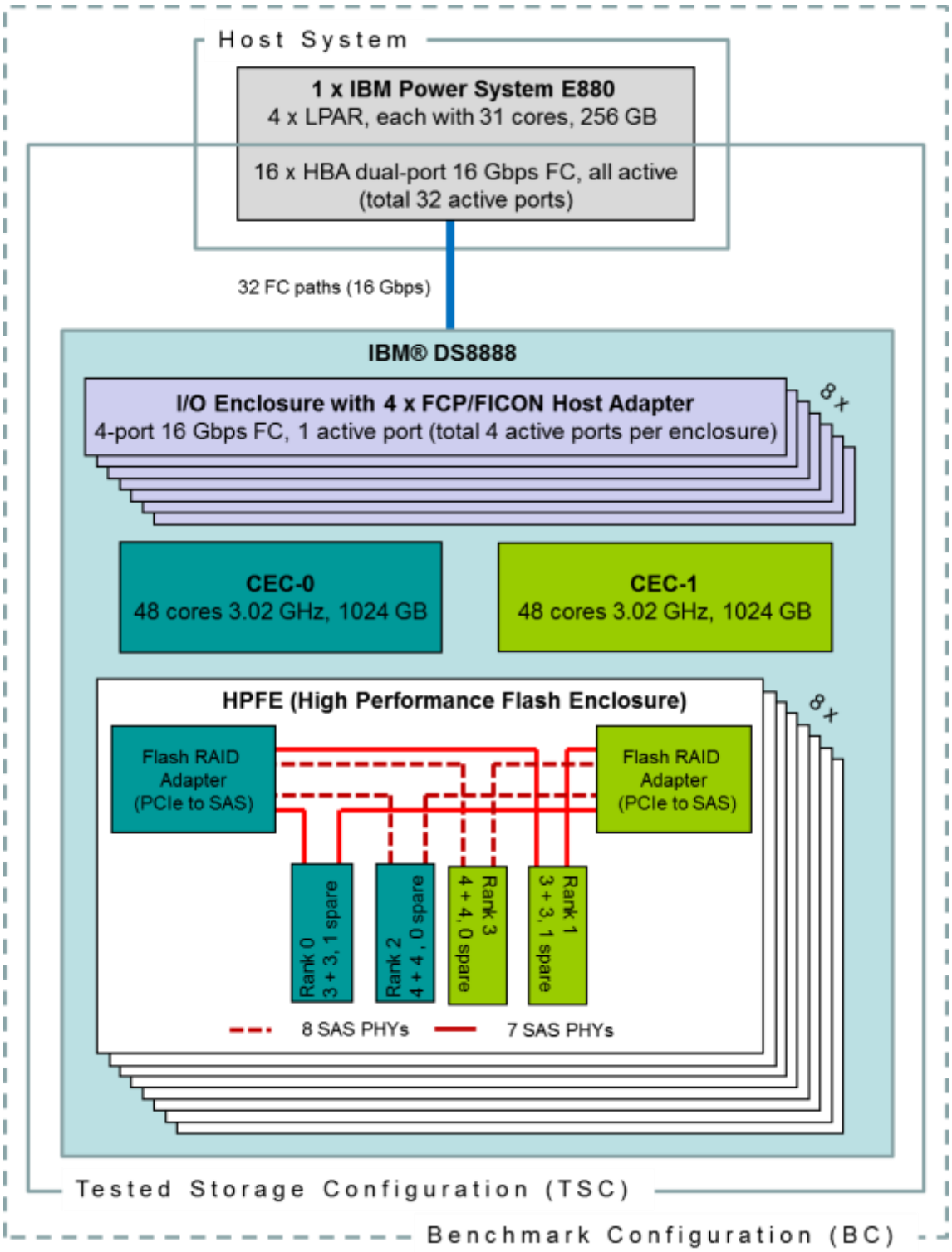
SPC-1 IOPS™	**1,500,187**
SPC-1 Price-Performance™	**$1,313.44/SPC-1 KIOPS™**
SPC-1 IOPS™ Response Time	0.60 ms
SPC-1 Overall Response Time	0.336 ms
SPC-1 ASU Capacity	34,360 GB
SPC-1 ASU Price	$57.35/GB
SPC-1 Total System Price	$1,970,396
Data Protection Level	Protected 2 (mirroring)
Physical Storage Capacity	96,000 GB
Pricing Currency / Target Country	U.S. Dollars / USA

SPC-1 V3.2

SUBMISSION IDENTIFIER: A31002

SUBMITTED FOR REVIEW: NOVEMBER 1, 2016

Benchmark Configuration Diagram



Tested Storage Product Description

The IBM® DS8888, an all flash storage system in the DS8000® product family, delivers world-class performance and data management in a single solution. The DS8888 changes the way companies do their business by accelerating application performance and improving server efficiency, delivering the benefits that make all-flash systems ready for broad enterprise deployment

Priced Storage Configuration Components

16 x 16Gb Dual-Port FC HBAs (all ports active)
1 x IBM DS8888 8 x I/O Enclosure, each with: 4 x FCP/FICON Host Adapter with 4-port 16Gbps FC (4 ports active per enclosure) PCIe connections to CECs PCIe connections to HPFEs 2 x CEC, each with: 4 x Power8 socket (12 cores, 3.02Ghz) 1024GB RAM 8 x HPFE (High Performance Flash Enclosure), each with: 2 x Flash RAID Adapter (PCIe to SAS) 30 x 400GB Flash Card, 1.8", dual SAS PHY

Storage Configuration Pricing

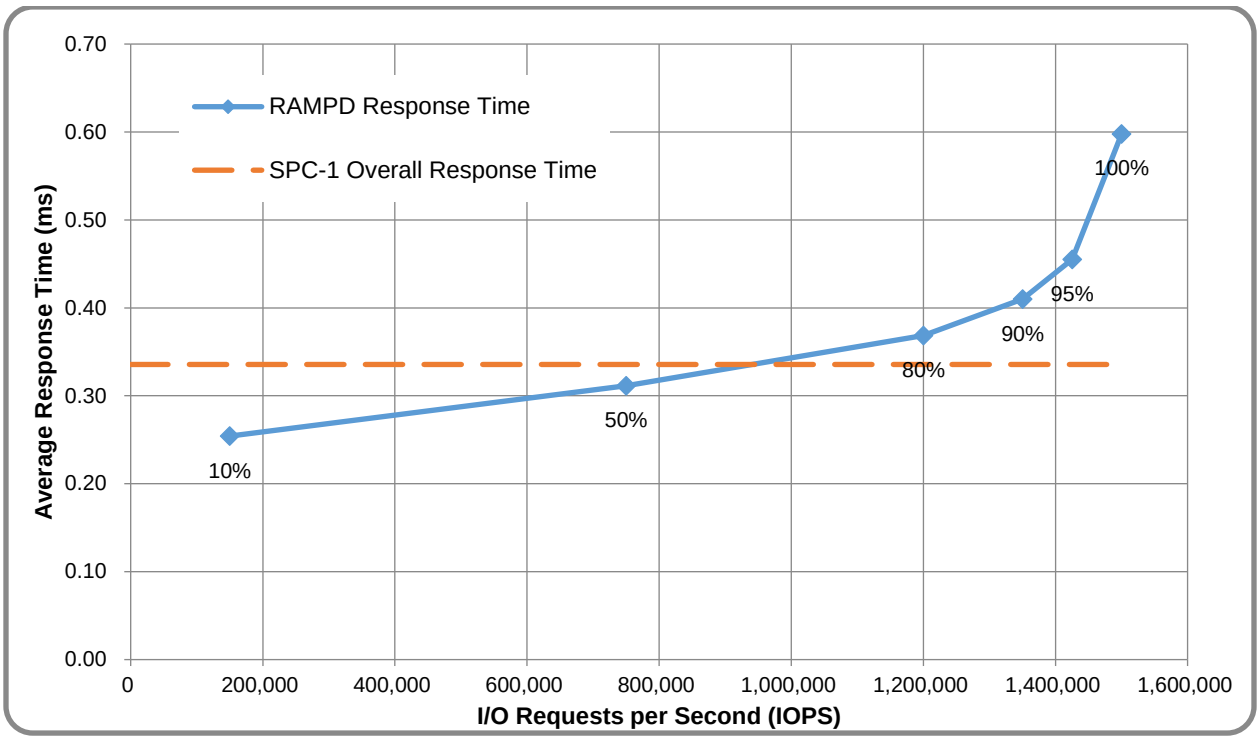
	Description	Qty	Unit Price	Ext. Price	Disc.	Disc. Price
Hardware						
2833-982	DS8888	1	78,015.00	78,015.00	50%	39,007.50
1052	Three phase DC-UPS	2	31,048.00	62,096.00	50%	31,048.00
1086	Three phase power cord	1	2,500.00	2,500.00	50%	1,250.00
1140	Mgmt console - Primary	1	12,120.00	12,120.00	50%	6,060.00
1302	I/O enclosure pair PCIe 3	2	17,140.00	34,280.00	50%	17,140.00
1410	50 um Fibre cable (LC)	32	110.00	3,520.00	50%	1,760.00
1500	High-performance flash enclosure	4	20,500.00	82,000.00	50%	41,000.00
1596	400 GB 1.8-inch flash card set A (	4	130,500.00	522,000.00	50%	261,000.00
1598	400 GB 1.8-inch flash card set B (	4	114,728.00	458,912.00	50%	229,456.00
1881	DS8000 LMC R8.1	1	20,000.00	20,000.00	50%	10,000.00
3353	16Gb 4-port SW FCP/FICON to PCIE	16	12,446.00	199,136.00	50%	99,568.00
4488	2 TB Processor memory (48-core (	1	331,400.00	331,400.00	50%	165,700.00
4888	48-core processor indicator	1	511,800.00	511,800.00	50%	255,900.00
AGA8	Shipping and handling 982	1	3,250.00	3,250.00	50%	1,625.00
2833-98F	DS8888 Expansion Unit	1	51,205.00	51,205.00	50%	25,602.50
1052	Three phase DC-UPS	2	31,048.00	62,096.00	50%	31,048.00
1086	Three phase power cord	1	2,500.00	2,500.00	50%	1,250.00
1302	I/O enclosure pair PCIe 3	2	17,140.00	34,280.00	50%	17,140.00
3353	16Gb 4-port SW FCP/FICON to PCIE	16	12,446.00	199,136.00	50%	99,568.00
1500	High-performance flash enclosure	4	20,500.00	82,000.00	50%	41,000.00
1596	400 GB 1.8-inch flash card set A (	4	130,500.00	522,000.00	50%	261,000.00
1598	400 GB 1.8-inch flash card set B (	4	114,728.00	458,912.00	50%	229,456.00
AGA9	Shipping and handling 98F	1	3,250.00	3,250.00	50%	1,625.00
2838-LF8	Adv Func License BF (up to 100TE	10	11,008.00	110,080.00	50%	55,040.00
9119-EN0A	PCIe2 16Gb 2-port FC Adapter	16	5,894.00	94,304.00	50%	47,152.00
				Hardware Subtotal		**1,970,396.00**
Support & Maintenance						
	3-year Warranty (7x24 @ 4h)		Included			0.00
				Support & Maintenance Subtotal		**0.00**
SPC-1 Total System Price						**1,970,396.00**
SPC-1 IOPS™						1,500,187
SPC-1 Price-Performance™ ($/SPC-1 KIOPS™)						**1,313.44**
SPC-1 ASU Capacity (GB)						34,360
SPC-1 ASU Price ($/GB)						**57.35**

Discount Details: The discounts shown are on a "field delegation" basis. A discount of 50 percent was applied to all priced components.

Warranty: 3-year warranty included on all components, with 7x24 service and 4-hour response.

Availability Date: November 30, 2016.

Response Time and Throughput Graph



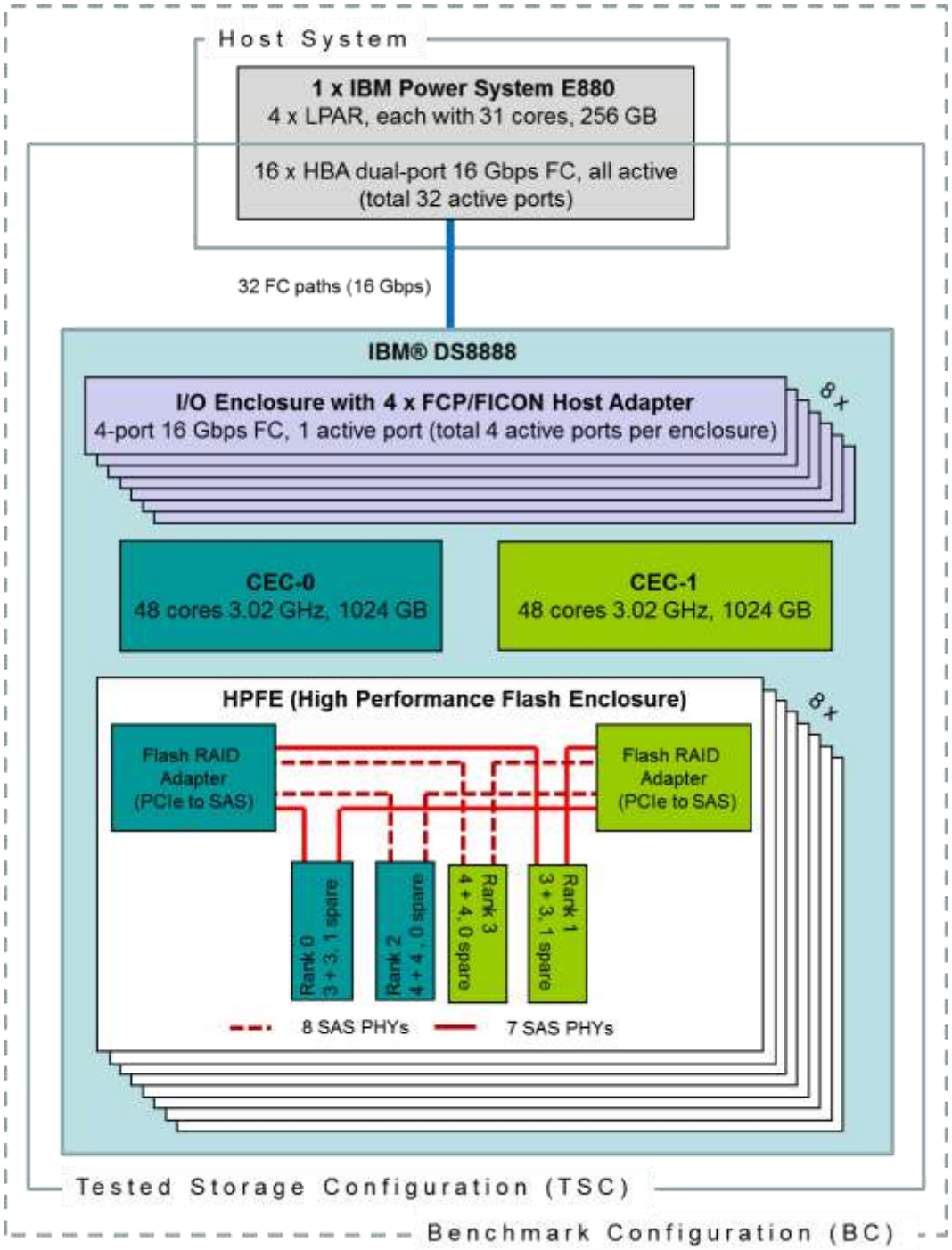
Contact Information	
Test Sponsor Primary Contact	IBM – http://www.ibm.com Bruce McNutt – bmcnutt@us.ibm.com
SPC Auditor	InfoSizing, Inc. http://www.sizing.com Francois Raab – francois@sizing.com

Revision Information	
SPC Benchmark 1™ Revision	V3.2.0
SPC-1 Workload Generator Revision	V3.0 build 2565
Publication Revision History	• First Edition: November 1, 2016 • Second Edition: February 15, 2018 - Updated SPC-1 Price-Performance™ metric based on SPC-1 v3.6.0 definition.

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 an external storage subsystem (IBM DS8888), driven by four logical partitions (LPAR) carved out of a single host system (IBM Power System E880). The host system was directly connected to the external storage subsystem via 16 dual-port Fibre Chanel HBAs on the host side and 32 4-port Fibre Chanel HBAs on the DS8888 side, with a single port active for each HBA. The Fibre Chanel paths operated at 16 Gbps.

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 x IBM Power System E880 4 x LPAR (Logical Partition), each with 31 Cores 256GB RAM
Priced Storage Configuration
16 x 16Gb Dual-Port FC HBAs (all ports active)
1 x IBM DS8888 8 x I/O Enclosure, each with: 4 x FCP/FICON Host Adapter with 4-port 16Gbps FC (4 ports active per enclosure) PCIe connections to CECs PCIe connections to HPFEs 2 x CEC, each with: 4 x Power8 socket (12 cores, 3.02Ghz) 1024GB RAM 8 x HPFE (High Performance Flash Enclosure), each with: 2 x Flash RAID Adapter (PCIe to SAS) 30 x 400GB Flash Card, 1.8", dual SAS PHY

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	45	343.597	343.597	15,461.865	45.00%
ASU-2	45	343.597	343.597	15,461.865	45.00%
ASU-3	10	343.597	343.597	3,435.970	10.00%
			SPC-1 ASU Capacity	**34,359.7**	

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
400GB Flash Card	240	400	96,000
		Total Physical Capacity	96,000
		Physical Capacity Utilization	35.79%

Data Protection

The data protection level used for all logical volumes was **Protected 2**, which was accomplished with RAID-1 (mirroring). RAID-1 arrays are configured in 2 ranks of 6 drives and 2 ranks of 8 drives per HPFE.

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).

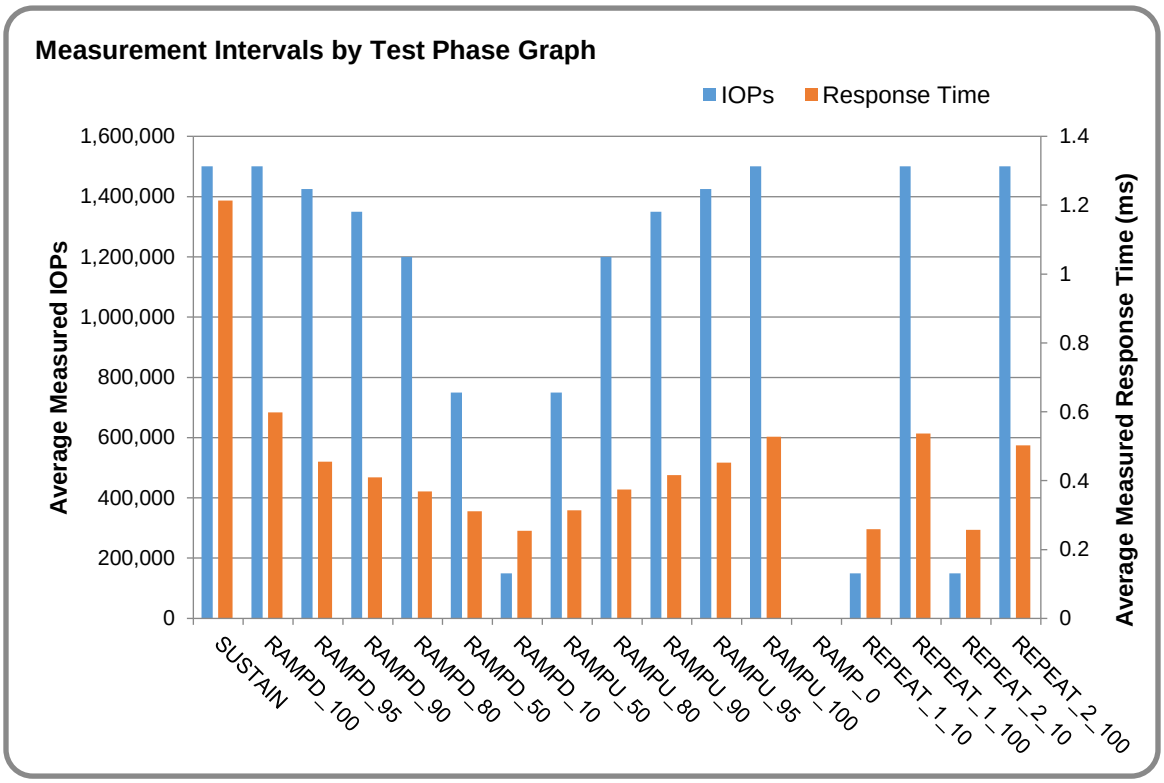
Primary Metrics Test Phases

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

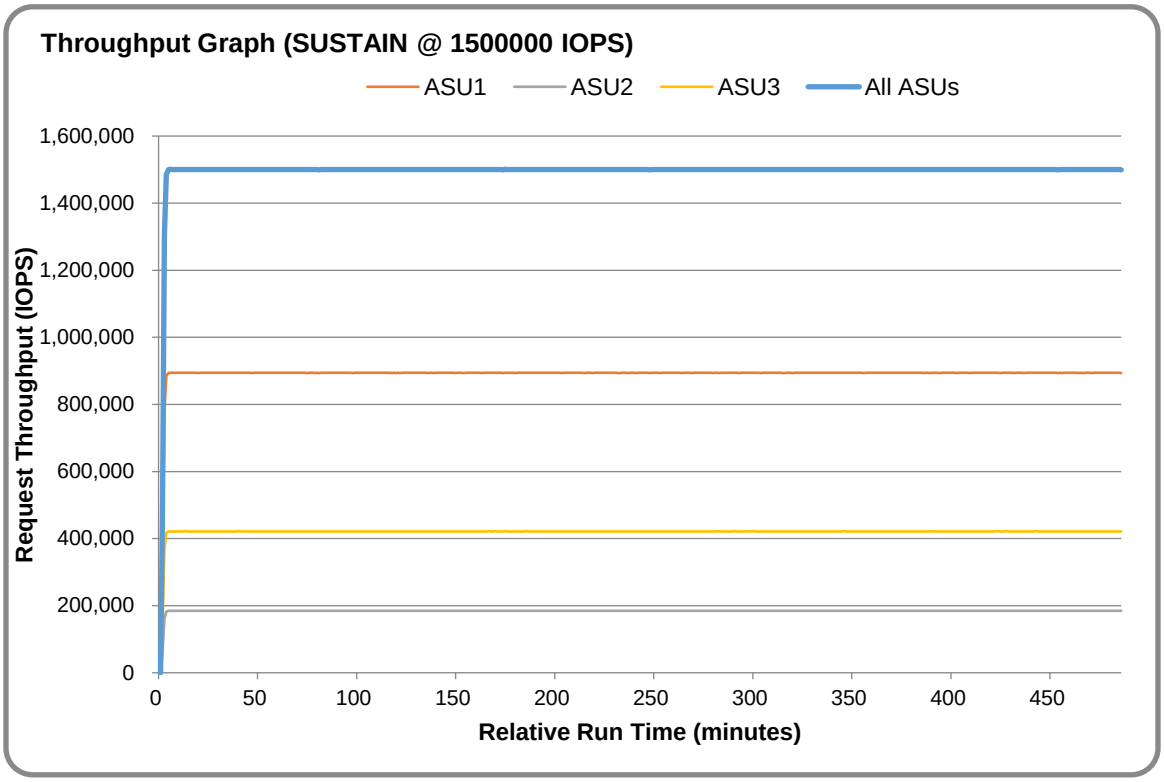
The results file generated during the execution of the SUSTAIN Test Phase is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

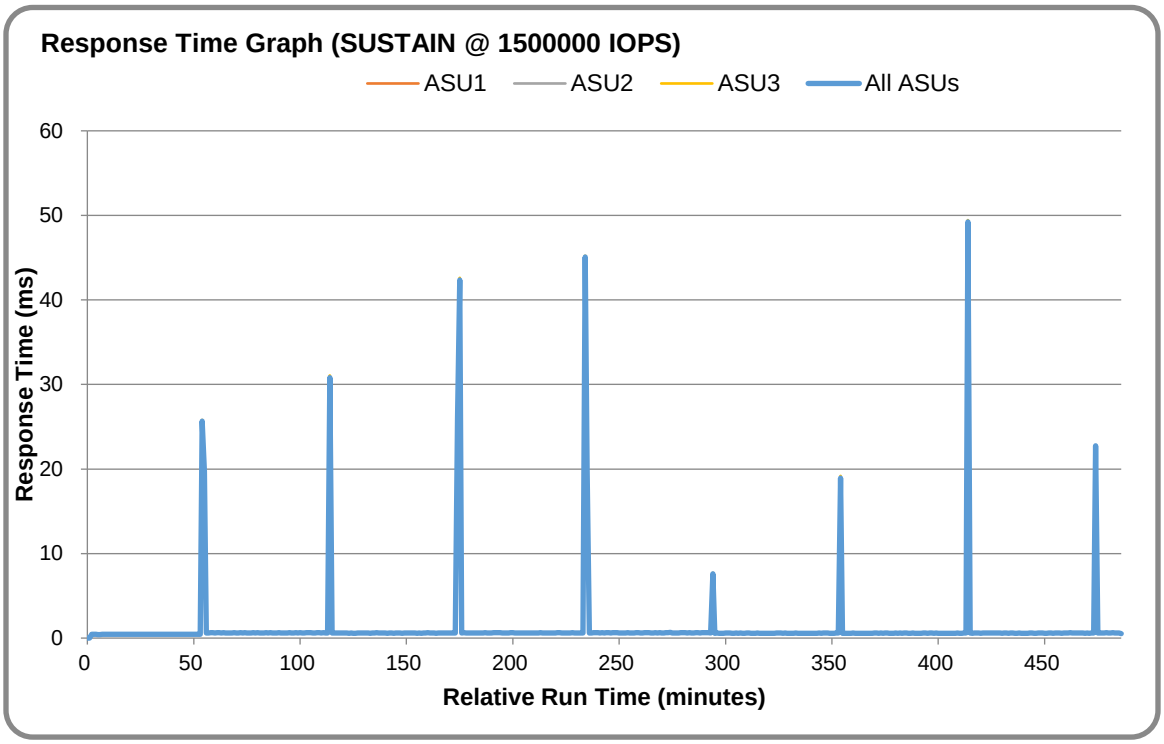
SUSTAIN – Execution Times

Interval	Start Date	Start Time	End Time	Duration
Transition Period	9-Sep-16	19:17:34.973	19:21:34.974	0:04:00.001
Measurement Interval	9-Sep-16	19:21:34.974	3:21:35.974	8:00:01.000

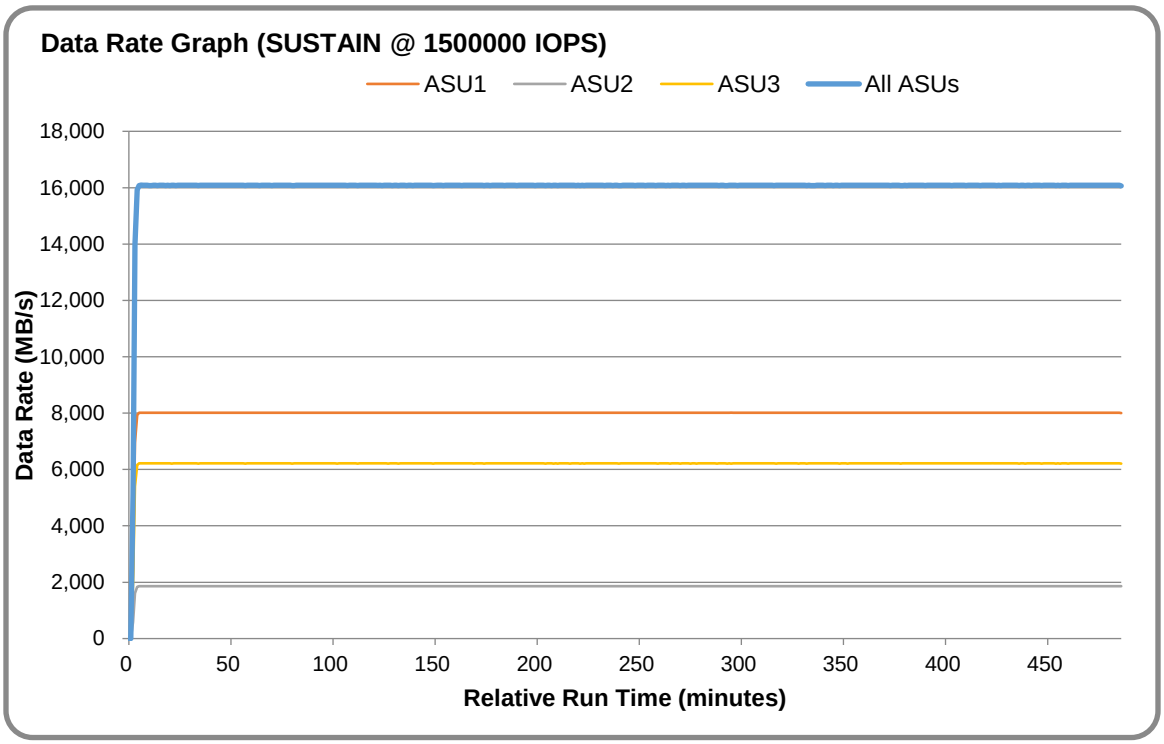
SUSTAIN – Throughput Graph



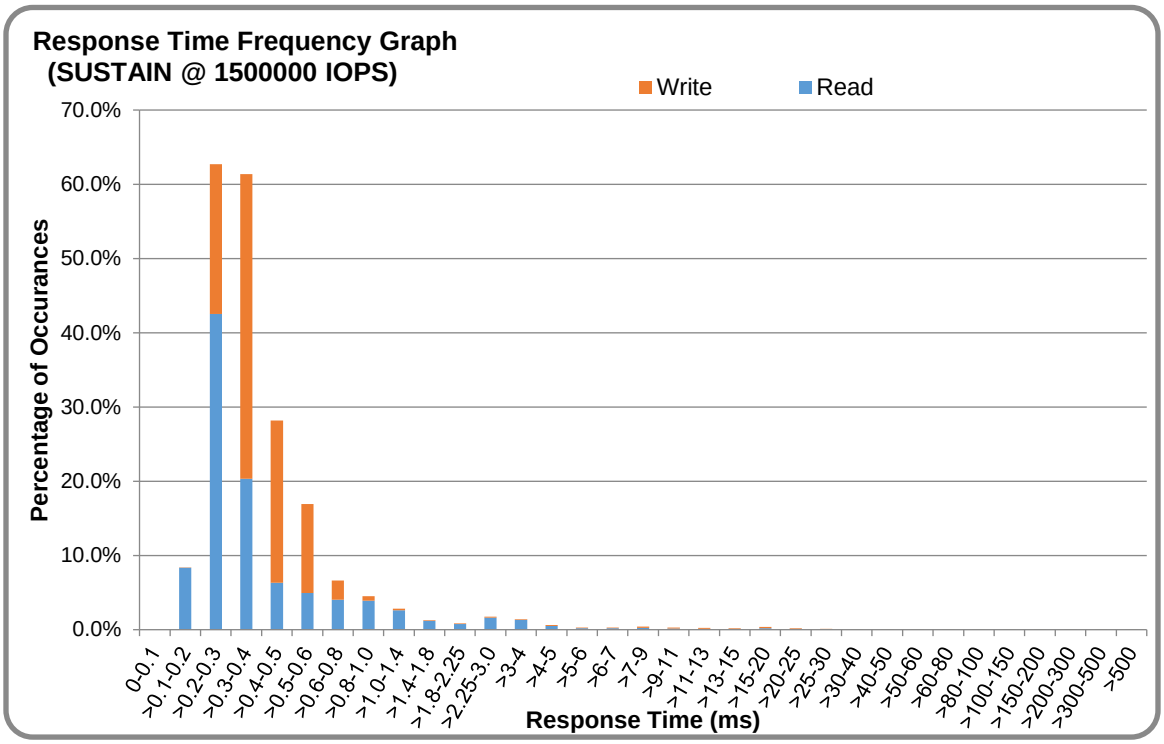
SUSTAIN – Response Time Graph



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	0.0006	0.0002	0.0004	0.0002	0.0008	0.0004	0.0006	0.0002
Difference	0.004%	0.002%	0.004%	0.002%	0.003%	0.001%	0.000%	0.001%

RAMPD_100 Test Phase

RAMPD_100 – Results File

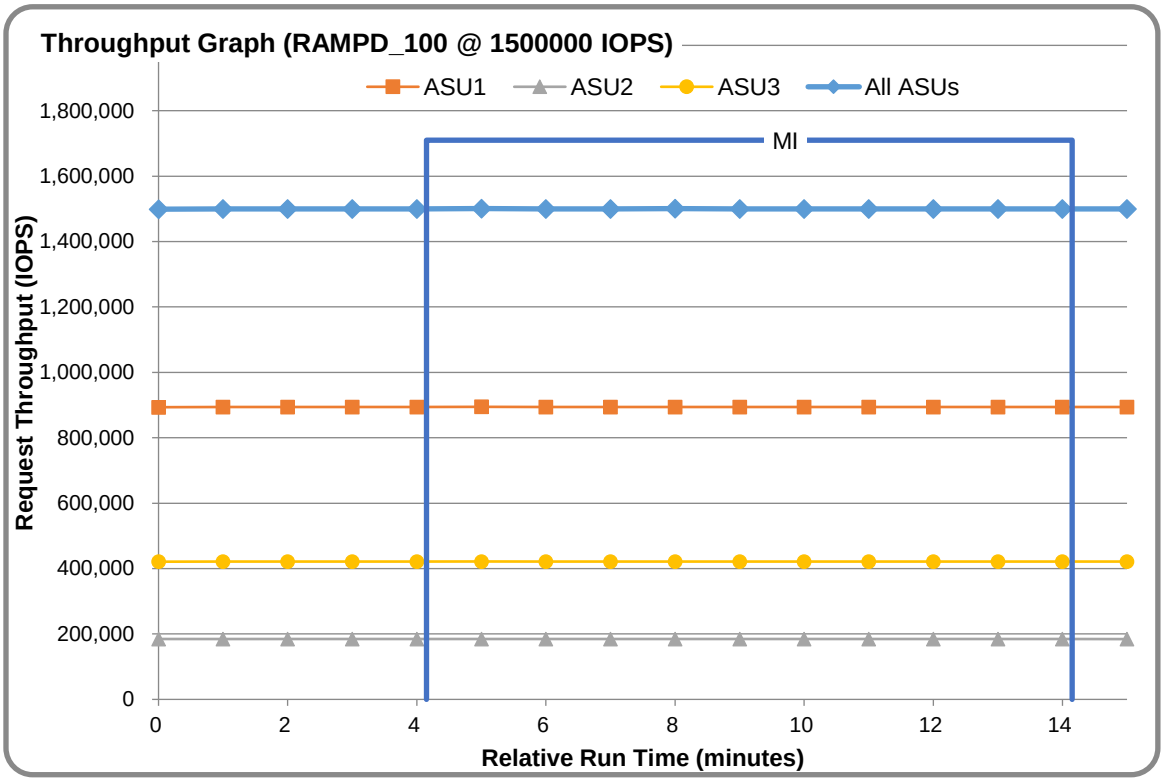
The results file generated during the execution of the RAMPD_100 Test Phase is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

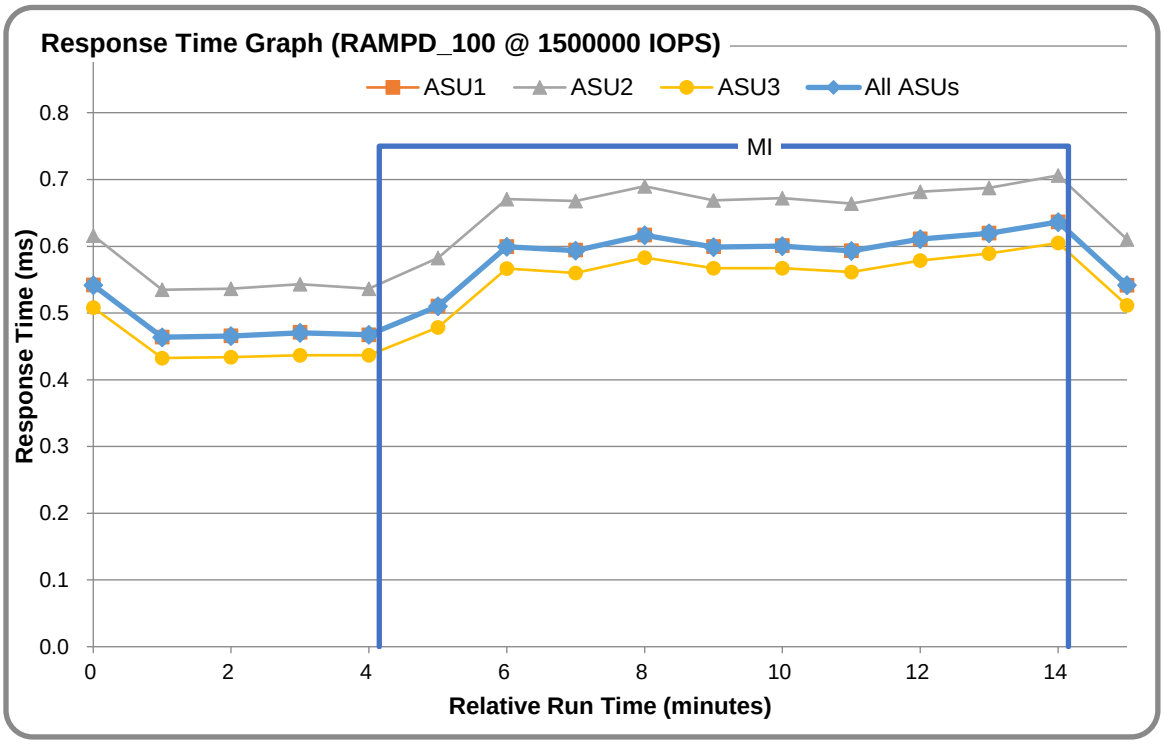
RAMPD_100 – Execution Times

Interval	Start Date	Start Time	End Time	Duration
Transition Period	10-Sep-16	3:22:35.073	3:26:36.074	0:04:01.001
Measurement Interval	10-Sep-16	3:26:36.074	3:36:36.074	0:10:00.000

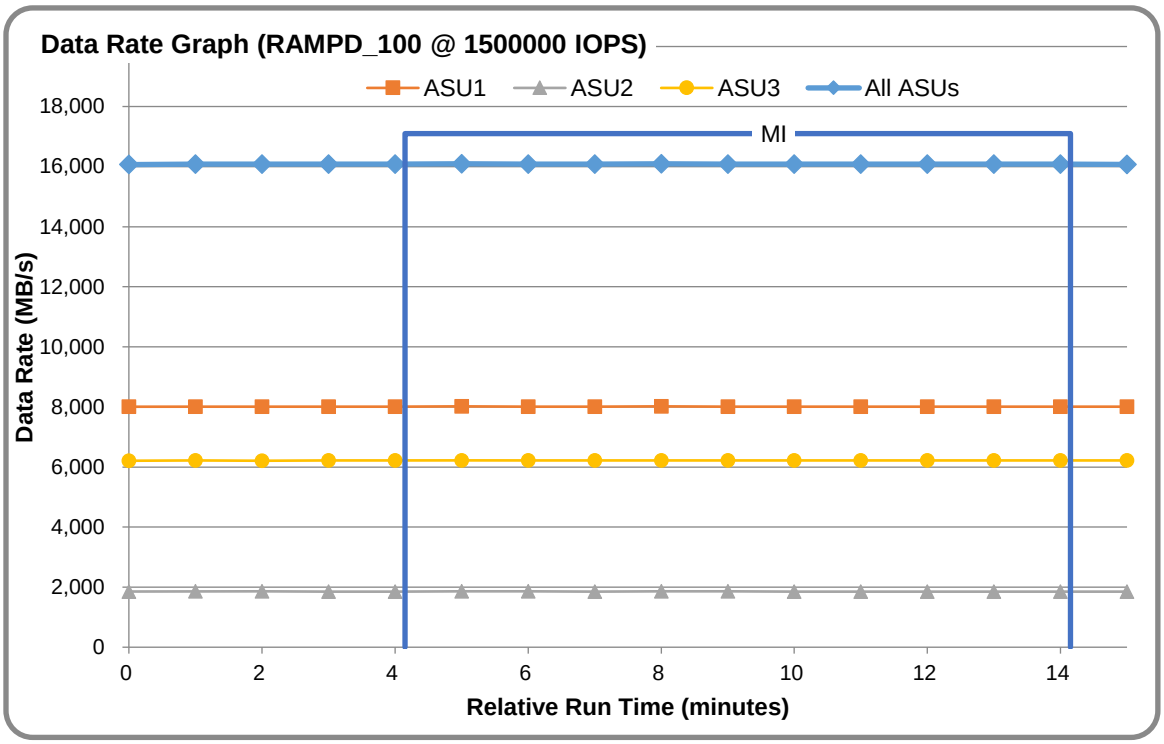
RAMPD_100 – Throughput Graph



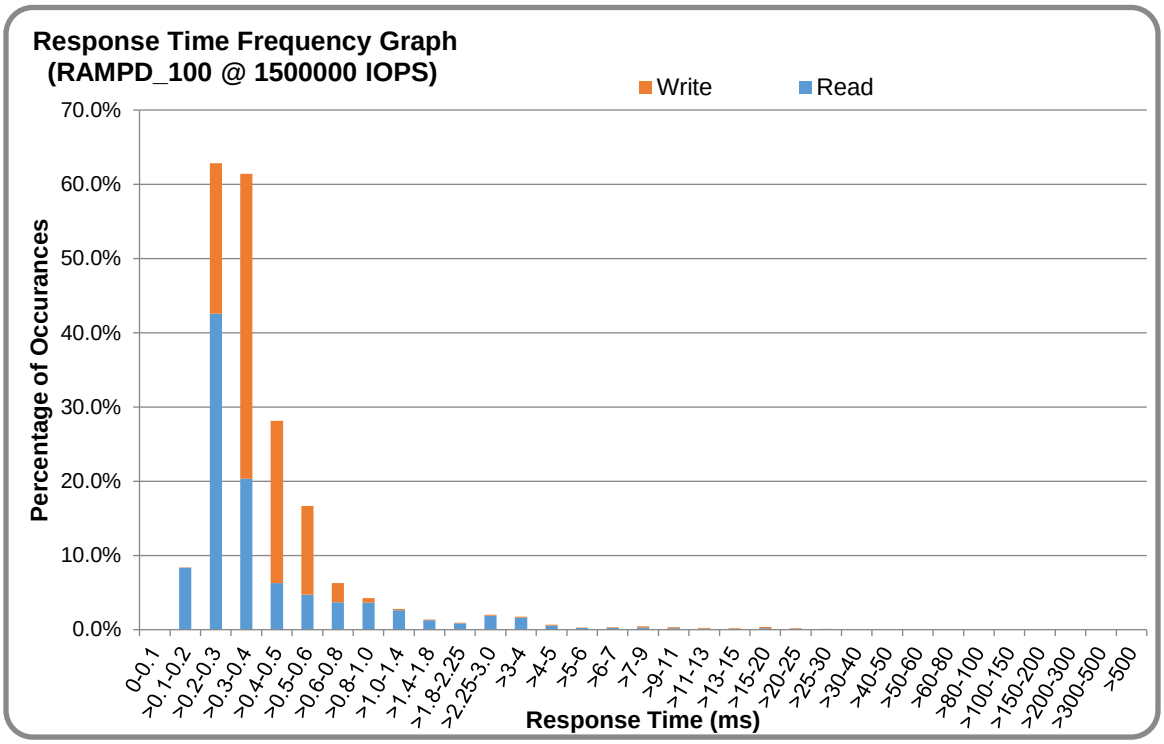
RAMPD_100 – Response Time Graph



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	0.0007	0.0002	0.0003	0.0002	0.0006	0.0004	0.0005	0.0002
Difference	0.017%	0.004%	0.000%	0.002%	0.012%	0.014%	0.003%	0.008%

RAMPD_100 – I/O Request Summary

I/O Requests Completed in the Measurement Interval	900,055,631
I/O Requests Completed with Response Time <= 30 ms	899,794,061
I/O Requests Completed with Response Time > 30 ms	261,570

Response Time Ramp Test

Response Time Ramp Test – Results File

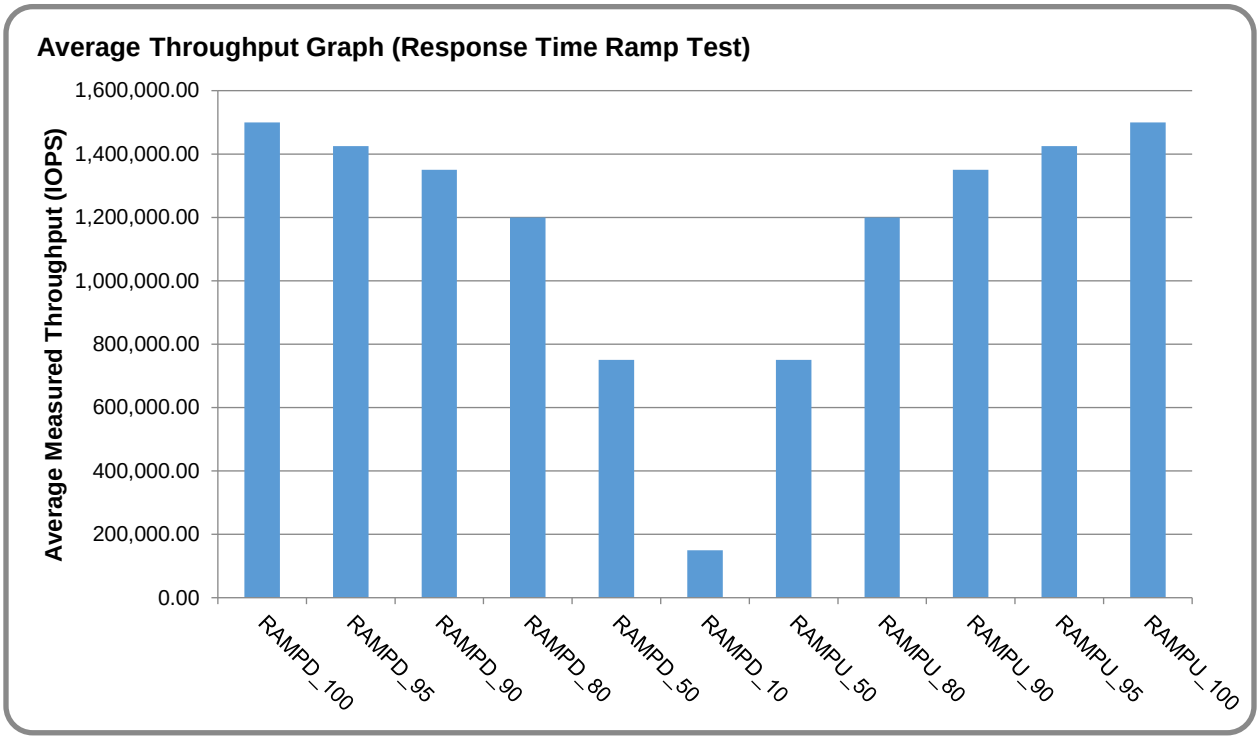
The results file generated during the execution of the Response Time Ramp Test is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

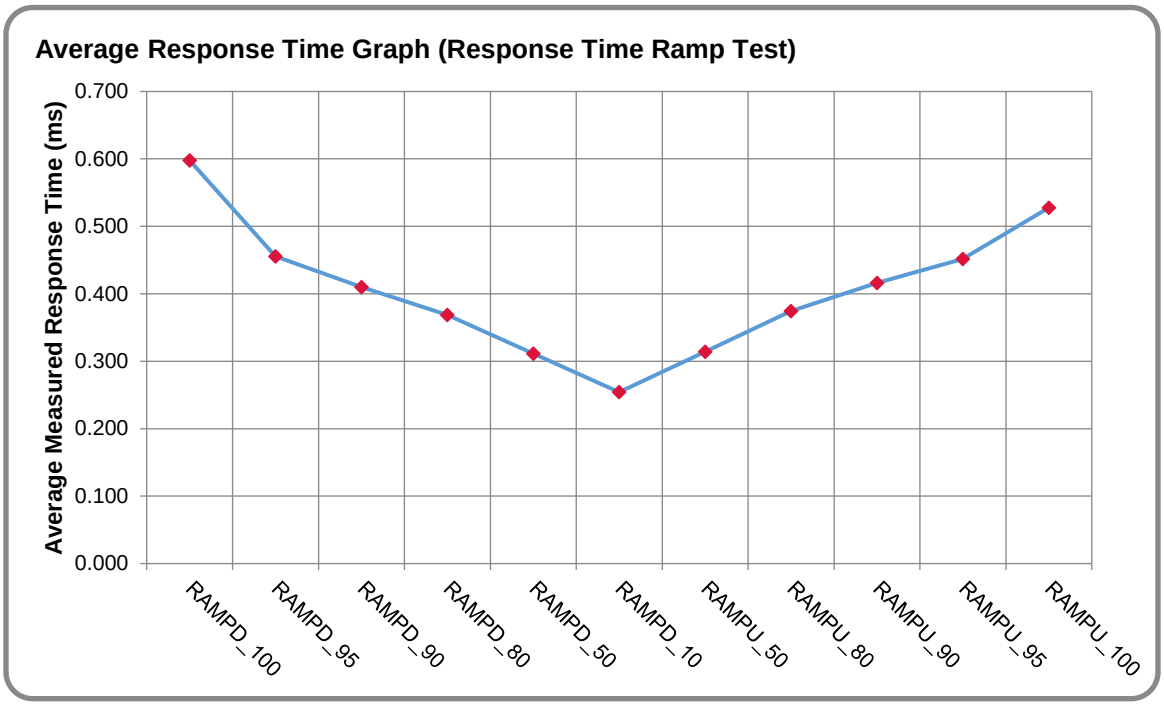
Response Time Ramp Test – Phases

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).

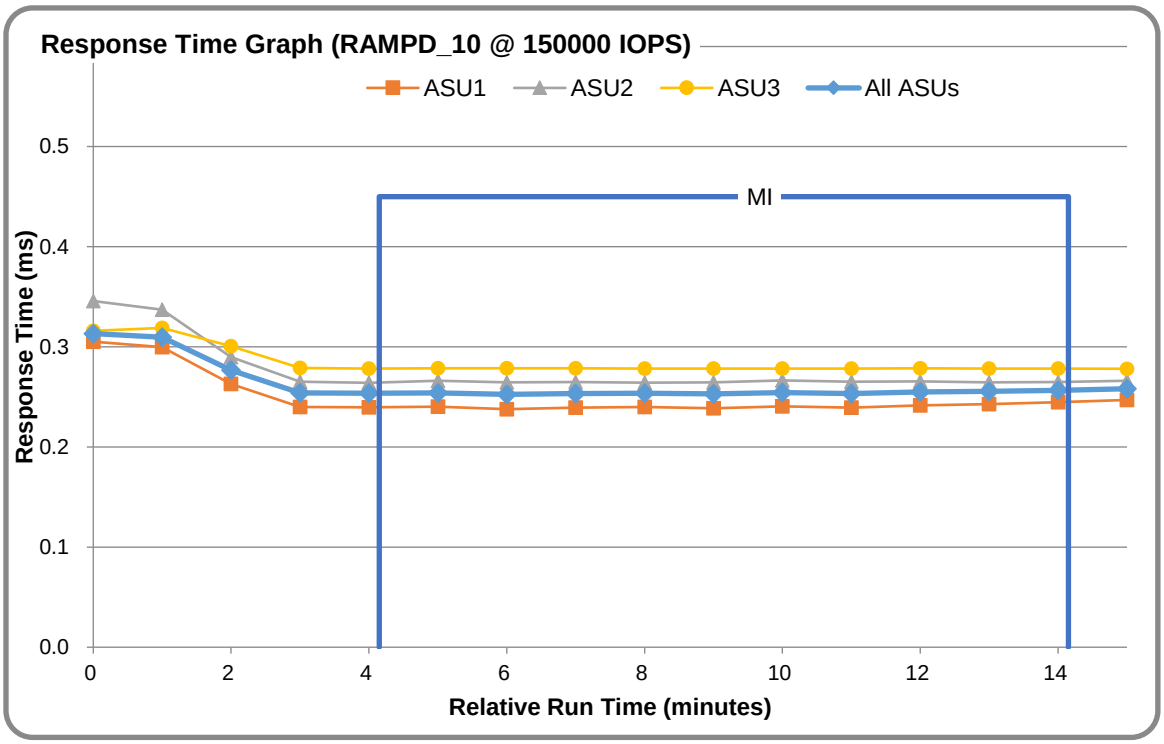
Response Time Ramp Test – Average Throughput Graph



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:

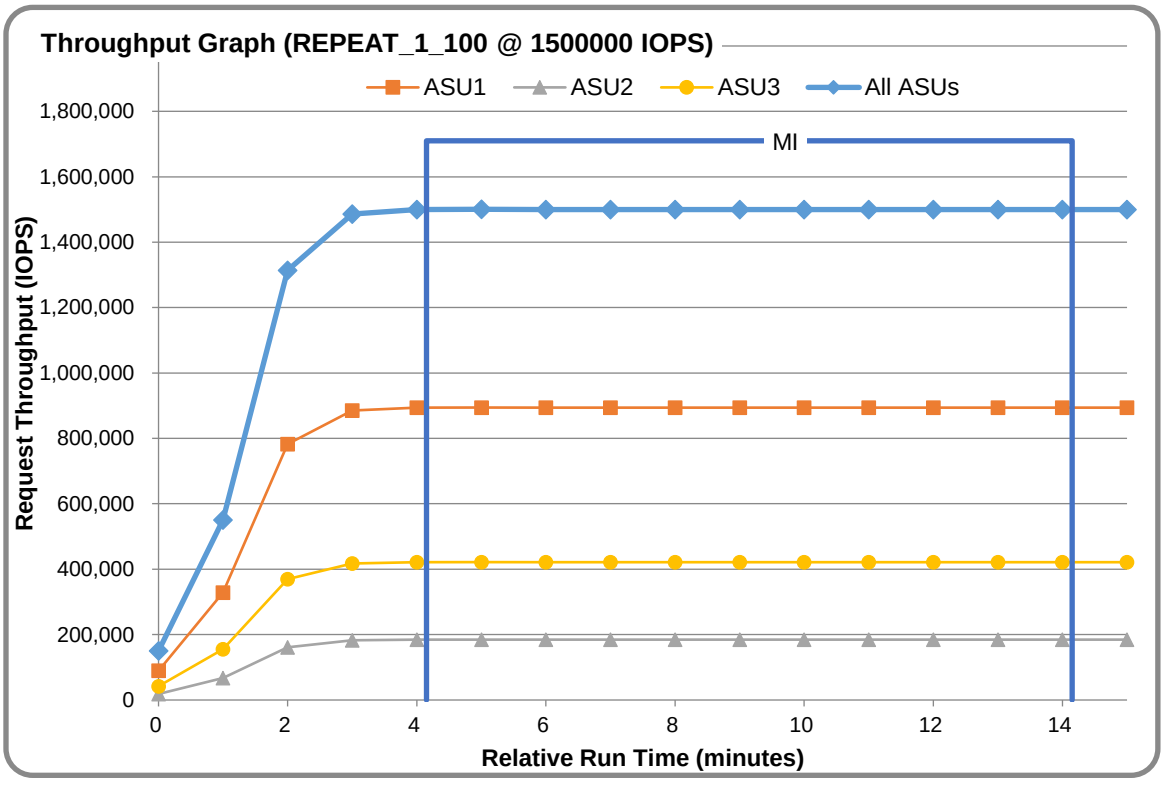
- **SPC1_METRICS_0_Raw_Results.xlsx**

Repeatability Test Results

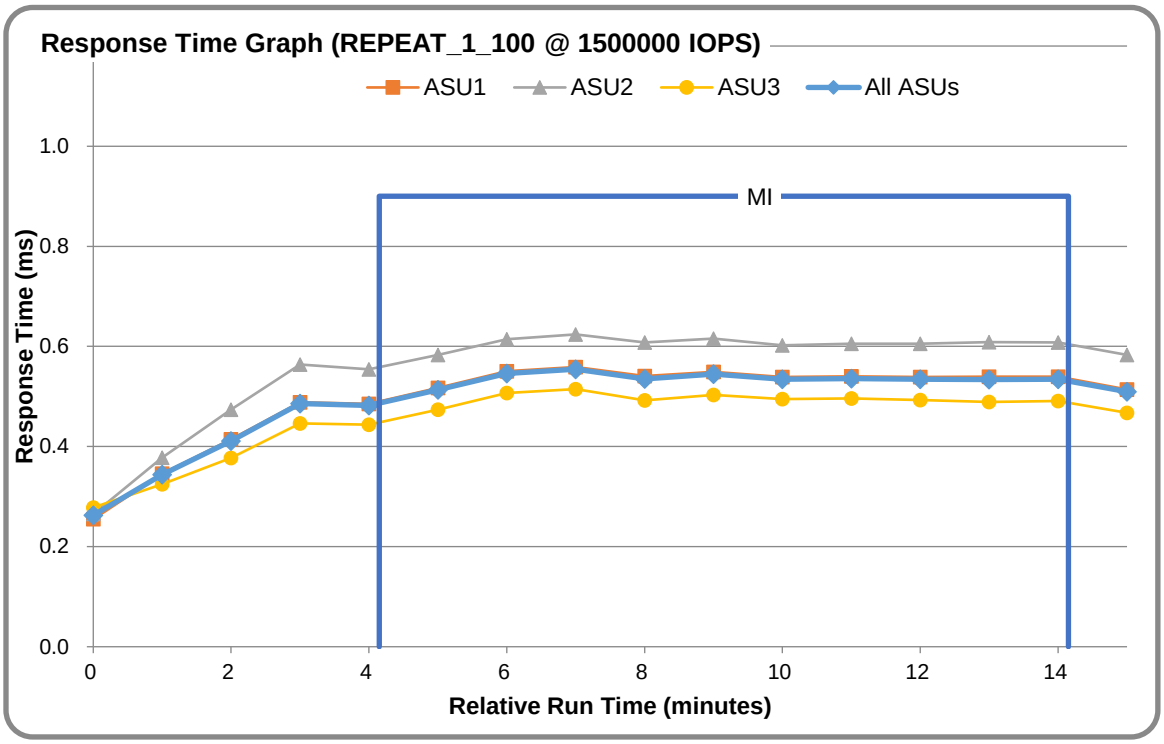
The throughput measurements for the Response Time Ramp Test (RAMPD) and the Repeatability Test Phases (REPEAT_1 and REPEAT_2) are listed in the tables below.

Test Phase	100% IOPS	10% IOPS
RAMPD	1,500,187.8	150,010.6
REPEAT_1	1,500,032.0	150,019.8
REPEAT_2	1,500,158.4	150,026.2

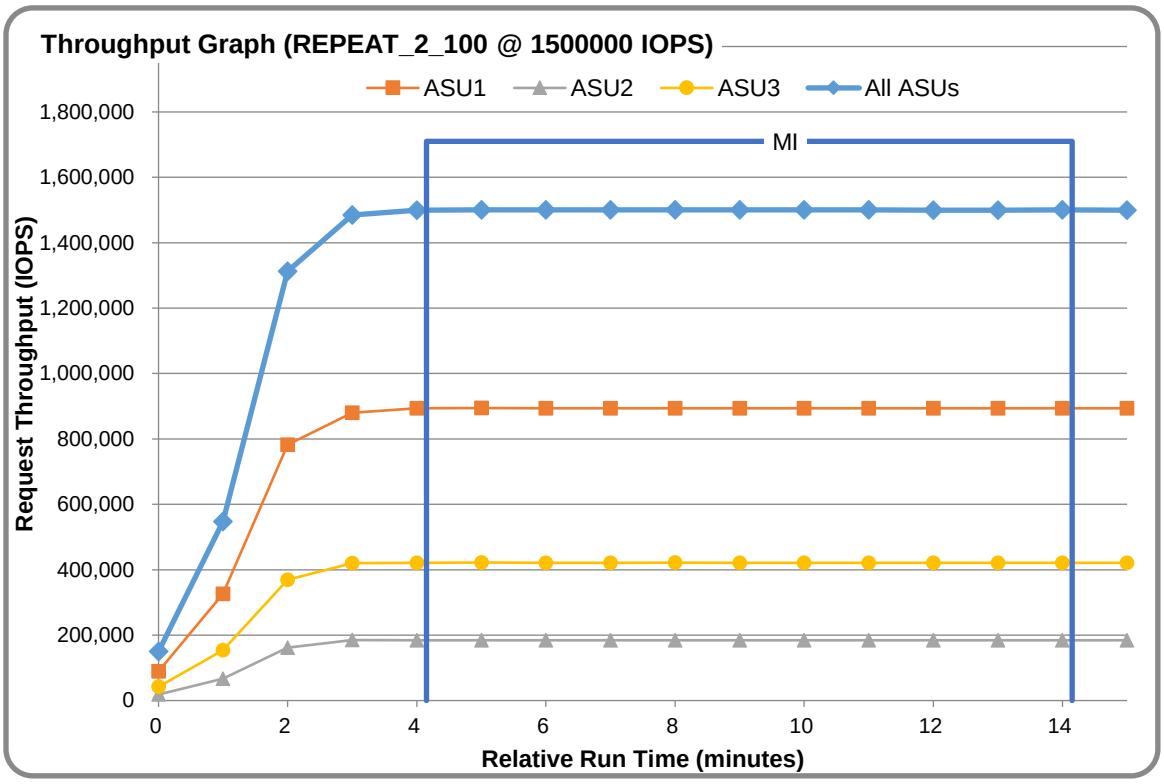
REPEAT_1_100 – Throughput Graph



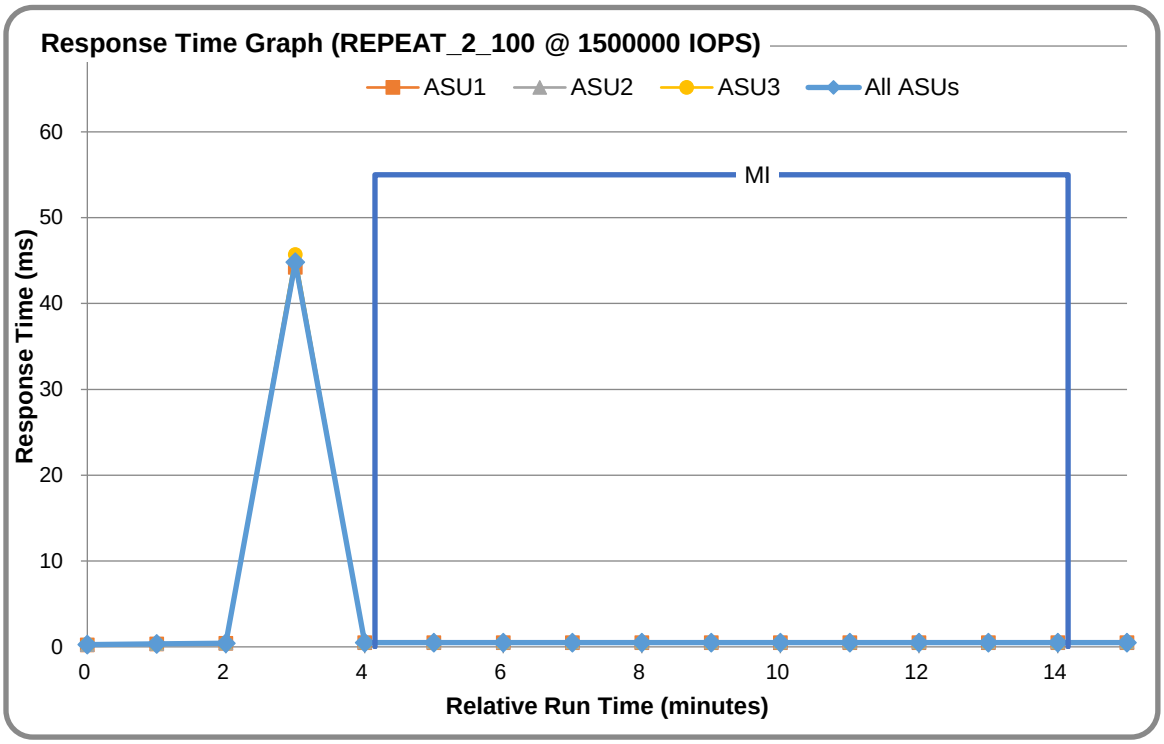
REPEAT_1_100 – Response Time Graph



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	0.2100	0.0180	0.0700	0.0350	0.2810
Variation	0.0005	0.0002	0.0003	0.0002	0.0009	0.0003	0.0007	0.0001
Difference	0.030%	0.015%	0.004%	0.017%	0.011%	0.019%	0.008%	0.001%

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	0.0005	0.0001	0.0005	0.0002	0.0011	0.0002	0.0004	0.0001
Difference	0.034%	0.002%	0.007%	0.006%	0.020%	0.012%	0.017%	0.001%

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	185,871,241
Total Number of Logical Blocks Verified	181,818,330
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

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 VERIFY Test Phase	/SPC1_RESULTS
/C_Tuning	**Tuning parameters and options**	**root**
		/C_Tuning
/D_Creation	**Storage configuration creation**	**root**
step1_makearray.txt	Create the RAID-10 ranks (1)	/D_Creation
step2_mkranks.txt	Create the RAID-10 ranks (2)	/D_Creation
step3_makevols.txt	Create the LUNs	/D_Creation
step4_define_paths.txt	Define the LUN access path	/D_Creation
step5_discover.sh	Discover LUNs, create multi-path “hdisks”	/D_Creation
step6_create_lvs.sh	Create VG and striped LV on the “hdisks”	/D_Creation
step7_importvg.sh	Import VG on all four host systems	/D_Creation
/E_Inventory	**Configuration inventory**	**root**
ds8kConfig.txt	List of Benchmark Config. components	/E_Inventory
/F_Generator	**Workload generator**	**root**
SPC1.asu	Defining LUNs hosting the ASUs	/F_generator
overnight4Host.sh	Executing all test phases up to PERSIST_1	/F_generator
runpersist2.sh	Executing PERSIST_2	

APPENDIX B: THIRD PARTY QUOTATION

None

APPENDIX C: TUNING PARAMETERS AND OPTIONS

All default values were used for tuning parameters and options.

APPENDIX D: STORAGE CONFIGURATION CREATION

Environment

The following scripts, listed below, are scripts written in the DSCLI command language and executed on one of the Host Systems.

- ***step1_makearray.txt***
- ***step2_mkranks.txt***
- ***step3_makevols.txt***
- ***step4_define_paths.txt***

DSCI was installed and configured to allow management of the DS8888.

The ***step5_discover.sh*** script, listed below, is a Shell script executed from an AIX command window on all Host Systems.

The ***step6_create_lvs.sh*** script, listed below, is a Shell script executed from an AIX command window on one of the Host Systems.

The ***step7_importvg.sh*** script, listed below, is a Shell script executed from an AIX command window on all Host Systems.

Create the RAID-10 ranks

The Step1 script, ***step1_makearray.txt***, groups the physical volumes into 32 RAID-10 arrays and the system automatically generates a set of array names, A0-A31. A predefined set of 6 or 8 physical flash cards is associated with each array in a specified "array site". Each "array site" is associated with an HPFE, as shown on the Tested Storage Configuration Diagram (Page 13).

During the execution of the Step1 script, two of the 30 flash cards per HPFE are reserved as spares, as also illustrated on the Tested Storage Configuration Diagram.

The Step1 script configures all "array site" flash cards other than the spares into RAID-10 arrays. Thus, the effect of the script is to produce 32 RAID-10 arrays.

The Step2 script ***step2_mkranks.txt***, defines the arrays, A0-A31, as 32 open system ranks, R0-R31. As in the Step1 script, the rank names are assigned by the system. The Step2 script also defines the ranks R0-R31 to comprise a set of 32 "extentpools" (pools of available storage) with the names P0-P31.

Create the LUNs

The Step3 script, ***step3_makevols.txt***, defines 64 LUNs on the set of 32 RAID-10 ranks. There are 2 LUNs of size 703 GiB on each 4x4 rank, and 2 LUNS of size 523 GiB on each 3x3 rank. All LUNs were used for the benchmark measurements. Each LUN is assigned to one of 4 volume groups, V0-V3, so that paths can be assigned by groups of volumes.

Define the LUN access path

The next Step4 script, ***step4_define_paths.txt***, is used to define the paths by which each LUN can be accessed by AIX. Four AIX lpars are used; each host has 8 connections to the DS8888. The path definitions are created by the Step4 script. Each host WWPN (total of 32) is assigned to one of the four volume groups, V0-V3.

Discover the LUNs and create multi-path "hdisks"

The Step5 script, ***step5_discover.sh***, performs discovery on each of the 8 Host System paths on each of the 4 lpars. In this configuration, AIX MPIO capability is utilized, creating one multi-path hdisk that corresponds to each LUN.

Create volume groups and striped logical volumes on the "hdisks"

The Step6 script, ***step6_create_lvs.sh***, creates volume groups and striped logical volumes on the hdisks. The volume group "stripevg" contains all of the hdisks. The "stripevg" volume group contains 100 logical volumes named "fat*" that are striped across all of the arrays. All of the logical volumes were used for the benchmark measurements.

Import volume groups on all four host systems

The Step7 script, ***step7_importvg.sh***, imports the volume groups as shared volume groups on each host system.

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

step1_makearray.txt

```
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S1
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S2
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S3
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S4
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S5
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S6
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S7
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S8
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S9
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S10
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S11
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S12
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S13
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S14
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S15
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S16
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S17
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S18
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S19
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S20
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S21
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S22
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S23
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S24
```

```
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S25
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S26
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S27
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S28
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S29
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S30
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S31
mkarray -dev IBM.2107-75GAH71 -raidtype 10 -arsite S32
```

step2_makeranks.txt

```
mkrank -dev IBM.2107-75GAH71 -array A0 -stgtype fb  -extpool P0
mkrank -dev IBM.2107-75GAH71 -array A1 -stgtype fb  -extpool P1
mkrank -dev IBM.2107-75GAH71 -array A2 -stgtype fb  -extpool P2
mkrank -dev IBM.2107-75GAH71 -array A3 -stgtype fb  -extpool P3
mkrank -dev IBM.2107-75GAH71 -array A4 -stgtype fb  -extpool P4
mkrank -dev IBM.2107-75GAH71 -array A5 -stgtype fb  -extpool P5
mkrank -dev IBM.2107-75GAH71 -array A6 -stgtype fb  -extpool P6
mkrank -dev IBM.2107-75GAH71 -array A7 -stgtype fb  -extpool P7
mkrank -dev IBM.2107-75GAH71 -array A8 -stgtype fb  -extpool P8
mkrank -dev IBM.2107-75GAH71 -array A9 -stgtype fb  -extpool P9
mkrank -dev IBM.2107-75GAH71 -array A10 -stgtype fb -extpool P10
mkrank -dev IBM.2107-75GAH71 -array A11 -stgtype fb -extpool P11
mkrank -dev IBM.2107-75GAH71 -array A12 -stgtype fb -extpool P12
mkrank -dev IBM.2107-75GAH71 -array A13 -stgtype fb -extpool P13
mkrank -dev IBM.2107-75GAH71 -array A14 -stgtype fb -extpool P14
mkrank -dev IBM.2107-75GAH71 -array A15 -stgtype fb -extpool P15
mkrank -dev IBM.2107-75GAH71 -array A16 -stgtype fb -extpool P16
mkrank -dev IBM.2107-75GAH71 -array A17 -stgtype fb -extpool P17
mkrank -dev IBM.2107-75GAH71 -array A18 -stgtype fb -extpool P18
mkrank -dev IBM.2107-75GAH71 -array A19 -stgtype fb -extpool P19
mkrank -dev IBM.2107-75GAH71 -array A20 -stgtype fb -extpool P20
mkrank -dev IBM.2107-75GAH71 -array A21 -stgtype fb -extpool P21
mkrank -dev IBM.2107-75GAH71 -array A22 -stgtype fb -extpool P22
mkrank -dev IBM.2107-75GAH71 -array A23 -stgtype fb -extpool P23
mkrank -dev IBM.2107-75GAH71 -array A24 -stgtype fb -extpool P24
mkrank -dev IBM.2107-75GAH71 -array A25 -stgtype fb -extpool P25
mkrank -dev IBM.2107-75GAH71 -array A26 -stgtype fb -extpool P26
mkrank -dev IBM.2107-75GAH71 -array A27 -stgtype fb -extpool P27
mkrank -dev IBM.2107-75GAH71 -array A28 -stgtype fb -extpool P28
mkrank -dev IBM.2107-75GAH71 -array A29 -stgtype fb -extpool P29
mkrank -dev IBM.2107-75GAH71 -array A30 -stgtype fb -extpool P30
mkrank -dev IBM.2107-75GAH71 -array A31 -stgtype fb -extpool
```

step3_makevols.txt

```
mkfbvol -dev IBM.2107-75GAH71 -extpool P0 -type ds -cap 703 -name da_#h 1004
mkfbvol -dev IBM.2107-75GAH71 -extpool P0 -type ds -cap 703 -name da_#h 1005
mkfbvol -dev IBM.2107-75GAH71 -extpool P2 -type ds -cap 523 -name da_#h 1006
mkfbvol -dev IBM.2107-75GAH71 -extpool P2 -type ds -cap 523 -name da_#h 1007
mkfbvol -dev IBM.2107-75GAH71 -extpool P4 -type ds -cap 703 -name da_#h 1200
mkfbvol -dev IBM.2107-75GAH71 -extpool P4 -type ds -cap 703 -name da_#h 1201
mkfbvol -dev IBM.2107-75GAH71 -extpool P6 -type ds -cap 523 -name da_#h 1202
mkfbvol -dev IBM.2107-75GAH71 -extpool P6 -type ds -cap 523 -name da_#h 1203
mkfbvol -dev IBM.2107-75GAH71 -extpool P1 -type ds -cap 703 -name da_#h 1104
```

```
mkfbvol -dev IBM.2107-75GAH71 -extpool P1 -type ds -cap 703 -name da_#h 1105
mkfbvol -dev IBM.2107-75GAH71 -extpool P3 -type ds -cap 523 -name da_#h 1106
mkfbvol -dev IBM.2107-75GAH71 -extpool P3 -type ds -cap 523 -name da_#h 1107
mkfbvol -dev IBM.2107-75GAH71 -extpool P5 -type ds -cap 703 -name da_#h 1300
mkfbvol -dev IBM.2107-75GAH71 -extpool P5 -type ds -cap 703 -name da_#h 1301
mkfbvol -dev IBM.2107-75GAH71 -extpool P7 -type ds -cap 523 -name da_#h 1302
mkfbvol -dev IBM.2107-75GAH71 -extpool P7 -type ds -cap 523 -name da_#h 1303

mkfbvol -dev IBM.2107-75GAH71 -extpool P8  -type ds -cap 703 -name da_#h 1400
mkfbvol -dev IBM.2107-75GAH71 -extpool P8  -type ds -cap 703 -name da_#h 1401
mkfbvol -dev IBM.2107-75GAH71 -extpool P10 -type ds -cap 523 -name da_#h 1402
mkfbvol -dev IBM.2107-75GAH71 -extpool P10 -type ds -cap 523 -name da_#h 1403
mkfbvol -dev IBM.2107-75GAH71 -extpool P12 -type ds -cap 703 -name da_#h 1604
mkfbvol -dev IBM.2107-75GAH71 -extpool P12 -type ds -cap 703 -name da_#h 1605
mkfbvol -dev IBM.2107-75GAH71 -extpool P14 -type ds -cap 523 -name da_#h 1606
mkfbvol -dev IBM.2107-75GAH71 -extpool P14 -type ds -cap 523 -name da_#h 1607
mkfbvol -dev IBM.2107-75GAH71 -extpool P9  -type ds -cap 703 -name da_#h 1500
mkfbvol -dev IBM.2107-75GAH71 -extpool P9  -type ds -cap 703 -name da_#h 1501
mkfbvol -dev IBM.2107-75GAH71 -extpool P11 -type ds -cap 523 -name da_#h 1502
mkfbvol -dev IBM.2107-75GAH71 -extpool P11 -type ds -cap 523 -name da_#h 1503
mkfbvol -dev IBM.2107-75GAH71 -extpool P13 -type ds -cap 703 -name da_#h 1704
mkfbvol -dev IBM.2107-75GAH71 -extpool P13 -type ds -cap 703 -name da_#h 1705
mkfbvol -dev IBM.2107-75GAH71 -extpool P15 -type ds -cap 523 -name da_#h 1706
mkfbvol -dev IBM.2107-75GAH71 -extpool P15 -type ds -cap 523 -name da_#h 1707

mkfbvol -dev IBM.2107-75GAH71 -extpool P16 -type ds -cap 703 -name da_#h 1800
mkfbvol -dev IBM.2107-75GAH71 -extpool P16 -type ds -cap 703 -name da_#h 1801
mkfbvol -dev IBM.2107-75GAH71 -extpool P18 -type ds -cap 523 -name da_#h 1802
mkfbvol -dev IBM.2107-75GAH71 -extpool P18 -type ds -cap 523 -name da_#h 1803
mkfbvol -dev IBM.2107-75GAH71 -extpool P20 -type ds -cap 703 -name da_#h 1A04
mkfbvol -dev IBM.2107-75GAH71 -extpool P20 -type ds -cap 703 -name da_#h 1A05
mkfbvol -dev IBM.2107-75GAH71 -extpool P22 -type ds -cap 523 -name da_#h 1A06
mkfbvol -dev IBM.2107-75GAH71 -extpool P22 -type ds -cap 523 -name da_#h 1A07
mkfbvol -dev IBM.2107-75GAH71 -extpool P17 -type ds -cap 703 -name da_#h 1900
mkfbvol -dev IBM.2107-75GAH71 -extpool P17 -type ds -cap 703 -name da_#h 1901
mkfbvol -dev IBM.2107-75GAH71 -extpool P19 -type ds -cap 523 -name da_#h 1902
mkfbvol -dev IBM.2107-75GAH71 -extpool P19 -type ds -cap 523 -name da_#h 1903
mkfbvol -dev IBM.2107-75GAH71 -extpool P21 -type ds -cap 703 -name da_#h 1B04
mkfbvol -dev IBM.2107-75GAH71 -extpool P21 -type ds -cap 703 -name da_#h 1B05
mkfbvol -dev IBM.2107-75GAH71 -extpool P23 -type ds -cap 523 -name da_#h 1B06
mkfbvol -dev IBM.2107-75GAH71 -extpool P23 -type ds -cap 523 -name da_#h 1B07

mkfbvol -dev IBM.2107-75GAH71 -extpool P24 -type ds -cap 703 -name da_#h 1C04
mkfbvol -dev IBM.2107-75GAH71 -extpool P24 -type ds -cap 703 -name da_#h 1C05
mkfbvol -dev IBM.2107-75GAH71 -extpool P26 -type ds -cap 523 -name da_#h 1C06
mkfbvol -dev IBM.2107-75GAH71 -extpool P26 -type ds -cap 523 -name da_#h 1C07
mkfbvol -dev IBM.2107-75GAH71 -extpool P28 -type ds -cap 703 -name da_#h 1E00
mkfbvol -dev IBM.2107-75GAH71 -extpool P28 -type ds -cap 703 -name da_#h 1E01
mkfbvol -dev IBM.2107-75GAH71 -extpool P30 -type ds -cap 523 -name da_#h 1E02
mkfbvol -dev IBM.2107-75GAH71 -extpool P30 -type ds -cap 523 -name da_#h 1E03
mkfbvol -dev IBM.2107-75GAH71 -extpool P25 -type ds -cap 703 -name da_#h 1D04
mkfbvol -dev IBM.2107-75GAH71 -extpool P25 -type ds -cap 703 -name da_#h 1D05
mkfbvol -dev IBM.2107-75GAH71 -extpool P27 -type ds -cap 523 -name da_#h 1D06
mkfbvol -dev IBM.2107-75GAH71 -extpool P27 -type ds -cap 523 -name da_#h 1D07
mkfbvol -dev IBM.2107-75GAH71 -extpool P29 -type ds -cap 703 -name da_#h 1F00
mkfbvol -dev IBM.2107-75GAH71 -extpool P29 -type ds -cap 703 -name da_#h 1F01
mkfbvol -dev IBM.2107-75GAH71 -extpool P31 -type ds -cap 523 -name da_#h 1F02
mkfbvol -dev IBM.2107-75GAH71 -extpool P31 -type ds -cap 523 -name da_#h 1F03

mkvolgrp -dev IBM.2107-75GAH71 -hosttype pSeries -volume 1004-1007,1104-
   1107,1800-1803,1900-1903 V0
```

```
mkvolgrp -dev IBM.2107-75GAH71 -hosttype pSeries -volume 1200-1203,1300-
   1303,1A04-1A07,1B04-1B07 V1
mkvolgrp -dev IBM.2107-75GAH71 -hosttype pSeries -volume 1400-1403,1500-
   1503,1C04-1C07,1D04-1D07 V2
mkvolgrp -dev IBM.2107-75GAH71 -hosttype pSeries -volume 1604-1607,1704-
   1707,1E00-1E03,1F00-1F03 V3
```

step4_define_paths.txt

```
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05611 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1a_FCS0
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05612 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1a_FCS1
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05431 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1b_FCS0
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05432 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1b_FCS1
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB056D1 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1c_FCS0
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB056D2 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1c_FCS1
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05572 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1d_FCS0
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05573 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V0 1b_1d_FCS1

MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05560 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1a_FCS2
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05561 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1a_FCS3
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB055B7 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1b_FCS2
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB055B8 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1b_FCS3
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05638 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1c_FCS2
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05639 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1c_FCS3
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB053A1 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1d_FCS2
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB053A2 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V1 1b_1d_FCS3

MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05623 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1a_FCS4
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05624 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1a_FCS5
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB056B0 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1b_FCS4
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB056B1 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1b_FCS5
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB056A7 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1c_FCS6
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB056A8 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1c_FCS7
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05554 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1d_FCS6
MKHOSTCONNECT -DEV IBM.2107-75GAH71 -WWNAME 10000090FAB05555 -PROFILE "IBM
   PSERIES - AIX" -VOLGRP V2 1b_1d_FCS7
```

```
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB05332  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1a_FCS6
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB05333  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1a_FCS7
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB05A0A  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1b_FCS8
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB05A0B  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1b_FCS9
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB055C6  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1c_FCS10
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB055C7  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1c_FCS11
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB056BF  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1d_FCS10
MKHOSTCONNECT  -DEV  IBM.2107-75GAH71  -WWNAME  10000090FAB056C0  -PROFILE  "IBM
   PSERIES - AIX" -VOLGRP V3 1b_1d_FCS11
```

step5_discover.sh

```
cfgmgr
```

step6_createlvs.sh

```
FIRST=1
LAST=64
hdisks=""

i=$FIRST
while [ i -le LAST ]
do
        hdisks="$hdisks hdisk$i"
        (( i=i+1 ))
done

mkvg -S -P 64 -f -y stripevg -s 1024 $hdisks


i=1
while [[ i -le 100 ]]
do
        mklv -a e -y fat$i -x 5000 -u 64 -S 128M stripevg 320
        (( i=i+1 ))
done

varyoffvg stripevg; exportvg stripevg
```

step7_importvg.sh

```
importvg -ny stripevg hdisk1;  varyonvg -bu stripevg
```

APPENDIX E: CONFIGURATION INVENTORY

An inventory of the Tested Storage Configuration was collected during the execution the script *step5_discover.sh*. It generated the following log file:

- ***ds8kConfig.txt*** List of configured components

The above log file is included in the Supporting Files (see Appendix A).

APPENDIX F: WORKLOAD GENERATOR

The ASUs accessed by the SPC-1 workload generator, are defined based upon the LUNs rfat1, rfat2, …, rfat100, using the script ***SPC1.asu***.

The phases of the benchmark are executed using the script ***overnight4Host.sh***, up until the end of the PERSIST_1 test phase. The script was truncated by commenting out the execution of the PERSIST_2 test phase (as shown below).

The PERSIST_2 test phase is executed using the script ***runpersist2.sh***.

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

SPC1.asu

```
offset=0
--
asu=1
size=320gib
device=/dev/rfat1
device=/dev/rfat2
device=/dev/rfat3
device=/dev/rfat4
device=/dev/rfat5
device=/dev/rfat6
device=/dev/rfat7
device=/dev/rfat8
device=/dev/rfat9
device=/dev/rfat10
device=/dev/rfat11
device=/dev/rfat12
device=/dev/rfat13
device=/dev/rfat14
device=/dev/rfat15
device=/dev/rfat16
device=/dev/rfat17
device=/dev/rfat18
device=/dev/rfat19
device=/dev/rfat20
device=/dev/rfat21
device=/dev/rfat22
device=/dev/rfat23
device=/dev/rfat24
device=/dev/rfat25
device=/dev/rfat26
device=/dev/rfat27
device=/dev/rfat28
device=/dev/rfat29
device=/dev/rfat30
device=/dev/rfat31
device=/dev/rfat32
device=/dev/rfat33
device=/dev/rfat34
device=/dev/rfat35
device=/dev/rfat36
device=/dev/rfat37
```

```
device=/dev/rfat38
device=/dev/rfat39
device=/dev/rfat40
device=/dev/rfat41
device=/dev/rfat42
device=/dev/rfat43
device=/dev/rfat44
device=/dev/rfat45
--
asu=2
size=320gib
device=/dev/rfat46
device=/dev/rfat47
device=/dev/rfat48
device=/dev/rfat49
device=/dev/rfat50
device=/dev/rfat51
device=/dev/rfat52
device=/dev/rfat53
device=/dev/rfat54
device=/dev/rfat55
device=/dev/rfat56
device=/dev/rfat57
device=/dev/rfat58
device=/dev/rfat59
device=/dev/rfat60
device=/dev/rfat61
device=/dev/rfat62
device=/dev/rfat63
device=/dev/rfat64
device=/dev/rfat65
device=/dev/rfat66
device=/dev/rfat67
device=/dev/rfat68
device=/dev/rfat69
device=/dev/rfat70
device=/dev/rfat71
device=/dev/rfat72
device=/dev/rfat73
device=/dev/rfat74
device=/dev/rfat75
device=/dev/rfat76
device=/dev/rfat77
device=/dev/rfat78
device=/dev/rfat79
device=/dev/rfat80
device=/dev/rfat81
device=/dev/rfat82
device=/dev/rfat83
device=/dev/rfat84
device=/dev/rfat85
device=/dev/rfat86
device=/dev/rfat87
device=/dev/rfat88
device=/dev/rfat89
device=/dev/rfat90
--
asu=3
size=320gib
device=/dev/rfat91
device=/dev/rfat92
```

```
device=/dev/rfat93
device=/dev/rfat94
device=/dev/rfat95
device=/dev/rfat96
device=/dev/rfat97
device=/dev/rfat98
device=/dev/rfat99
device=/dev/rfat100
```

overnight4Host.sh

```
#Sequence of tests needed for an audited SPC-1 submission.
#For internal use, the persistance test can be omitted.
#If the content of storage does not matter to performance (e.g. a fully allocated
   HDD config) INIT can be omitted.
outputDir=/perform/spc1/8888/Four_p8_Server/smt4_32Path32PQ_8BHRaid10_officialR
   un_1.5M
export PATH=/perform/spc1/8888:$PATH
ds8kConfig=$outputDir/ds8kConfig.txt

if [ ! -d $outputDir ]; then
    mkdir -p $outputDir
fi

LINE="================================================================================
   ======="

lsvg stripevg >> $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
lsvg -p stripevg >> $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
lsvg -l stripevg >> $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
dscli -hmc1 perfss02h -user admin -passwd passw0rd lsarray -dev IBM.2107-75GAH71
   -l >> $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
dscli -hmc1 perfss02h -user admin -passwd passw0rd lsddm >> $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
dscli -hmc1 perfss02h -user admin -passwd passw0rd lsrank -dev IBM.2107-75GAH71
   -l >> $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
dscli -hmc1 perfss02h -user admin -passwd passw0rd lsda IBM.2107-75GAH71 >>
   $ds8kConfig
echo "$LINE\n\n" >> $ds8kConfig
dscli -hmc1 perfss02h -user admin -passwd passw0rd lsioport -dev IBM.2107-75GAH71
   -l >> $ds8kConfig


spc1 -master 4HOST-31-core.HST -run SPC1_INIT -output $outputDir -iops 10000 -
   storage SPC1.8BhRaid10.asu -slave_iops 1000 -iops_per_session 1000
spc1 -run SPC1_VERIFY -output $outputDir -iops 100 -storage SPC1.8BhRaid10.asu
spc1 -master 4HOST-31-core.HST -run SPC1_METRICS -output $outputDir -iops 1500000
   -storage SPC1.8BhRaid10.asu
spc1 -run SPC1_VERIFY -output $outputDir -iops 100 -storage SPC1.8BhRaid10.asu
spc1 -master 4HOST-31-core.HST -run SPC1_PERSIST_1 -output $outputDir -iops
   375000 -storage SPC1.8BhRaid10.asu

#For formal submission the following run should occur after a power cycle
#spc1 -master 4HOST-31-core.HST -run SPC1_PERSIST_2 -output $outputDir -iops
   375000 -storage SPC1.8BhRaid10.asu
```

```
perfsh1b-1a (/perform/spc1/8888/Four_p8_Server)
```

runpersist2.sh

```
export PATH=/perform/spc1/8888:$PATH
outputDir=/perform/spc1/8888/Four_p8_Server/smt4_32Path32PQ_8BHRaid10_officialR
   un_1.5M
spc1 -master 4HOST-31-core.HST -run SPC1_PERSIST_2 -output $outputDir -iops
   375000 -storage SPC1.8BhRaid10.asu
```