



# SPC BENCHMARK 1™

# FULL DISCLOSURE REPORT

## HUAWEI TECHNOLOGIES CO., LTD.
## OCEANSTOR 5510 V5

## SPC-1 V3.9.1

**SUBMISSION IDENTIFIER: A32016**

**SUBMITTED FOR REVIEW: AUGUST 3, 2020**

## First Edition – August 2020

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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.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

Zhong Xu
Huawei Technologies Co., Ltd.
Huawei Industrial Base, Bantian, Longgang
Shenzhen city
Guangdong province
China

August 1, 2020

I verified the SPC Benchmark 1™ (SPC-1™ v3.9.1) test execution and performance results of the following Tested Storage Product:

**OceanStor 5510 V5**

The results were:

| | |
|---|---|
| **SPC-1 IOPS™** | **3,800,781** |
| **SPC-1 Price-Performance™** | **¥3,218.69/SPC-1 KIOPS™** |
| SPC-1 IOPS™ Response Time | 0.337 ms |
| SPC-1 Overall Response Time | 0.263 ms |
| SPC-1 ASU Capacity | 38,311 GB |
| SPC-1 ASU Price | ¥319.33/GB |
| SPC-1 Total System Price | ¥12,233,503.42 |

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 v3.0.2. 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 A32016.

63 Lourdes Dr. | Leominster, MA 01453 | 978-343-6562 | www.sizing.com

Huawei Technologies Co., Ltd. OceanStor 5510 V5 A32013

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 each 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 in accordance with the SPC Policies:

None.

Respectfully Yours,

Doug Johnson, Certified SPC Auditor

63 Lourdes Dr. | Leominster, MA 01453 | 978-343-6562 | www.sizing.com

# LETTER OF GOOD FAITH

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Huawei Industrial Base, Bantian, Longgang
Shenzhen city
Guangdong province
China
Tel: 0086-755-28780808
http://www.huawei.com/en/

Date: July 29, 2020

From: Huawei Technologies Co., Ltd.

To: Doug Johnson, SPC Auditor
PerfLabs, Inc. DBA InfoSizing
63 Lourdes Drive
Leominster, MA 01453-6709 USA

Subject: SPC-1 Letter of Good Faith for the Huawei OceanStor 5510V5

Huawei Technologies Co., Ltd. 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 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: Date: 29/07/2020.

Yuefeng Zhou
Data Storage and Intelligent Vision Product Line

SPC Benchmark 1™

*Executive Summary*

# *OceanStor 5510 V5*

| | | | |
|---|---|---|---|
| SPC-1 IOPS™ | **3,800,781** | SPC-1 Price Performance | **¥3,218.69/SPC-1 KIOPS™** |
| SPC-1 IOPS Response Time | **0.337 ms** | SPC-1 Total System Price | **¥12,233,503.42** |
| SPC-1 Overall Response Time | 0.263 ms | SPC-1 Overall Discount | 56.02% |
| | | Currency / Target Country | CNY / China |
| | | Availability Date | June 30, 2020 |

*Extensions*

| | |
|---|---|
| SPC-1 Data Reduction | NA |
| SPC-1 Encryption | NA |
| SPC-1 NDU | NA |
| SPC-1 Synchronous Replication | NA |
| SPC-1 Snapshot | NA |

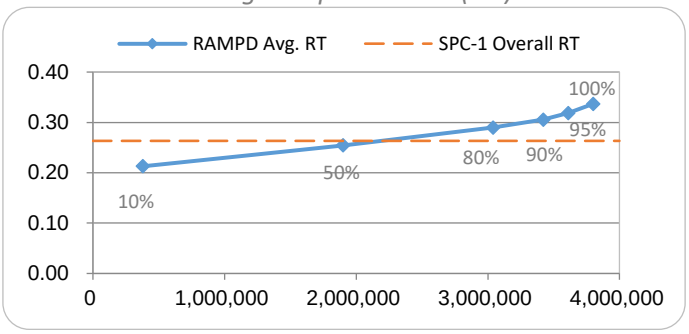
*Storage Metrics*

| | |
|---|---|
| SPC-1 Data Protection Level | Protected 2 |
| SPC-1 Physical Storage Capacity | 92,160 GB |
| SPC-1 ASU Capacity | 38,311 GB |
| SPC-1 ASU Price | ¥319.33/GB |

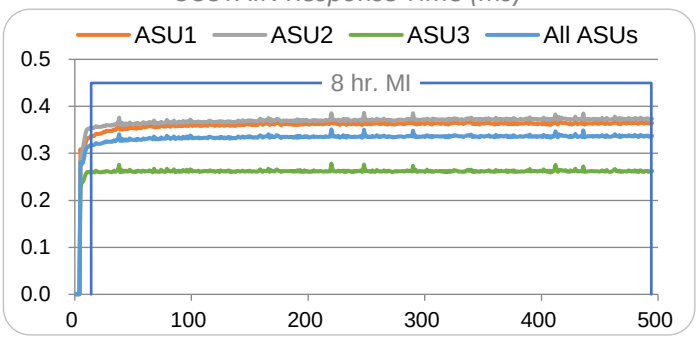
*Priced Storage Configuration Summary*

| | |
|---|---|
| 40 | QLogic dual-ported QLE2692 FC HBAs |
| 1 | OceanStor 5510 V5 |
| 8 | Active-Active Controllers |
| 2,048 | GB Total Cache |
| 24 | 4-port 16 Gbps Smart I/O Modules |
| 96 | 960 GB SSDs |
| 8 | Total RUs |

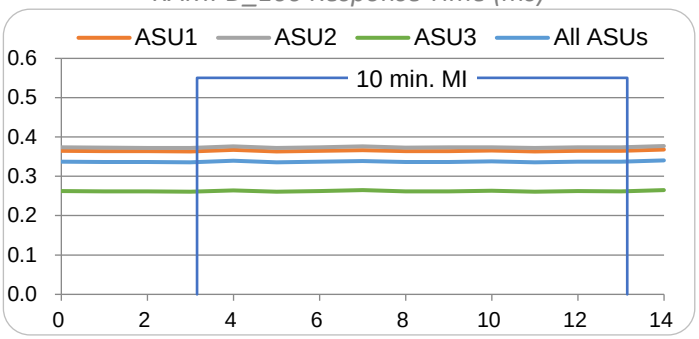
*RAMPD Average Response Time (ms) vs. IOPS*




*SUSTAIN Response Time (ms)*




*RAMPD_100 Response Time (ms)*




| | |
|---|---|
| SPC Benchmark 1™ Specification Revision | v3.9.1 |
| SPC Benchmark 1™ Workload Generator Revision | v3.0.2 |
| Submitted for Review | August 3, 2020 |
| Submission Details | www.storageperformance.org/r/A32016 |

# PRICING DETAILS

| Part No. | Description | Source | Qty | Unit Price | Ext. Price | Disc. | Disc. Price |
|---|---|---|---|---|---|---|---|
| **Hardware & Software** | | | | | | | |
| 5510 V5-H25 | 5510 V5(2U,Dual Ctrl,SAS,AC\240V HVDC,512GB Cache,4*(4*12Gb) SAS,25*2.5",SPE52C0225) | 1 | 4 | 2,541,000.00 | 10,164,000.00 | 45.00% | 5,590,200.00 |
| SMART16GbFE | 4 ports SmartIO I/O module(SFP+,16Gb FC) | 1 | 24 | 151,300.00 | 3,631,200.00 | 60.00% | 1,452,480.00 |
| 25GeScale | 4 ports 25Gb RDMA I/O module(SFP28,Scale-out for direct connection) | 1 | 16 | 31,824.50 | 509,192.00 | 73.50% | 134,935.88 |
| L3-S-SSD960 | 960GB SSD SAS Disk Unit(2.5") | 1 | 96 | 133,980.00 | 12,862,080.00 | 65.00% | 4,501,728.00 |
| SN2F01FCPC | Patch Cord,DLC/PC,DLC/PC,Multi-mode,3m,A1a.2,2mm,42mm DLC,OM3 bending insensitive | 1 | 80 | 100.00 | 8,000.00 | 0.00% | 8,000.00 |
| SFP28-AOC-010 | Active Optical Cable Assembly,SFP28 AOC,25.78125G,0.01km | 1 | 32 | 1,095.00 | 35,040.00 | 0.00% | 35,040.00 |
| Qlogic QLE2692 | Qlogic QLE2692 HBA Card, PCIE, 16Gbps 2-Ports, Fiber Channel Multimode LC Optic Interface | 1 | 40 | 5,350.00 | 214,000.00 | 0.00% | 214,000.00 |
| LIC-55X0-BS | Basic Software License (Including DeviceManager,SmartThin,SmartMulti-Tenant,SmartMigration,SmartErase,SmartMotion,SystemReporter,eService,SmartQuota,NFS,CIFS,NDMP) | 1 | 1 | 140,170.00 | 140,170.00 | 45.00% | 77,093.50 |
| LIC-55X0-ULTRAPATH | OceanStor UltraPath Software License | 1 | 1 | 67,670.00 | 67,670.00 | 45.00% | 37,218.50 |
| | | | | | | **Hardware & Software Subtotal** | **12,050,695.88** |
| **Support & Maintenance** | | | | | | | |
| 02352TSA_88136SCH-244_36 | 5510 V5(2U,Dual Ctrl,SAS,AC\240V HVDC,512GB Cache,4*(4*12Gb) SAS,25*2.5",SPE52C0225)_Hi-Care Onsite Premier OceanStor 5510 V5 Controller Enclosure_36Month(s) | 1 | 4 | 17,174.25 | 68,697.00 | 0% | 68,697.00 |
| 02352WEM_88136SCH-128_36 | 960GB SSD SAS Disk Unit(2.5")_Hi-Care Onsite Premier OceanStor 960GB SSD_36Month(s) | 1 | 96 | 208.50 | 20,016.00 | 0% | 20,016.00 |
| 88035SKL_88134UGC-0N3_36 | Basic Software License (Including DeviceManager,SmartThin,SmartMulti-Tenant,SmartMigration,SmartErase,SmartMotion,SystemReporter,eService,SmartQuota,NFS,CIFS,NDMP)_Hi-Care Application Software Upgrade Support Service OceanStor 5510 V5 Basic Software License_36Month(s) | 1 | 1 | 29,436.00 | 29,436.00 | 0% | 29,436.00 |
| 88035TDQ_88134UGC-0N2_36 | OceanStor UltraPath Software License_Hi-Care Application Software Upgrade Support Service OceanStor 5510 V5 OceanStor UltraPath Software License_36Month(s) | 1 | 1 | 17,256.00 | 17,256.00 | 0% | 17,256.00 |
| 8812153244 | OceanStor 5510 V5 OceanStor 5500 Series Enterprise Storage Hardware Installation Service | 1 | 1 | 47,402.54 | 47,402.54 | 0% | 47,402.54 |
| | | | | | | **Support & Maintenance Subtotal** | **182,807.54** |
| | | | | | | | |
| **SPC-1 Total System Price** | | | | | | | **12,233,503.42** |
| SPC-1 IOPS™ | | | | | | | 3,800,781 |
| **SPC-1 Price-Performance™ (¥/SPC-1 KIOPS™)** | | | | | | | **3,218.69** |
| SPC-1 ASU Capacity (GB) | | | | | | | 38,311 |
| **SPC-1 ASU Price (¥/GB)** | | | | | | | **319.33** |

**Pricing Details**: All prices are in CNY and reflect prices generally available in China.

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

**Warranty**: Hi-Care Premier On-Site Service includes: 7*24 Technical Assistance Center Access. Access to all new software updates and Online Support. 24*7*4 Hours Onsite Hardware Replacement.

## Differences Between Tested and Priced Storage Configurations

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

# PUBLICATION DETAILS

This section provides contact information for the test sponsor and auditor, a revision history of this document, and a description of any exceptions or waivers associated with this publication.

## Contact Information

| Role | Name | Details |
|---|---|---|
| **Test Sponsor Primary Contact** | Huawei Technologies Co., Ltd.<br>LiFei luo | www.huawei.com<br>luolifei@huawei.com |
| **SPC Auditor** | InfoSizing<br>Doug Johnson | www.sizing.com<br>doug@sizing.com |

## Revision Information

| Date | FDR Revision | Details |
|---|---|---|
| August 3, 2020 | First Edition | Initial Publication |

## Exceptions and Waivers

None.

# CONFIGURATION INFORMATION

## Tested Storage Product Description

The new generation of mid-range hybrid flash storage dedicated to providing the reliable and efficient data services for enterprises.

Cloud-ready operating system, flash-enabled performance, and intelligent management software, delivering top-of-the-line functionality, performance, efficiency, reliability, and ease of use.

Satisfies the data storage requirements of large-database OLTP/OLAP, cloud computing, and many other applications, making it a perfect choice for sectors such as government, finance, telecommunications, and manufacturing.

For more details, visit:

https://e.huawei.com/cn/products/cloud-computing-dc/storage/hybrid-flash-storage/oceanstor-5X10-v5

## Host System and Tested Storage Configuration Components

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

| Host Systems |
|---|
| 9x Huawei FusionServer RH2288H V3, 1x Huawei FusionServer RH2288 V3<br>2x Intel® Xeon® CPU E5-2680 v3 (2.50 GHz, 12-Core, 30 MB L3)<br>128 GB Main Memory<br>CentOS Linux release 7.3.1611 (Core)<br>Huawei OceanStor Ultrapath software |
| **Tested Storage Configuration** |
| 40x QLogic dual-ported QLE2692 FC HBAs |
| **1x OceanStor 5510 V5, with:**<br>**8x OceanStor 5510 V5 Active-Active Controllers, each with:**<br>**256 GB cache (2,048 GB total)**<br>**24x 4-port 16 Gbps Smart I/O Modules**<br>**16x 4-port 25 Gbps Smart I/O Modules**<br>**96x 960 GB SSD Storage Devices (24 per enclosure)** |

### Component Changes in Revised Full Disclosure Report

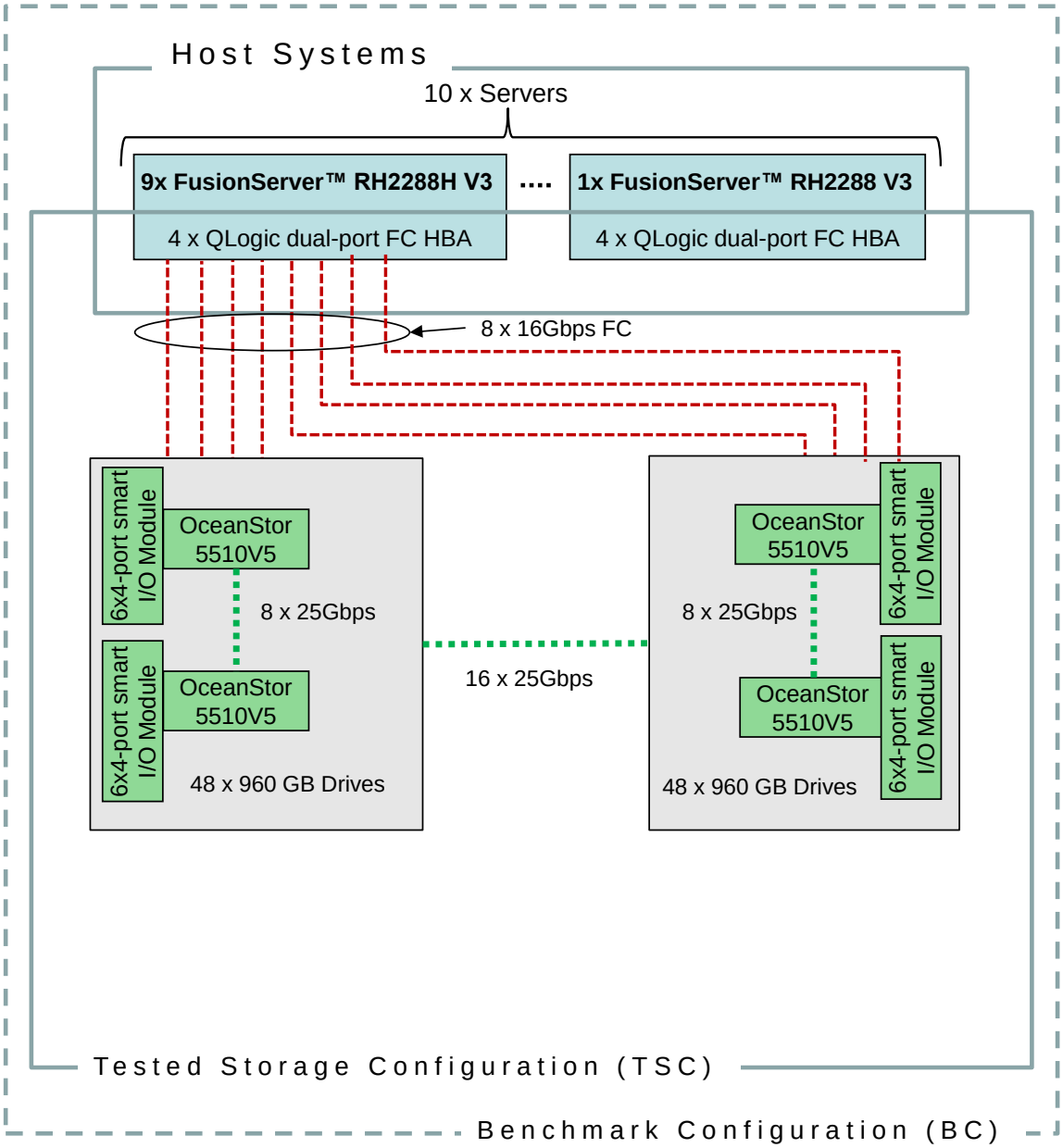
The following table outlines component changes that were made in revisions to this Full Disclosure Report.

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

# Configuration Diagrams

## BC/TSC Configuration Diagram

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 utilized an external storage subsystem comprising 8 OceanStor 5510 V5 Active-Active controllers, driven by 10 host systems (9x FusionServer RH2288H V3, 1x FusionServer RH2288 V3). Each FusionServer host system was connected one-to-one to each OceanStor controller via 16 Gbps FC.

# 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 Application Storage Unit Mapping

The following table details the capacity of the Application Storage Units (ASUs) and how they are mapped to logical volumes (LVs). All capacities are reported in GB.

| | LV per ASU | LV Capacity | Used per LV | Total per ASU | % ASU Capacity | Optimized* |
|---|---|---|---|---|---|---|
| **ASU-1** | 18 | 957.7 | 957.7 | 17,239.9 | 45.0% | No |
| **ASU-2** | 18 | 957.7 | 957.7 | 17,239.9 | 45.0% | No |
| **ASU-3** | 2 | 1,915.5 | 1,915.5 | 3,831.1 | 10.0% | No |
| | **SPC-1 ASU Capacity** | | | 38,311 | | |

*See Space Optimization Techniques

### 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. All capacities are reported in GB.

| Devices | Count | Physical Capacity | Total Capacity |
|---|---|---|---|
| SSD | 96 | 960.0 | 92,160.0 |
| **Total Physical Capacity** | | | **92,160** |
| **Physical Capacity Utilization** | | | **41.57%** |

### Data Protection

The data protection level used for all LVs was **Protected 2 (RAID10 and full redundancy)**, which was accomplished by configuring dual controller, dual power, dual fans and RAID-10 device protection.

## Space Optimization Information

### Description of Utilized Techniques

The TSC did not use any space optimization techniques.

### Physical Free Space Metrics

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.

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

# BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs.

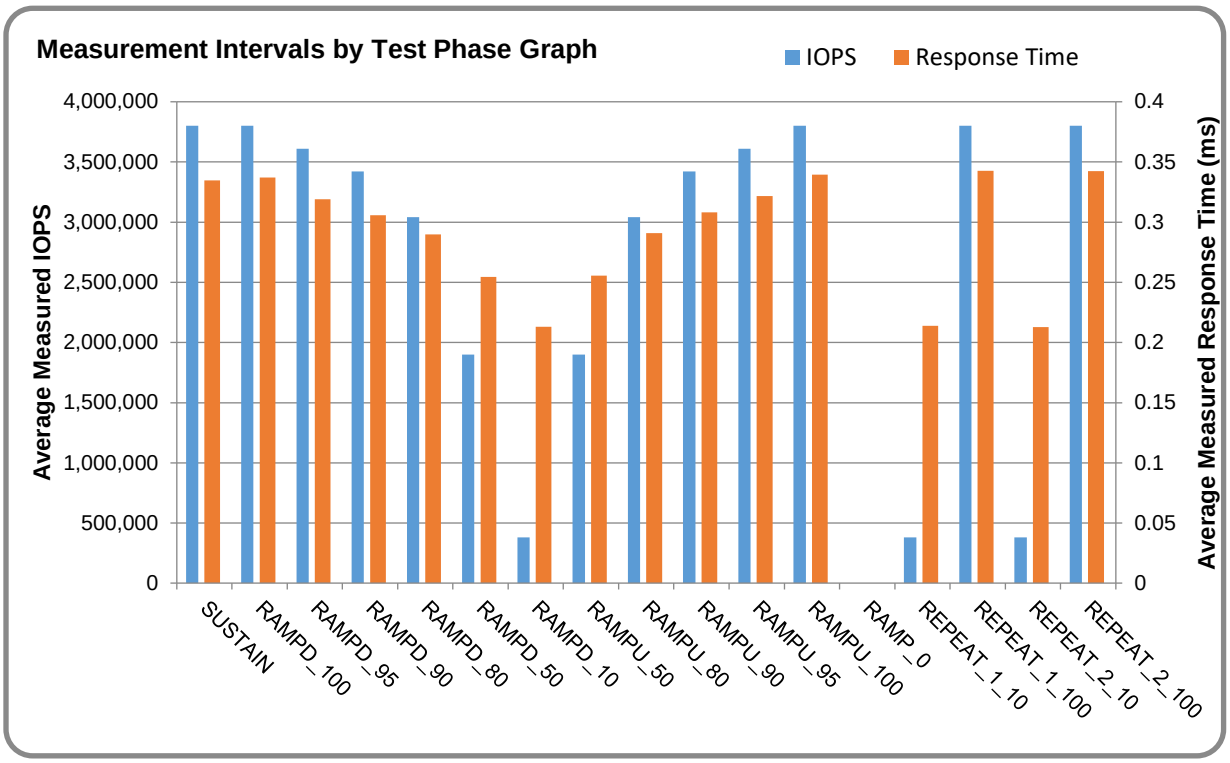
## Benchmark Execution Overview

### 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).

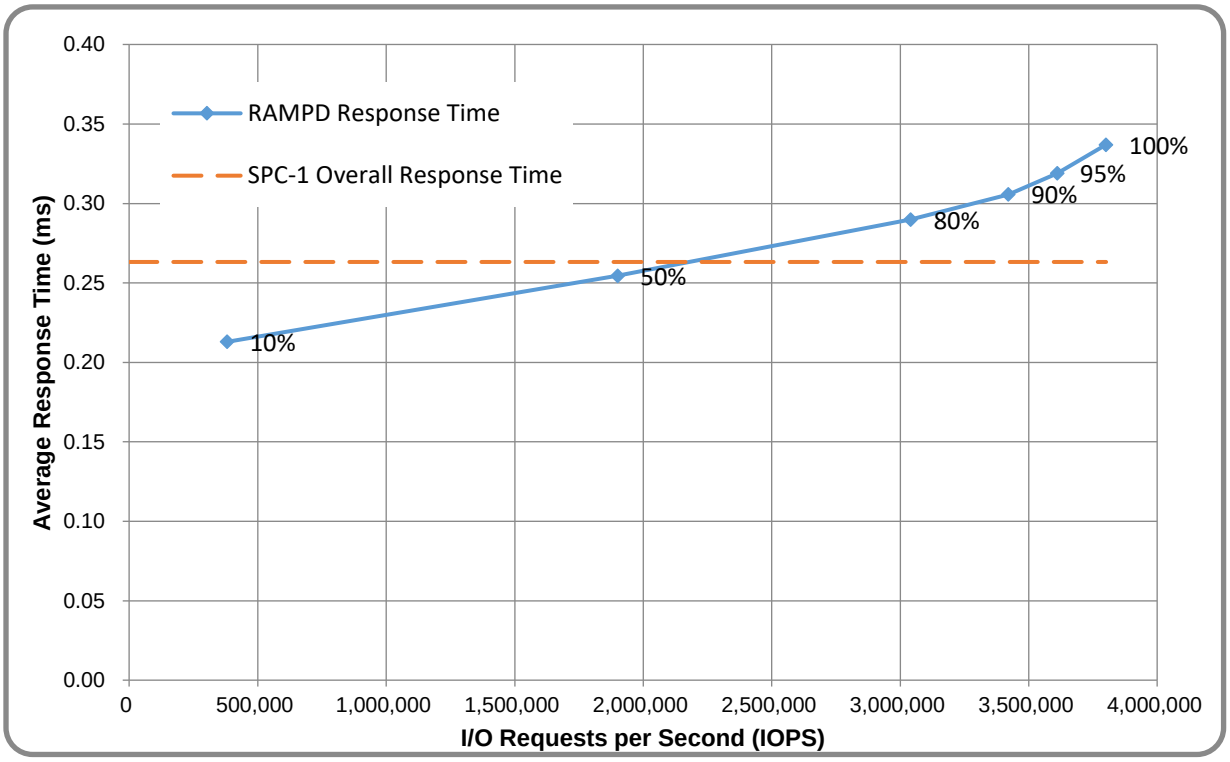
### Measurement Intervals by Test Phase Graph

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



### Response Time vs. Throughput Graph

The following graph presents the average Response Times versus the average IOPS for RAMPD_100 to RAMPD_10.




## ASU Pre-Fill

The following table provides a summary of the Pre-Fill performed on the ASU prior to testing.

| ASU Pre-Fill Summary | | | |
|---|---|---|---|
| **Start Time** | 16-Jul-20 22:00:22 | **Requested IOP Level** | 40,000 MB/sec |
| **End Time** | 16-Jul-20 22:17:46 | **Observed IOP Level** | 36,696 MB/sec |
| **Duration** | 0:17:24 | For additional details see the Supporting Files. | |

# SUSTAIN Test Phase

## SUSTAIN – Results File

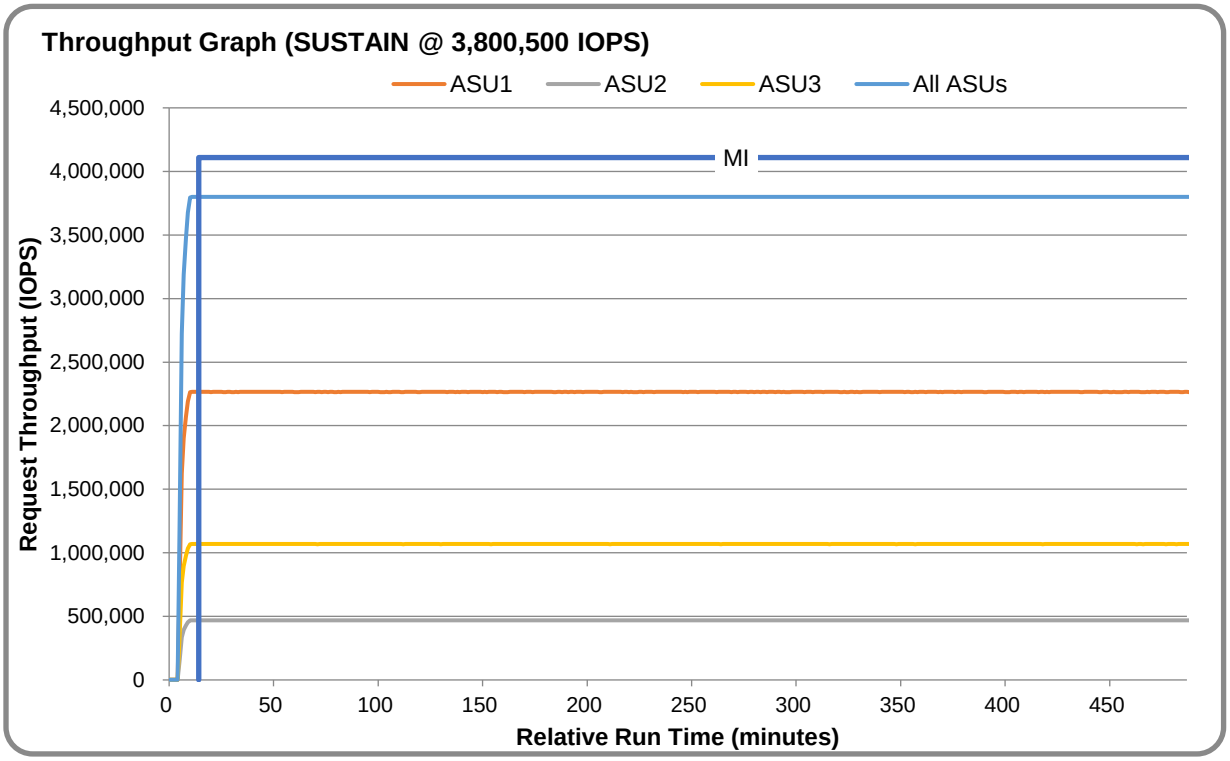
The results file generated during the execution of the SUSTAIN Test Phase is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

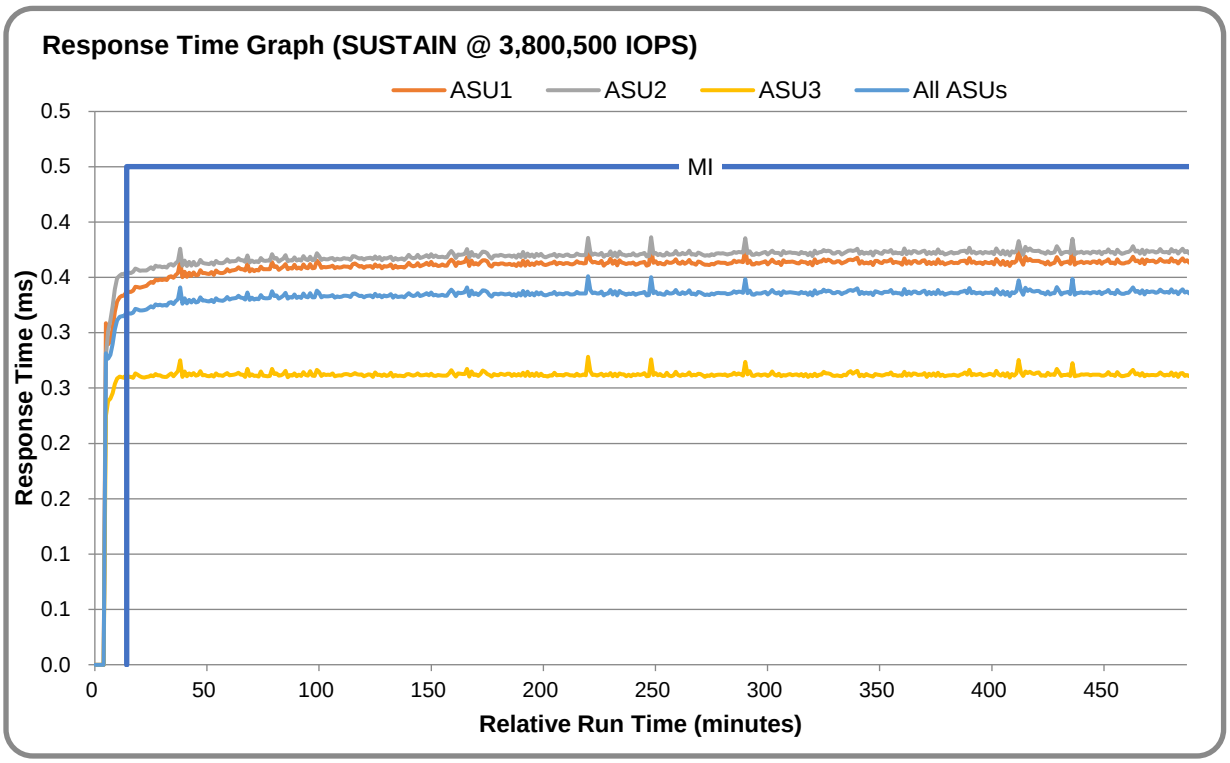
## SUSTAIN – Execution Times

| Interval | Start Date & Time | End Date & Time | Duration |
|---|---|---|---|
| **Transition Period** | 16-Jul-20 22:28:23 | 16-Jul-20 22:38:19 | 0:09:57 |
| **Measurement Interval** | 16-Jul-20 22:38:19 | 17-Jul-20 06:38:19 | 8:00:00 |

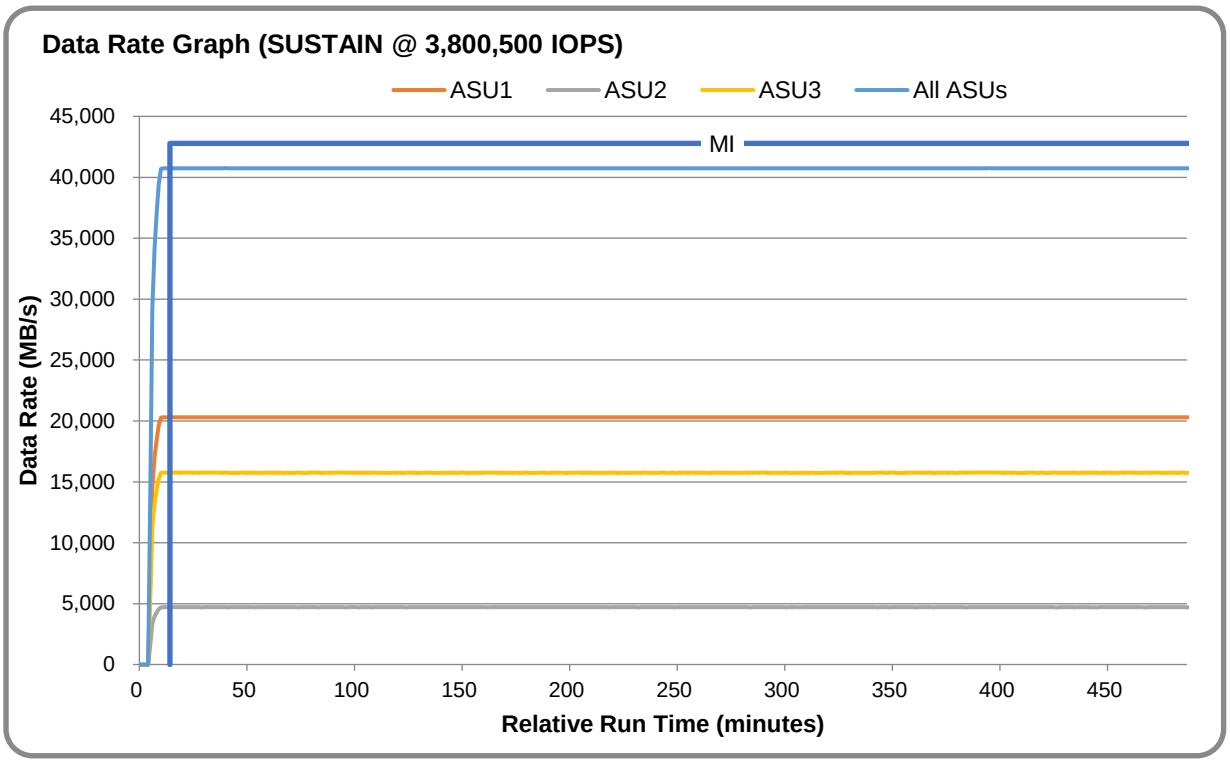
## SUSTAIN – Throughput Graph



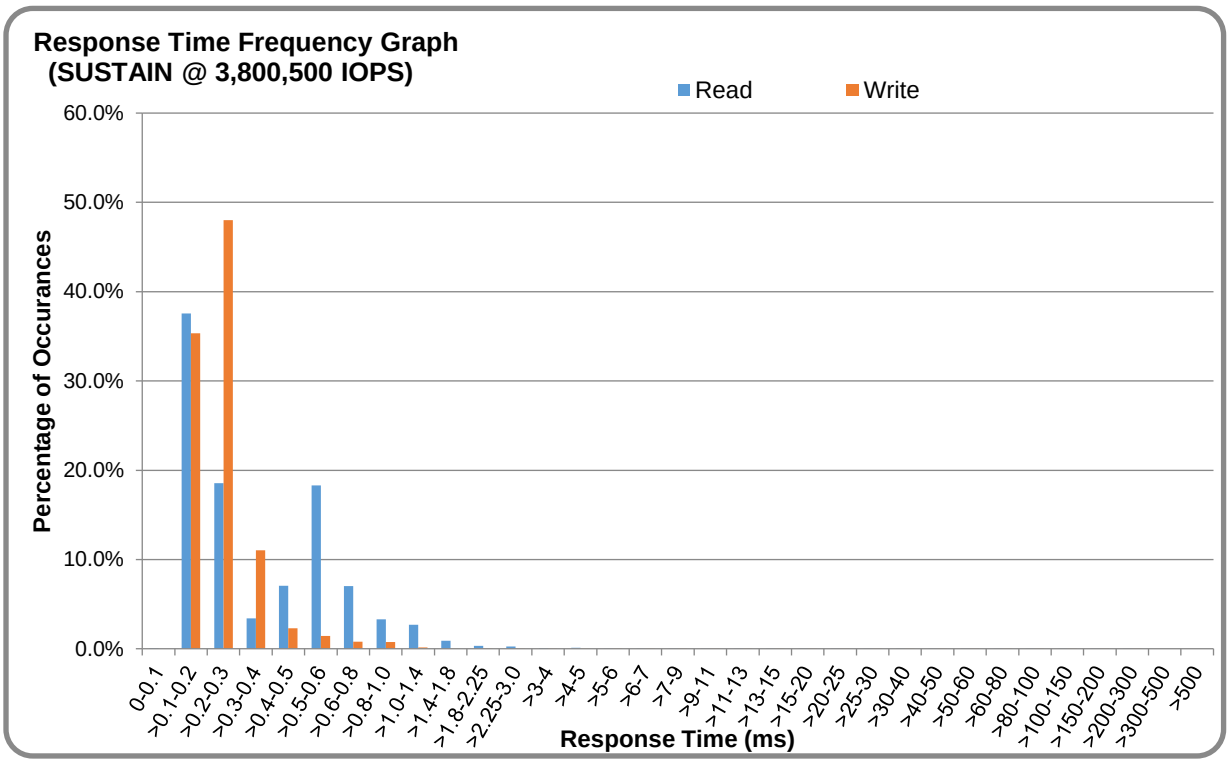
## SUSTAIN – Response Time Graph




## 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 Defined 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** | 0.0004 | 0.0001 | 0.0002 | 0.0001 | 0.0005 | 0.0002 | 0.0003 | 0.0001 |
| **Difference** | 0.009% | 0.002% | 0.002% | 0.000% | 0.003% | 0.003% | 0.005% | 0.002% |

# RAMPD_100 Test Phase

## RAMPD_100 – Results File

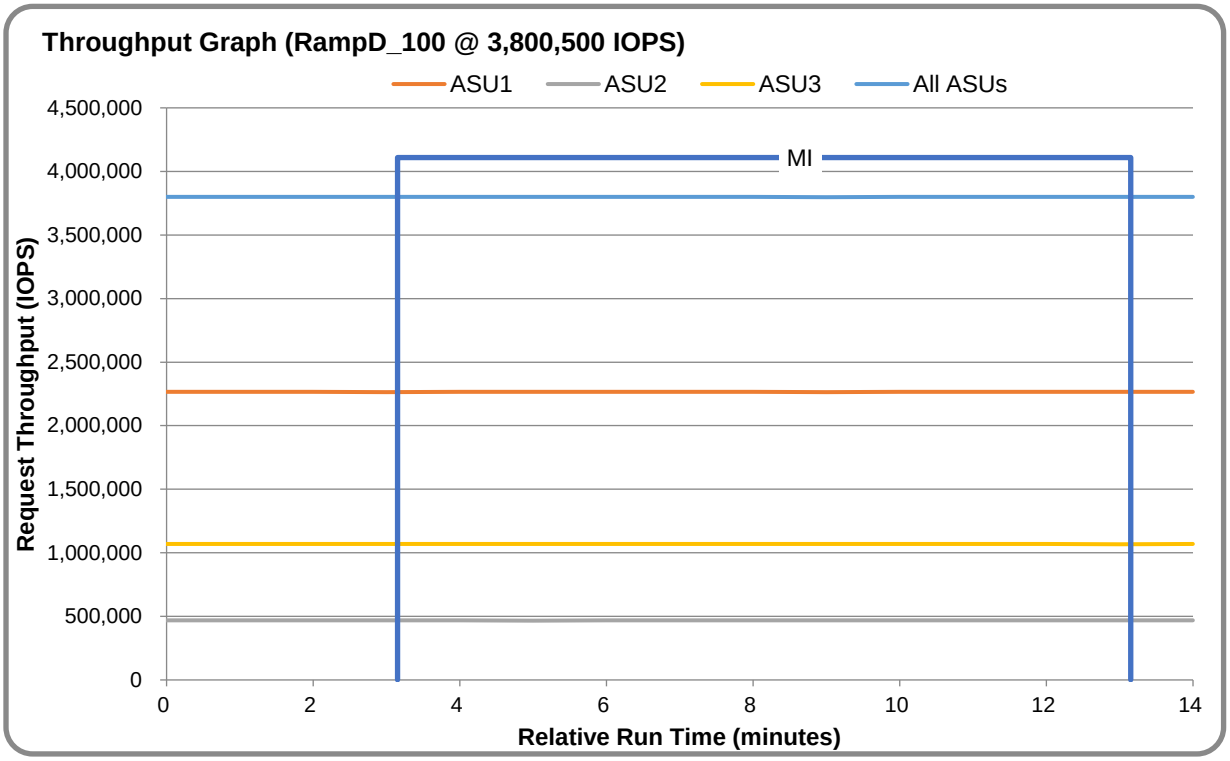
The results file generated during the execution of the RAMPD_100 Test Phase is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

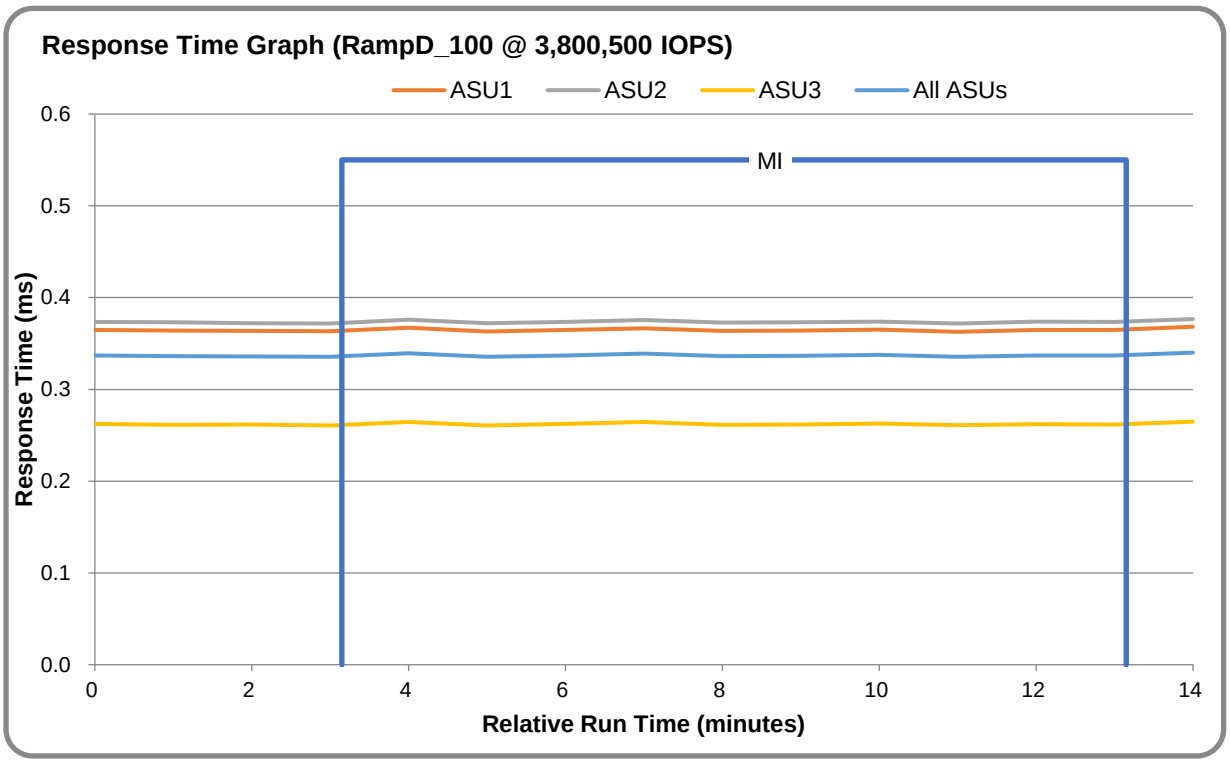
## RAMPD_100 – Execution Times

| Interval | Start Date & Time | End Date & Time | Duration |
|---|---|---|---|
| **Transition Period** | 17-Jul-20 06:39:20 | 17-Jul-20 06:42:20 | 0:03:00 |
| **Measurement Interval** | 17-Jul-20 06:42:20 | 17-Jul-20 06:52:20 | 0:10:00 |

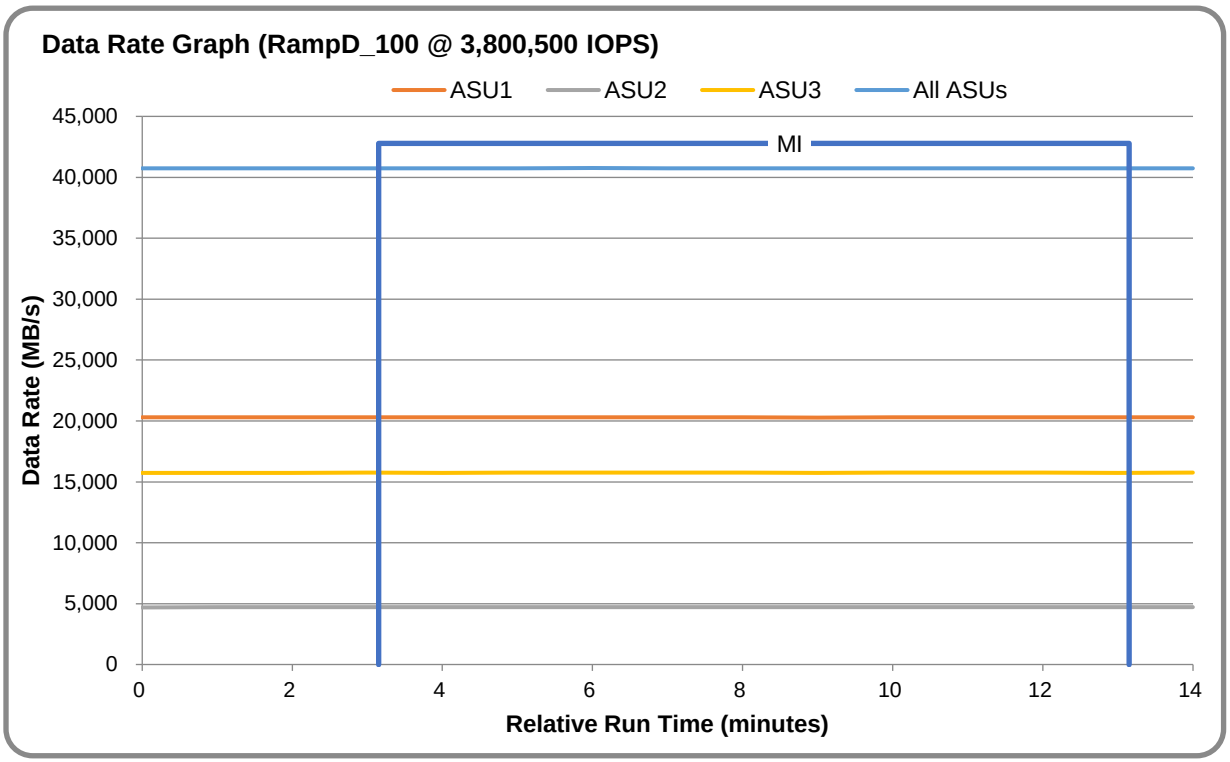
## RAMPD_100 – Throughput Graph



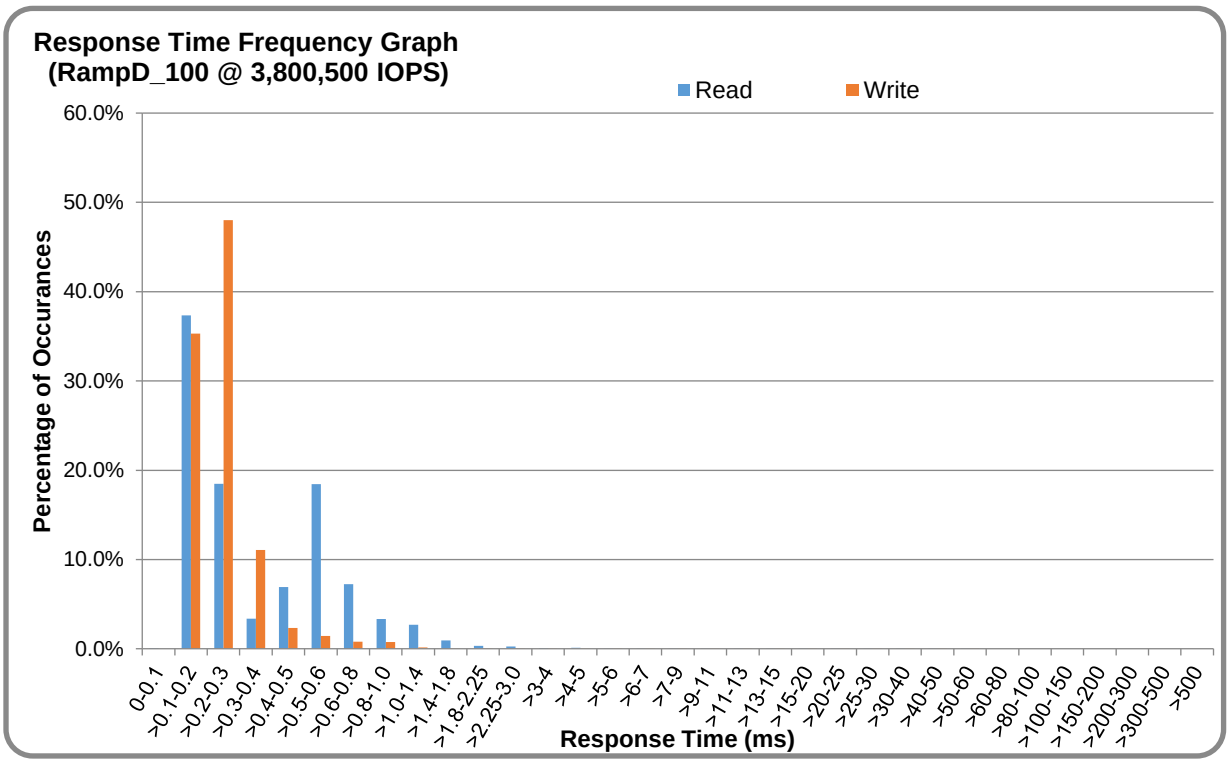
## RAMPD_100 – Response Time Graph




## 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 Defined 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** | 0.0003 | 0.0001 | 0.0002 | 0.0001 | 0.0005 | 0.0002 | 0.0004 | 0.0001 |
| **Difference** | 0.009% | 0.002% | 0.003% | 0.006% | 0.026% | 0.011% | 0.002% | 0.003% |

## RAMPD_100 – I/O Request Summary

| | |
|---|---|
| **I/O Requests Completed in the Measurement Interval** | 2,280,473,925 |
| **I/O Requests Completed with Response Time <= 30 ms** | 2,280,430,140 |
| **I/O Requests Completed with Response Time > 30 ms** | 43,785 |

# Response Time Ramp Test

## Response Time Ramp Test – Results File

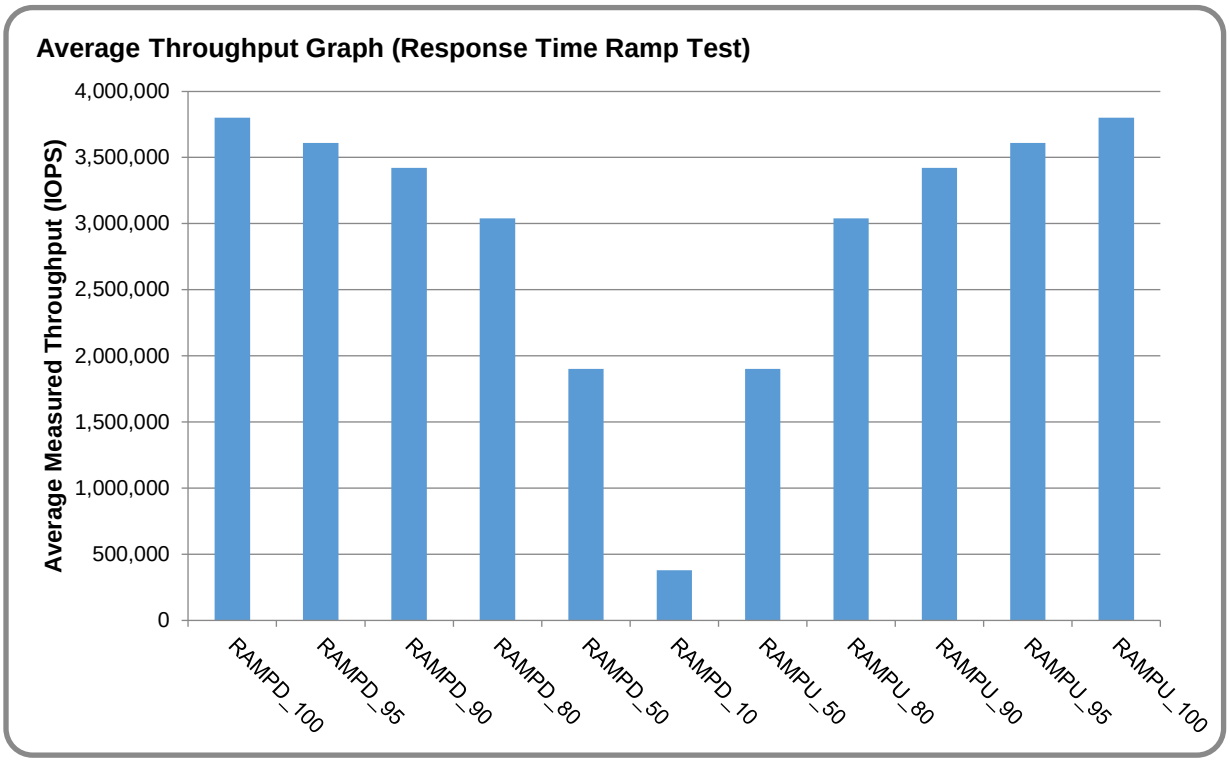
The results file generated during the execution of the Response Time Ramp Test is included in the Supporting Files (see Appendix A) as follows:

- **SPC1_METRICS_0_Raw_Results.xlsx**

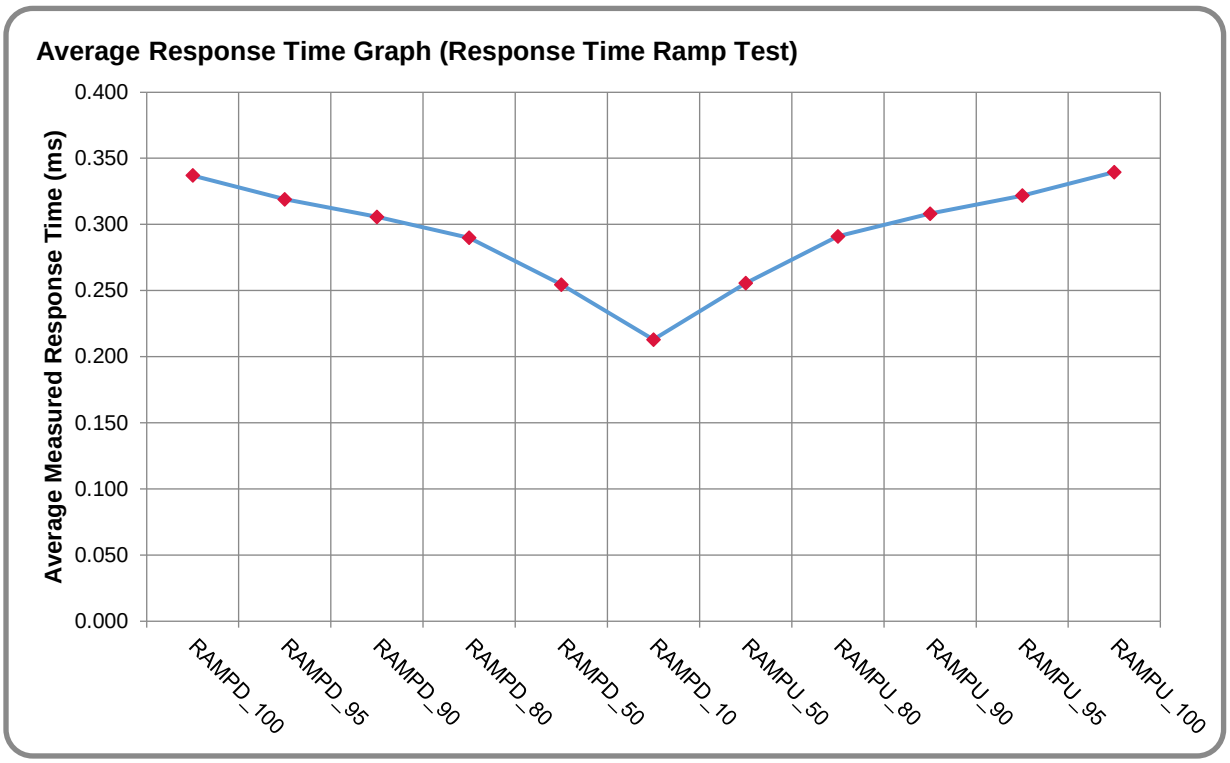
## Response Time Ramp Test – Phases

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).

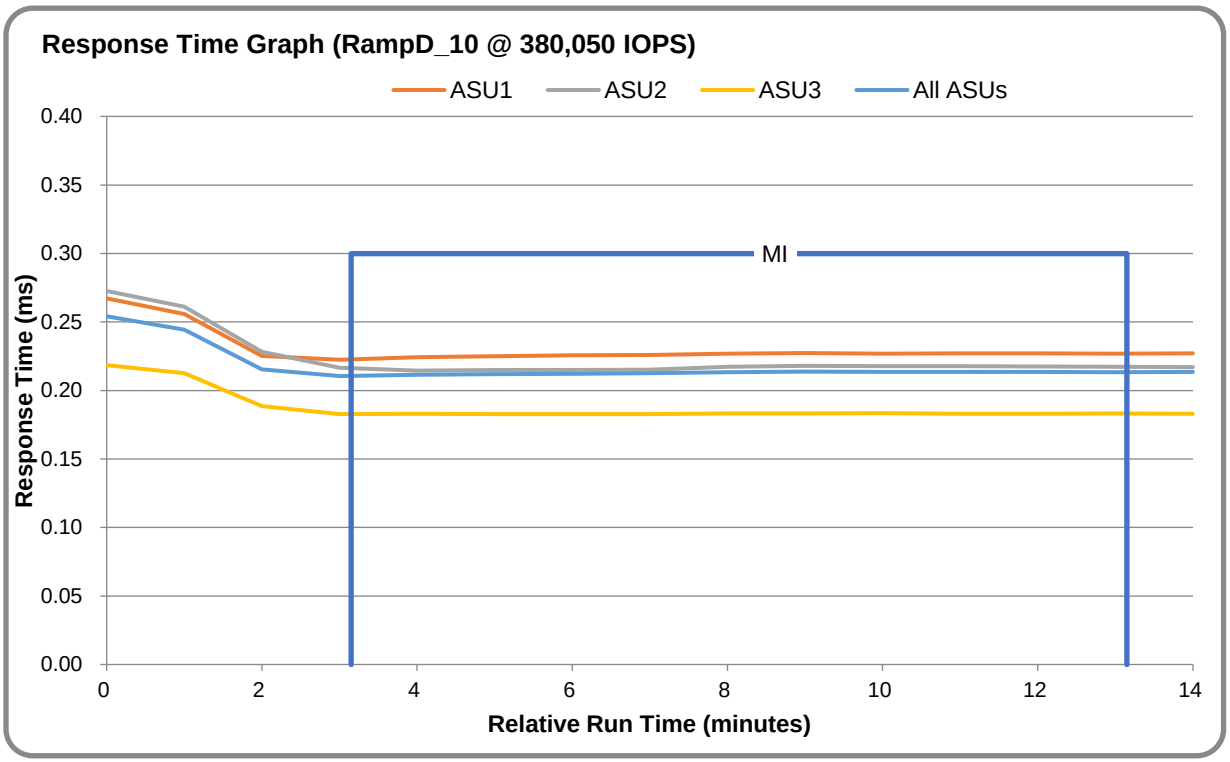
## Response Time Ramp Test – Average Throughput Graph



## 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:

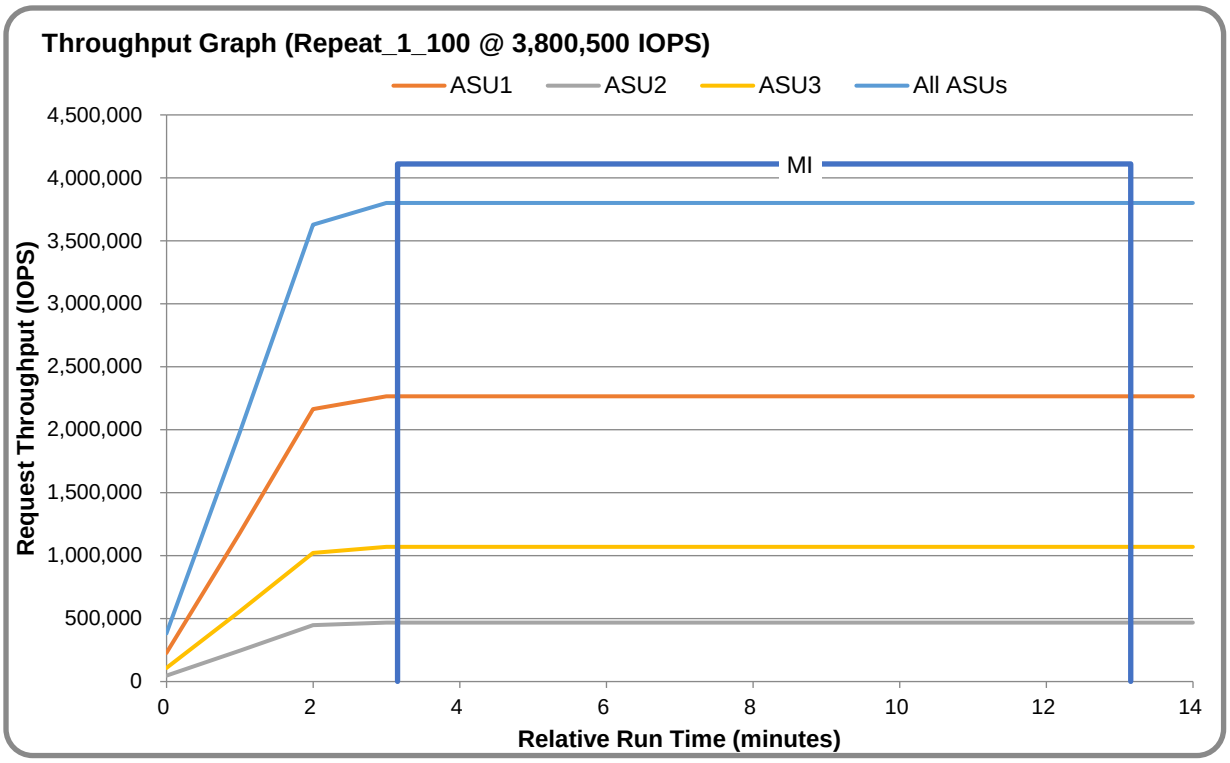
- **SPC1_METRICS_0_Raw_Results.xlsx**

## Repeatability Test Results

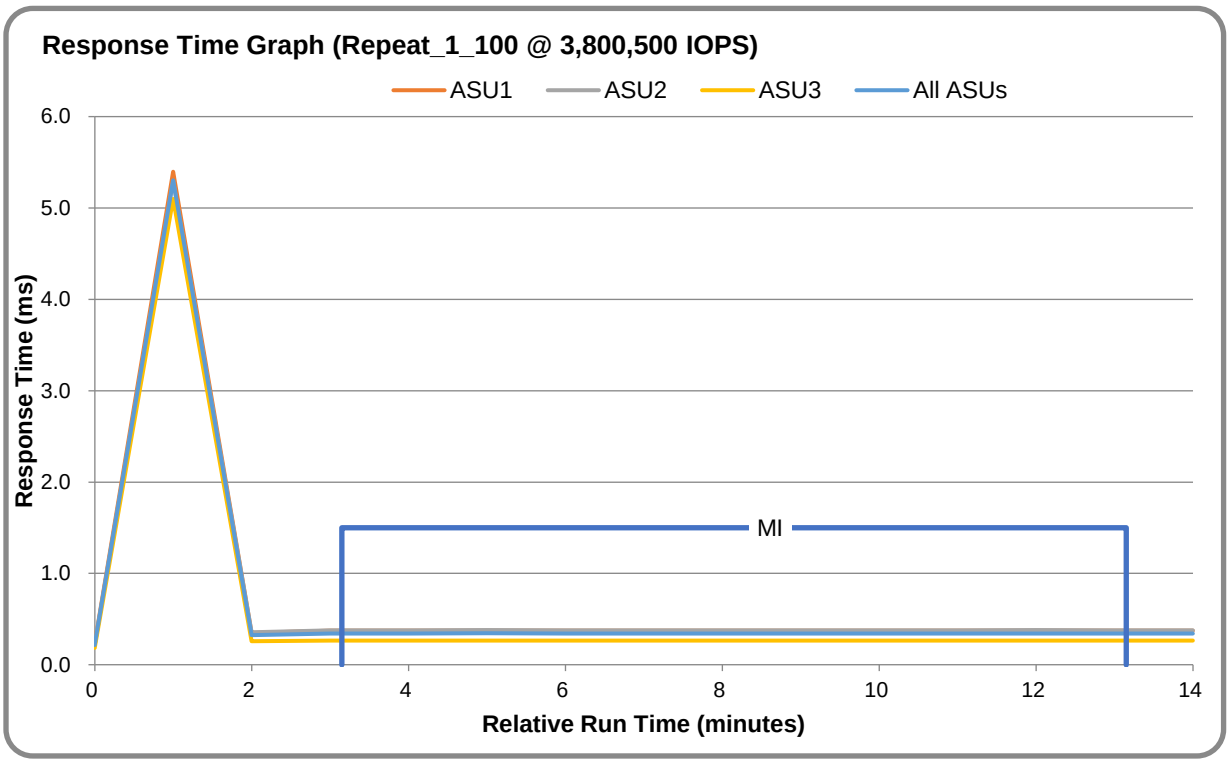
The throughput measurements for the Response Time Ramp Test (RAMPD) and the Repeatability Test Phases (REPEAT_1 and REPEAT_2) are listed in the table below.

| Test Phase | 100% IOPS | 10% IOPS |
|---|---|---|
| RAMPD | 3,800,781.2 | 380,014.8 |
| REPEAT_1 | 3,800,764.2 | 380,069.0 |
| REPEAT_2 | 3,800,789.8 | 380,039.7 |

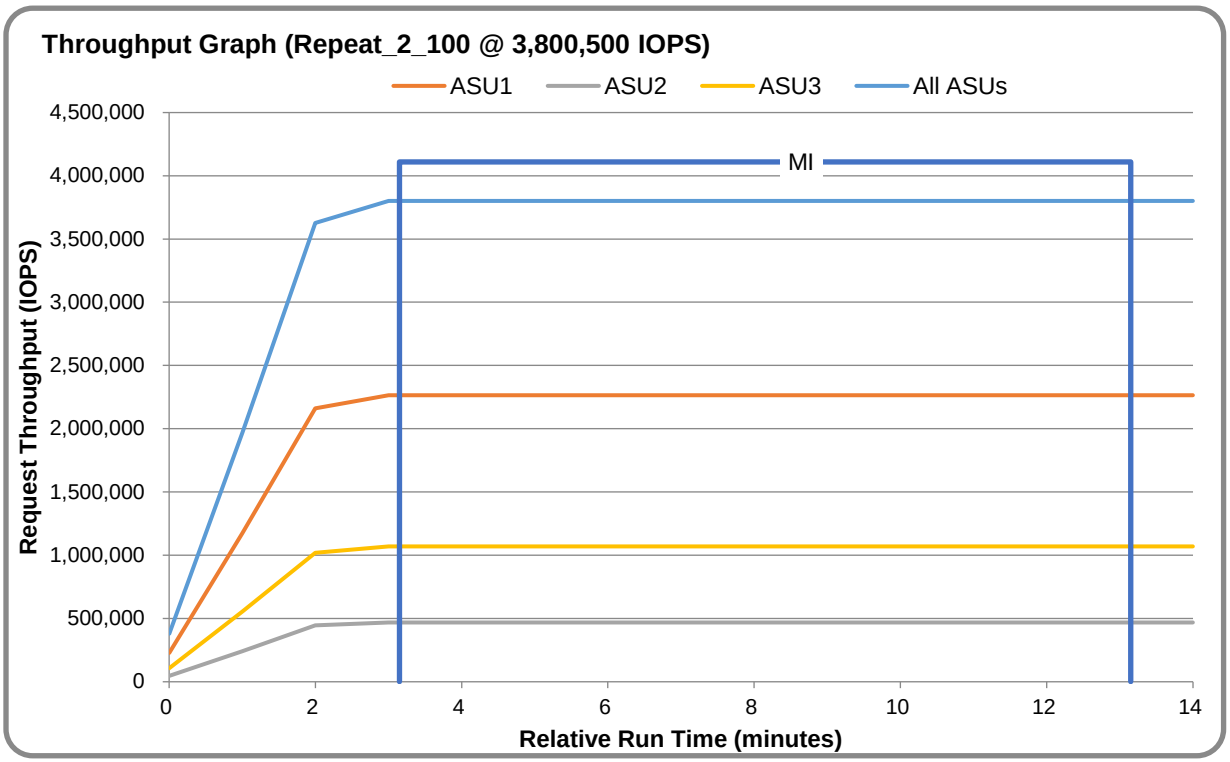
## REPEAT_1_100 – Throughput Graph



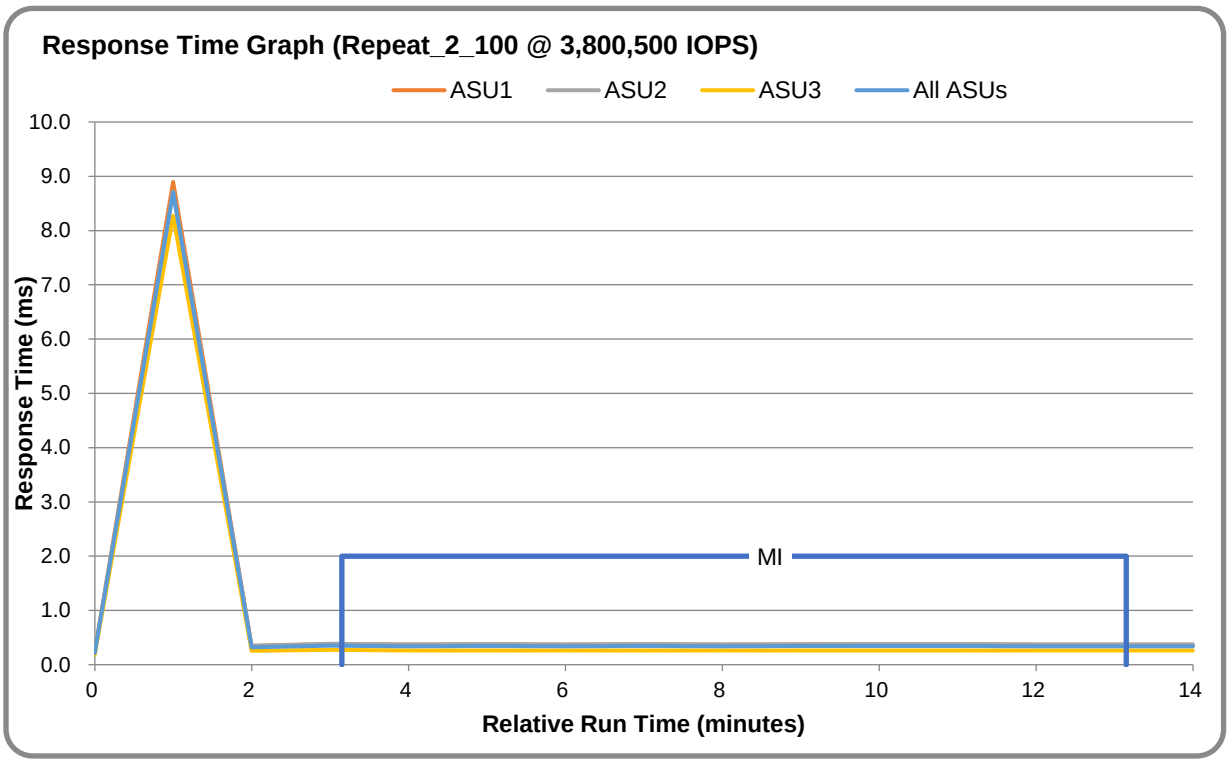
## REPEAT_1_100 – Response Time Graph




## 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 Defined 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** | 0.0004 | 0.0001 | 0.0003 | 0.0001 | 0.0005 | 0.0002 | 0.0003 | 0.0001 |
| **Difference** | 0.007% | 0.000% | 0.022% | 0.000% | 0.017% | 0.006% | 0.005% | 0.008% |

### 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** | 0.0003 | 0.0001 | 0.0003 | 0.0002 | 0.0006 | 0.0003 | 0.0004 | 0.0001 |
| **Difference** | 0.022% | 0.004% | 0.010% | 0.001% | 0.012% | 0.006% | 0.013% | 0.004% |

# 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** | 776,348,883 |
| **Total Number of Logical Blocks Verified** | 365,128,295 |
| **Total Number of Logical Blocks Overwritten** | 411,220,588 |
| **Total Number of Logical Blocks that Failed Verification** | 0 |
| **Time Duration for Writing Test Logical Blocks (sec.)** | 600 |
| **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

Committed data persistence is implemented at two levels. At the drive level, data loss is prevented using RAID-10 arrays. At the controller level, all caches are mirrored across controllers, where write requests are only completed once the local cache has been successfully mirrored in another controller's cache. In addition, cache content is protected from a loss of power by flushing the cache content to permanent flash memory as soon as a power loss is detected. The flushing action is powered by a battery backup located in each controller.

# BENCHMARK EXTENSION RESULTS

No benchmark extensions were tested as part of this submission.

# 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** |
| aio-max-nr.sh | Set maximum asynchronous I/O | /C_Tuning |
| nr_requests.sh | Increase disk queue depth | /C_Tuning |
| scheduler.sh | Change the I/O scheduler | /C_Tuning |
| **/D_Creation** | **Storage configuration creation** | **root** |
| mklun.txt | Create the storage environment | /D_Creation |
| mkvolume.sh | Create the logical volumes | /D_Creation |
| **/E_Inventory** | **Configuration inventory** | **root** |
| profile1_storage.log | List of storage devices before INIT | /E_Inventory |
| profile1_volume.log | List of logical volumes before INIT | /E_Inventory |
| profile2_storage.log | List of storage devices after restart | /E_Inventory |
| profile2_volume.log | List of logical volumes after restart | /E_Inventory |
| **/F_Generator** | **Workload generator** | **root** |
| 10host.HST | Host configuration file | /F_generator |
| full_run.sh | Execute all test phases | /F_generator |
| slave_asu.asu | Define LUNs hosting the ASUs | /F_generator |

# APPENDIX B: THIRD PARTY QUOTATION

All components are available directly through the Test Sponsor (Huawei Technologies Co., Ltd.).

# APPENDIX C: TUNING PARAMETERS AND OPTIONS

The following scripts were used to set the tuning parameters and options.

- aio-max-nr.sh – set the maximum number of AIO operations to 10485760
- nr_requests.sh – set nr_requests to 4096 for each drive
- scheduler.sh – set the I/O scheduler to noop for each device

Details are available in the Supporting Files (see Appendix A).

# APPENDIX D: STORAGE CONFIGURATION CREATION

## Step 1: Create Disk Domains, Storage Pools, LUNs, LUN Group

**mklun.txt** is a script including all the CLI commands to create disk domains, storage pools, LUNS:

- Create 8 ***disk_domain***
- Create 8 ***storage_pool***
- Create 64 ***lun***
- Create one ***lun_group(lg0)***
- Add the 64 LUNs to ***lun_group***, ***lg0***

```
create disk_domain name=dd0 disk_list=CTE0.0-11 disk_domain_id=0
create disk_domain name=dd1 disk_list=CTE0.12-23 disk_domain_id=1
create disk_domain name=dd2 disk_list=CTE1.0-11 disk_domain_id=2
create disk_domain name=dd3 disk_list=CTE1.12-23 disk_domain_id=3
create disk_domain name=dd4 disk_list=CTE2.0-11 disk_domain_id=4
create disk_domain name=dd5 disk_list=CTE2.12-23 disk_domain_id=5
create disk_domain name=dd6 disk_list=CTE3.0-11 disk_domain_id=6
create disk_domain name=dd7 disk_list=CTE3.12-23 disk_domain_id=7


create storage_pool name=pool0 disk_type=SSD capacity=4702GB pool_id=0 raid_level=RAID10 disk_domain_id=0
stripe_depth=32KB
create storage_pool name=pool1 disk_type=SSD capacity=4702GB pool_id=1 raid_level=RAID10 disk_domain_id=1
stripe_depth=32KB
create storage_pool name=pool2 disk_type=SSD capacity=4702GB pool_id=2 raid_level=RAID10 disk_domain_id=2
stripe_depth=32KB
create storage_pool name=pool3 disk_type=SSD capacity=4702GB pool_id=3 raid_level=RAID10 disk_domain_id=3
stripe_depth=32KB
create storage_pool name=pool4 disk_type=SSD capacity=4702GB pool_id=4 raid_level=RAID10 disk_domain_id=4
stripe_depth=32KB
create storage_pool name=pool5 disk_type=SSD capacity=4702GB pool_id=5 raid_level=RAID10 disk_domain_id=5
stripe_depth=32KB
create storage_pool name=pool6 disk_type=SSD capacity=4702GB pool_id=6 raid_level=RAID10 disk_domain_id=6
stripe_depth=32KB
create storage_pool name=pool7 disk_type=SSD capacity=4702GB pool_id=7 raid_level=RAID10 disk_domain_id=7
stripe_depth=32KB


create lun name=lun1 pool_id=0 capacity=587GB owner_controller=0A lun_id=1 lun_type=thick
create lun name=lun2 pool_id=0 capacity=587GB owner_controller=0A lun_id=2 lun_type=thick
create lun name=lun3 pool_id=0 capacity=587GB owner_controller=0A lun_id=3 lun_type=thick
create lun name=lun4 pool_id=0 capacity=587GB owner_controller=0A lun_id=4 lun_type=thick
create lun name=lun5 pool_id=0 capacity=587GB owner_controller=0A lun_id=5 lun_type=thick
create lun name=lun6 pool_id=0 capacity=587GB owner_controller=0A lun_id=6 lun_type=thick
create lun name=lun7 pool_id=0 capacity=587GB owner_controller=0A lun_id=7 lun_type=thick
create lun name=lun8 pool_id=0 capacity=587GB owner_controller=0A lun_id=8 lun_type=thick
create lun name=lun9 pool_id=1 capacity=587GB owner_controller=0B lun_id=9 lun_type=thick
create lun name=lun10 pool_id=1 capacity=587GB owner_controller=0B lun_id=10 lun_type=thick
create lun name=lun11 pool_id=1 capacity=587GB owner_controller=0B lun_id=11 lun_type=thick
create lun name=lun12 pool_id=1 capacity=587GB owner_controller=0B lun_id=12 lun_type=thick
```

```
create lun name=lun13 pool_id=1 capacity=587GB owner_controller=0B lun_id=13 lun_type=thick
create lun name=lun14 pool_id=1 capacity=587GB owner_controller=0B lun_id=14 lun_type=thick
create lun name=lun15 pool_id=1 capacity=587GB owner_controller=0B lun_id=15 lun_type=thick
create lun name=lun16 pool_id=1 capacity=587GB owner_controller=0B lun_id=16 lun_type=thick
create lun name=lun17 pool_id=2 capacity=587GB owner_controller=1A lun_id=17 lun_type=thick
create lun name=lun18 pool_id=2 capacity=587GB owner_controller=1A lun_id=18 lun_type=thick
create lun name=lun19 pool_id=2 capacity=587GB owner_controller=1A lun_id=19 lun_type=thick
create lun name=lun20 pool_id=2 capacity=587GB owner_controller=1A lun_id=20 lun_type=thick
create lun name=lun21 pool_id=2 capacity=587GB owner_controller=1A lun_id=21 lun_type=thick
create lun name=lun22 pool_id=2 capacity=587GB owner_controller=1A lun_id=22 lun_type=thick
create lun name=lun23 pool_id=2 capacity=587GB owner_controller=1A lun_id=23 lun_type=thick
create lun name=lun24 pool_id=2 capacity=587GB owner_controller=1A lun_id=24 lun_type=thick
create lun name=lun25 pool_id=3 capacity=587GB owner_controller=1B lun_id=25 lun_type=thick
create lun name=lun26 pool_id=3 capacity=587GB owner_controller=1B lun_id=26 lun_type=thick
create lun name=lun27 pool_id=3 capacity=587GB owner_controller=1B lun_id=27 lun_type=thick
create lun name=lun28 pool_id=3 capacity=587GB owner_controller=1B lun_id=28 lun_type=thick
create lun name=lun29 pool_id=3 capacity=587GB owner_controller=1B lun_id=29 lun_type=thick
create lun name=lun30 pool_id=3 capacity=587GB owner_controller=1B lun_id=30 lun_type=thick
create lun name=lun31 pool_id=3 capacity=587GB owner_controller=1B lun_id=31 lun_type=thick
create lun name=lun32 pool_id=3 capacity=587GB owner_controller=1B lun_id=32 lun_type=thick
create lun name=lun33 pool_id=4 capacity=587GB owner_controller=2A lun_id=33 lun_type=thick
create lun name=lun34 pool_id=4 capacity=587GB owner_controller=2A lun_id=34 lun_type=thick
create lun name=lun35 pool_id=4 capacity=587GB owner_controller=2A lun_id=35 lun_type=thick
create lun name=lun36 pool_id=4 capacity=587GB owner_controller=2A lun_id=36 lun_type=thick
create lun name=lun37 pool_id=4 capacity=587GB owner_controller=2A lun_id=37 lun_type=thick
create lun name=lun38 pool_id=4 capacity=587GB owner_controller=2A lun_id=38 lun_type=thick
create lun name=lun39 pool_id=4 capacity=587GB owner_controller=2A lun_id=39 lun_type=thick
create lun name=lun40 pool_id=4 capacity=587GB owner_controller=2A lun_id=40 lun_type=thick
create lun name=lun41 pool_id=5 capacity=587GB owner_controller=2B lun_id=41 lun_type=thick
create lun name=lun42 pool_id=5 capacity=587GB owner_controller=2B lun_id=42 lun_type=thick
create lun name=lun43 pool_id=5 capacity=587GB owner_controller=2B lun_id=43 lun_type=thick
create lun name=lun44 pool_id=5 capacity=587GB owner_controller=2B lun_id=44 lun_type=thick
create lun name=lun45 pool_id=5 capacity=587GB owner_controller=2B lun_id=45 lun_type=thick
create lun name=lun46 pool_id=5 capacity=587GB owner_controller=2B lun_id=46 lun_type=thick
create lun name=lun47 pool_id=5 capacity=587GB owner_controller=2B lun_id=47 lun_type=thick
create lun name=lun48 pool_id=5 capacity=587GB owner_controller=2B lun_id=48 lun_type=thick
create lun name=lun49 pool_id=6 capacity=587GB owner_controller=3A lun_id=49 lun_type=thick
create lun name=lun50 pool_id=6 capacity=587GB owner_controller=3A lun_id=50 lun_type=thick
create lun name=lun51 pool_id=6 capacity=587GB owner_controller=3A lun_id=51 lun_type=thick
create lun name=lun52 pool_id=6 capacity=587GB owner_controller=3A lun_id=52 lun_type=thick
create lun name=lun53 pool_id=6 capacity=587GB owner_controller=3A lun_id=53 lun_type=thick
create lun name=lun54 pool_id=6 capacity=587GB owner_controller=3A lun_id=54 lun_type=thick
create lun name=lun55 pool_id=6 capacity=587GB owner_controller=3A lun_id=55 lun_type=thick
create lun name=lun56 pool_id=6 capacity=587GB owner_controller=3A lun_id=56 lun_type=thick
create lun name=lun57 pool_id=7 capacity=587GB owner_controller=3B lun_id=57 lun_type=thick
create lun name=lun58 pool_id=7 capacity=587GB owner_controller=3B lun_id=58 lun_type=thick
create lun name=lun59 pool_id=7 capacity=587GB owner_controller=3B lun_id=59 lun_type=thick
create lun name=lun60 pool_id=7 capacity=587GB owner_controller=3B lun_id=60 lun_type=thick
create lun name=lun61 pool_id=7 capacity=587GB owner_controller=3B lun_id=61 lun_type=thick
```

```
create lun name=lun62 pool_id=7 capacity=587GB owner_controller=3B lun_id=62 lun_type=thick
create lun name=lun63 pool_id=7 capacity=587GB owner_controller=3B lun_id=63 lun_type=thick
create lun name=lun64 pool_id=7 capacity=587GB owner_controller=3B lun_id=64 lun_type=thick


create lun_group name=lg0 lun_group_id=1
add lun_group lun lun_group_id=1 lun_id_list=1-64
```

## Step 2: Create Mapping View, Host Group and Host

Execute the following commands using the OceanStor 5510V5 CLI from the Host System to complete the following:

- Create 10 ***hosts***
- Create one ***host_group*** (***hg***)
- Add *10* ***hosts*** to ***hg***
- Add the FC ports' WWN to *10* ***hosts***
- Create one ***mapping_view*** (***mv1***)

```
create host name=h1 operating_system=Linux host_id=1
create host name=h2 operating_system=Linux host_id=2
create host name=h3 operating_system=Linux host_id=3
create host name=h4 operating_system=Linux host_id=4
create host name=h5 operating_system=Linux host_id=5
create host name=h6 operating_system=Linux host_id=6
create host name=h7 operating_system=Linux host_id=7
create host name=h8 operating_system=Linux host_id=8
create host name=h9 operating_system=Linux host_id=9
create host name=h10 operating_system=Linux host_id=10

add host_group host host_group_id=1 host_id_list=1,2,3,4,5,6,7,8,9,10

add host initiator host_id=1 initiator_type=FC wwn=210034800d706e62
add host initiator host_id=1 initiator_type=FC wwn=210034800d706e63
add host initiator host_id=1 initiator_type=FC wwn=210034800d6fda68
add host initiator host_id=1 initiator_type=FC wwn=210034800d6fda69
add host initiator host_id=1 initiator_type=FC wwn=210034800d7072a0
add host initiator host_id=1 initiator_type=FC wwn=210034800d7072a1
add host initiator host_id=1 initiator_type=FC wwn=210034800d7072d6
add host initiator host_id=1 initiator_type=FC wwn=210034800d7072d7

add host initiator host_id=2 initiator_type=FC wwn=210034800d6fa808
add host initiator host_id=2 initiator_type=FC wwn=210034800d6fa808
add host initiator host_id=2 initiator_type=FC wwn=210034800d706d8a
add host initiator host_id=2 initiator_type=FC wwn=210034800d706d8b
add host initiator host_id=2 initiator_type=FC wwn=2100f4e9d4554608
add host initiator host_id=2 initiator_type=FC wwn=2100f4e9d4554609
add host initiator host_id=2 initiator_type=FC wwn=2100f4e9d45552aa
add host initiator host_id=2 initiator_type=FC wwn=2100f4e9d45552ab
```

```
add host initiator host_id=3 initiator_type=FC wwn=210034800d7072ea
add host initiator host_id=3 initiator_type=FC wwn=210034800d7072eb
add host initiator host_id=3 initiator_type=FC wwn=210034800d701996
add host initiator host_id=3 initiator_type=FC wwn=210034800d701997
add host initiator host_id=3 initiator_type=FC wwn=210034800d6fd9e0
add host initiator host_id=3 initiator_type=FC wwn=210034800d6fd9e1
add host initiator host_id=3 initiator_type=FC wwn=210034800d706d9c
add host initiator host_id=3 initiator_type=FC wwn=210034800d706d9d

add host initiator host_id=4 initiator_type=FC wwn=210034800d70729c
add host initiator host_id=4 initiator_type=FC wwn=210034800d70729d
add host initiator host_id=4 initiator_type=FC wwn=210034800d6fa7c4
add host initiator host_id=4 initiator_type=FC wwn=210034800d6fa7c5
add host initiator host_id=4 initiator_type=FC wwn=210034800d706da0
add host initiator host_id=4 initiator_type=FC wwn=210034800d706da1
add host initiator host_id=4 initiator_type=FC wwn=210034800d6fda8c
add host initiator host_id=4 initiator_type=FC wwn=210034800d6fda8d

add host initiator host_id=5 initiator_type=FC wwn=210034800d706d96
add host initiator host_id=5 initiator_type=FC wwn=210034800d706d97
add host initiator host_id=5 initiator_type=FC wwn=210034800d6fd9e6
add host initiator host_id=5 initiator_type=FC wwn=210034800d6fd9e7
add host initiator host_id=5 initiator_type=FC wwn=210034800d706fce
add host initiator host_id=5 initiator_type=FC wwn=210034800d706fcf
add host initiator host_id=5 initiator_type=FC wwn=210034800d70161a
add host initiator host_id=5 initiator_type=FC wwn=210034800d70161b

add host initiator host_id=6 initiator_type=FC wwn=210034800d6fabe8
add host initiator host_id=6 initiator_type=FC wwn=210034800d6fabe9
add host initiator host_id=6 initiator_type=FC wwn=210034800d6fda80
add host initiator host_id=6 initiator_type=FC wwn=210034800d6fda81
add host initiator host_id=6 initiator_type=FC wwn=210034800d6fda76
add host initiator host_id=6 initiator_type=FC wwn=210034800d6fda77
add host initiator host_id=6 initiator_type=FC wwn=210034800d701620
add host initiator host_id=6 initiator_type=FC wwn=210034800d701621

add host initiator host_id=7 initiator_type=FC wwn=210034800d6fd706
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fd707
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fd9f8
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fd9f9
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fd8aa
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fd8ab
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fda8e
add host initiator host_id=7 initiator_type=FC wwn=210034800d6fda8f

add host initiator host_id=8 initiator_type=FC wwn=210034800d706e70
add host initiator host_id=8 initiator_type=FC wwn=210034800d706e71
add host initiator host_id=8 initiator_type=FC wwn=210034800d6fd336
```

```
add host initiator host_id=8 initiator_type=FC wwn=210034800d6fd337
add host initiator host_id=8 initiator_type=FC wwn=210034800d7072db
add host initiator host_id=8 initiator_type=FC wwn=210034800d7072da
add host initiator host_id=8 initiator_type=FC wwn=210034800d706dee
add host initiator host_id=8 initiator_type=FC wwn=210034800d706def

add host initiator host_id=9 initiator_type=FC wwn=210034800d7015e2
add host initiator host_id=9 initiator_type=FC wwn=210034800d7015e3
add host initiator host_id=9 initiator_type=FC wwn=210034800d706dc2
add host initiator host_id=9 initiator_type=FC wwn=210034800d706dc3
add host initiator host_id=9 initiator_type=FC wwn=210034800d7072a2
add host initiator host_id=9 initiator_type=FC wwn=210034800d7072a3
add host initiator host_id=9 initiator_type=FC wwn=210034800d706d82
add host initiator host_id=9 initiator_type=FC wwn=210034800d706d83

add host initiator host_id=10 initiator_type=FC wwn=210034800d6fd8fe
add host initiator host_id=10 initiator_type=FC wwn=210034800d6fd8ff
add host initiator host_id=10 initiator_type=FC wwn=210034800d701998
add host initiator host_id=10 initiator_type=FC wwn=210034800d701999
add host initiator host_id=10 initiator_type=FC wwn=210034800d6fd70a
add host initiator host_id=10 initiator_type=FC wwn=210034800d6fd70b
add host initiator host_id=10 initiator_type=FC wwn=210034800d701604
add host initiator host_id=10 initiator_type=FC wwn=210034800d701605


create mapping_view name=mv mapping_view_id=1 lun_group_id=1 host_group_id=1
```

## Step 3: Create Volumes on the Master Host System

Execute the **mkvolume.sh** script on the Master Host System to create 38 logical volumes as follows:

1. **Create Physical Volume**

   Create 64 physical volumes using the **pvcreate** command.

2. **Create Volumes Groups**

   Create one volume group (**vg1**) using the **vgcreate** command and the following 64 physical volumes:

   /dev/sdb /dev/sdc /dev/sdd /dev/sde /dev/sdf /dev/sdg /dev/sdh /dev/sdi /dev/sdj /dev/sdk /dev/sdl /dev/sdm /dev/sdn /dev/sdo /dev/sdp /dev/sdq /dev/sdr /dev/sds /dev/sdt /dev/sdu /dev/sdv /dev/sdw /dev/sdx /dev/sdy /dev/sdz /dev/sdaa /dev/sdab /dev/sdac /dev/sdad /dev/sdae /dev/sdaf /dev/sdag /dev/sdah /dev/sdai /dev/sdaj /dev/sdak /dev/sdal /dev/sdam /dev/sdan /dev/sdao /dev/sdap /dev/sdaq /dev/sdar /dev/sdas /dev/sdat /dev/sdau /dev/sdav /dev/sdaw /dev/sdax /dev/sday /dev/sdaz /dev/sdba /dev/sdbb /dev/sdbc /dev/sdbd /dev/sdde /dev/sddf /dev/sddg /dev/sddh /dev/sddi /dev/sddj /dev/sddk /dev/sddl /dev/sddm **Create Logical Volumes**

- Create 18 logical volumes, each with a capacity of 892 GiB, on **vg1** for ASU-1.
- Create 18 logical volumes, each with a capacity of 892GiB, on **vg1** for ASU-2.
- Create 2 logical volumes, each with a capacity of 1784 GiB, on **vg1** for ASU-3.

## Step 4: Change the Scheduler on each Host System

Execute the **scheduler.sh** script on the Host System to change the I/O scheduler from cfq to noop on each Host System, which will result in all incoming I/O requests inserted into a simple, unordered FIFO queue.

## Step 5: Change the nr_requests on each Host System

Execute the **nr_requests.sh** script on the Host System to change nr_requests from 128 to 4096 on each Host System for each device.

## Step 6: Change the aio-max-nr on each Host System

Execute the **aio-max-nr.sh** script on the Host System to change the maximum number of AIO operations to 10485760.

# APPENDIX E: CONFIGURATION INVENTORY

An inventory of the TSC was collected during the execution of the script full_run.sh. It generated the following log files.

- profile1_storage.log – list of configured storage before the INIT phase
- profile1_volume.log – list of configured volumes before the INIT phase
- profile2_storage.log – list of configured storage after TSC restart
- profile2_volume.log – list of configured volumes after TSC restart

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 slave_asu.asu.

The phases of the benchmark are executed using the script full_run.sh. The script pauses at the end of the PERSIST_1 test phase. Once the TSC has been restarted, the PERSIST_2 test phase is executed by pressing ENTER from the console where the script has been invoked.

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