SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

HUAWEI TECHNOLOGIES CO., LTD.
HUAWEI OCEANSTOR™ S2600T

SPC-1 V1.13

Submitted for Review: November 12, 2012
Submission Identifier: A00123

First Edition – November 2012

Trademarks

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Table of Contents

AUDIT CERTIFICATION

Eric He
Huawei Technologies Co., Ltd.
Tianchen Road 88#
Chengdu, Sichuan, P.R. China 611711

November 9, 2012

The SPC Benchmark 1™ Reported Data listed below for the Huawei OceanStor™ S2600T was produced in compliance with the SPC Benchmark 1™ v1.13 Remote Audit requirements.

SPC Benchmark 1™ v1.13 Reported Data	
Tested Storage Product (TSP) Name: Huawei OceanStor™ S2600T	
Metric	**Reported Result**
SPC-1 IOPS™	40,266.25
SPC-1 Price-Performance	$2.77/SPC-1 IOPS™
Total ASU Capacity	11,811.160 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$111,415.00

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with 1.13 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by information supplied by Huawei Technologies Co., Ltd.:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.
- The total Application Storage Unit (ASU) Capacity was filled with random data, using an auditor approved tool, prior to execution of the SPC-1 Tests.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).

Storage Performance Council
643 Bair Island Road, Suite 103
Redwood City, CA 94062
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650.556.9384

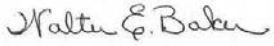
AUDIT CERTIFICATION *(CONT.)*

- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters that were changed from default values.
- SPC-1 Workload Generator commands and parameters used for the audited SPC Test Runs.
- The following Host System requirements were verified by information supplied by Huawei Technologies Co., Ltd.:
  - ✓ The type of each Host System including the number of processors and main memory.
  - ✓ The presence and version number of the SPC-1 Workload Generator on each Host System.
  - ✓ The TSC boundary within each Host System.
- The Test Results Files and resultant Summary Results Files received from Huawei Technologies Co., Ltd. for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification:
  - ✓ Data Persistence Test
  - ✓ Sustainability Test Phase
  - ✓ IOPS Test Phase
  - ✓ Response Time Ramp Test Phase
  - ✓ Repeatability Test
- There were no differences between the Tested Storage Configuration and Priced Storage Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 8 of the SPC-1 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 9 of the SPC-1 Benchmark Specification.
- This successfully audited SPC measurement is not subject to an SPC Confidential Review.

Audit Notes:

There were no audit notes or exceptions.

Respectfully,



Walter E. Baker
SPC Auditor

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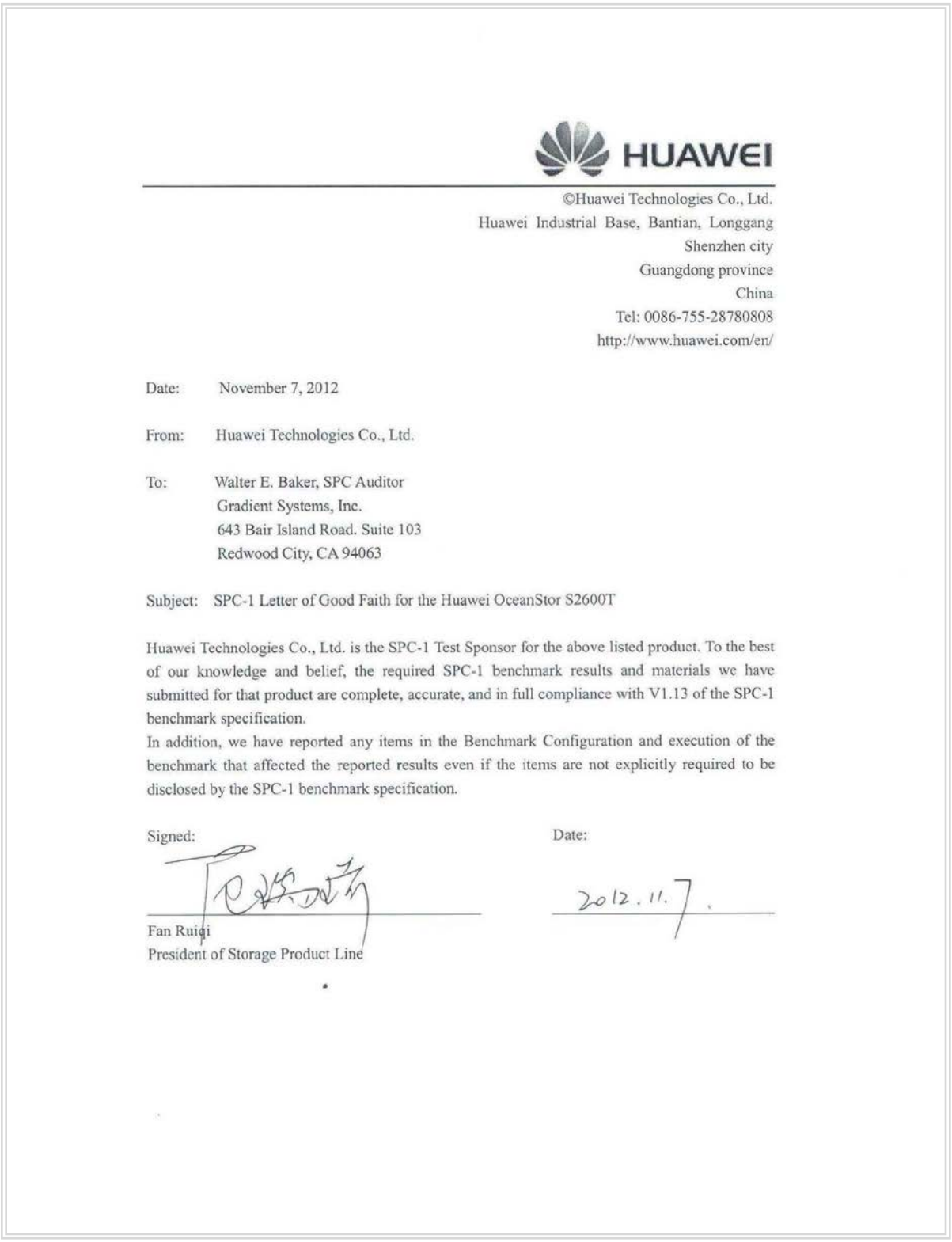
LETTER OF GOOD FAITH



HUAWEI

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Date: November 7, 2012

From: Huawei Technologies Co., Ltd.

To: Walter E. Baker, SPC Auditor
Gradient Systems, Inc.
643 Bair Island Road. Suite 103
Redwood City, CA 94063

Subject: SPC-1 Letter of Good Faith for the Huawei OceanStor S2600T

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 V1.13 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:

2012.11.7

Fan Ruiqi
President of Storage Product Line

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Eric He – eric.heji@huawei.com Tianchen Road 88# Chengdu, Sichuan, P.R. China 611711 Phone: 86 28 62905595 FAX: 86 28 62905793
Test Sponsor Alternate Contact	Huawei Technologies Co., Ltd. – http://www.huawei.com/en/ Xingxin Li – lixingxin@huawei.com Tianchen Road 88# Chengdu, Sichuan, P.R. China 611711 Phone: 86 28 62905591 FAX: 86 28 62905793
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.13
SPC-1 Workload Generator revision number	V2.3.0
Date Results were first used publicly	November 12, 2012
Date the FDR was submitted to the SPC	November 12, 2012
Date the Priced Storage Configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	November 9, 2012

Tested Storage Product (TSP) Description

Huawei OceanStor T series unified storage system (T series) is a new-generation storage product for mid-range and high-end storage applications. It boasts integration of block-level and file-level data storage, support for a variety of storage protocols, and GUI-based central storage management. Delivering leading performance, enhanced efficiency, maximized return on investment, and all-in-one solutions, the T series is ideally applicable to scenarios such as large-database OLTP/OLAP, high-performance computing, digital media, Internet applications, central storage, backup, disaster recovery, and data migration.

Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: Huawei OceanStor™ S2600T	
Metric	**Reported Result**
SPC-1 IOPS™	40,266.25
SPC-1 Price-Performance™	$2.77/SPC-1 IOPS™
Total ASU Capacity	11,811.160 GB
Data Protection Level	Protected 1 *(Mirroring)*
Total Price	$111,415.00
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

SPC-1 Price-Performance™ is the ratio of **Total Price** to **SPC-1 IOPS™**.

Total ASU (Application Storage Unit) **Capacity** represents the total storage capacity available to be read and written in the course of executing the SPC-1 benchmark.

A **Data Protection Level** of **Protected 1** using ***Mirroring*** configures two or more identical copies of user data.

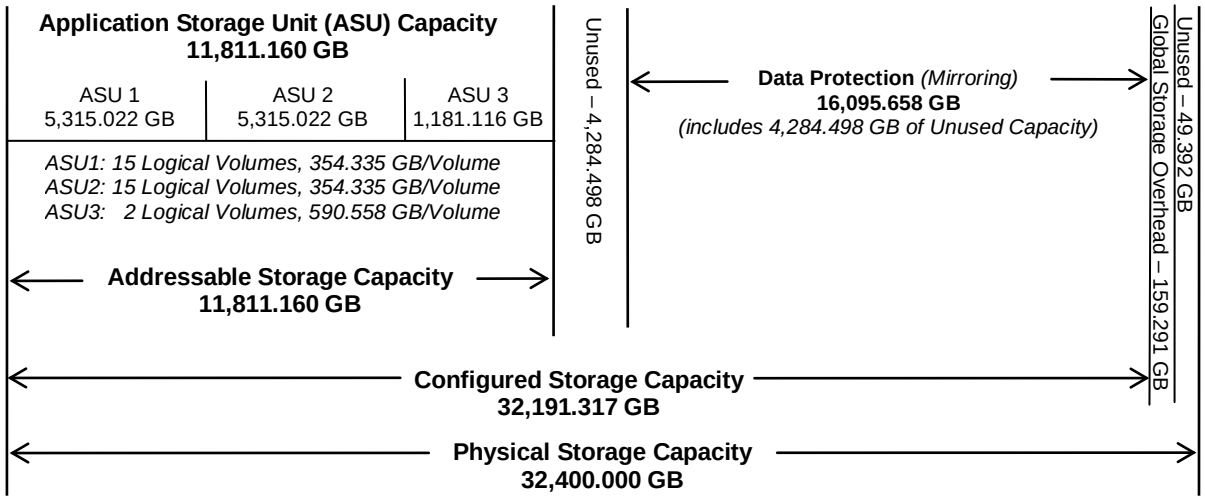
Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 14.

Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-1 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country *(non-local currency)*.

The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

Storage Capacities, Relationships, and Utilization

The following diagram *(not to scale)* and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.



SPC-1 Storage Capacity Utilization	
Application Utilization	36.45%
Protected Application Utilization	72.91%
Unused Storage Ratio	26.60%

Application Utilization: Total ASU Capacity *(11,881.160 GB)* divided by Physical Storage Capacity *(32,400.000 GB)*

Protected Application Utilization: Total ASU Capacity *(11,881.160 GB)* plus total Data Protection Capacity *(16,095.658 GB)* minus unused Data Protection Capacity *(4,284.498 GB)* divided by Physical Storage Capacity *(32,400.000 GB)*

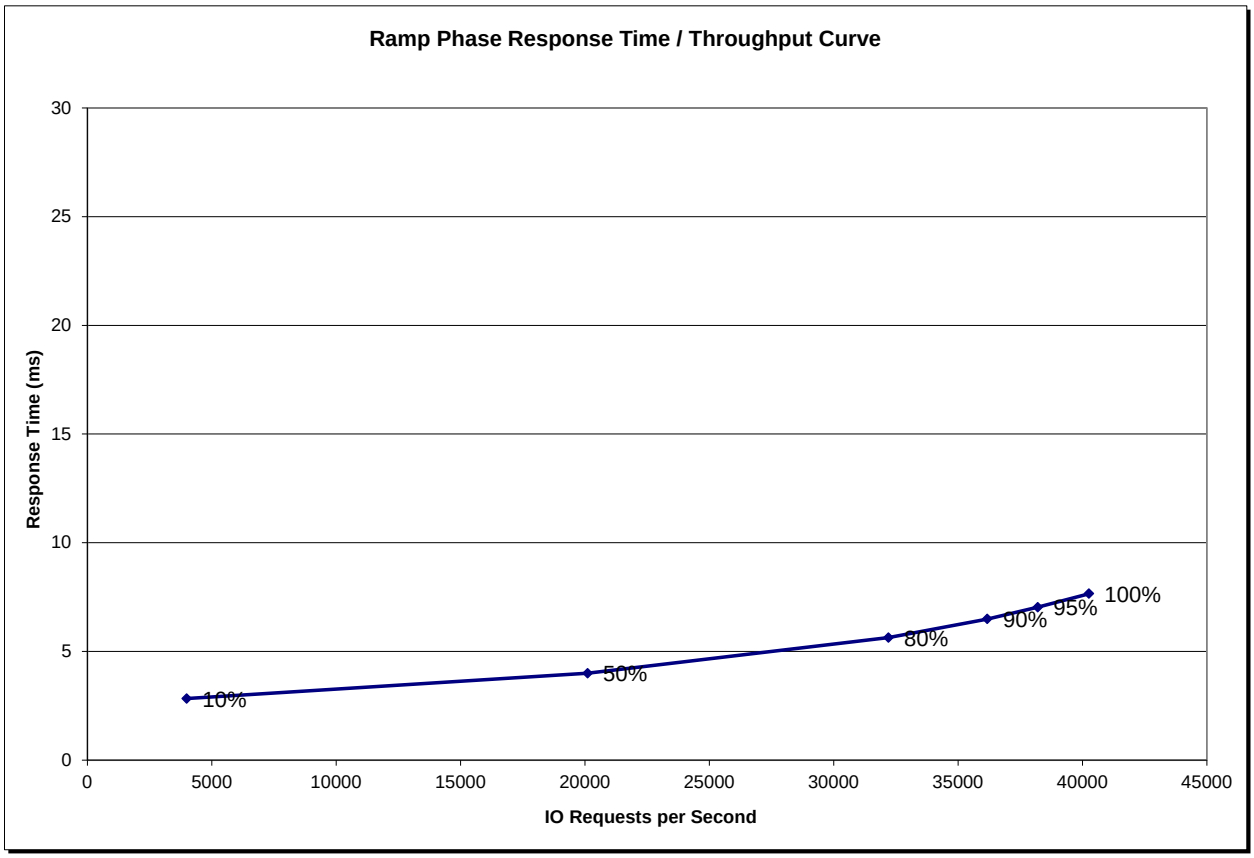
Unused Storage Ratio: Total Unused Capacity *(8,618.389 GB)* divided by Physical Storage Capacity *(32,400.000 GB)* and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 21-22.

Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPS™ metric.

The Average Response Time measured at any of the above load points cannot exceed 30 milliseconds or the benchmark measurement is invalid.



Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	3,996.98	20,109.37	32,206.02	36,180.71	38,204.08	40,266.25
Average Response Time (ms):						
All ASUs	2.83	4.00	5.64	6.49	7.03	7.65
ASU-1	3.85	5.13	7.13	8.15	8.79	9.47
ASU-2	3.59	5.46	8.64	10.47	11.71	13.26
ASU-3	0.34	0.95	1.15	1.23	1.27	1.34
Reads	6.69	8.88	12.75	14.81	16.12	17.59
Writes	0.32	0.81	1.00	1.07	1.12	1.18

Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

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

Priced Storage Configuration Pricing

Part Number	Description	Quantity	Unit Price	Total Price
Control module				**8,029.00**
2C16G-12I1-AC-BASE	OceanStor S2600T Controller Enclosure(Dual Controller,AC,16GB Cache,2*6*GE iSCSI Front-End Port,2*2*24G SAS Back-End Port(Wide Port),with UPS Cache Protected Module,HS Storage Array Control System Software,SPE32C0212)	1	8,029.00	8,029.00
Hard Disk Drives				**44,064.00**
SAS300-15K-2	300GB 15K RPM SAS Disk Unit(3.5")	108	408.00	44,064.00
Disk Enclosure				**11,908.00**
DAE12435U4-AC-2	OceanStor DAE12435U4 Disk Enclosure(4U,3.5",AC,SAS Expansion Module,without Disk Unit,with HS SAS in Band Management Software)	4	2,977.00	11,908.00
IO Interface				**2,438.00**
LPU4F8	4*8Gbps Fibre Channel I/O modules(Total 4 ports)	2	1,219.00	2,438.00
Accessory				**155.00**
SS-OP-D-LC-M-3	Patchcord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m	8	11.00	88.00
MINI-SAS-3	Purchased Cable,MiniSAS Cable,Key246,3m	1	67.00	67.00
Storage management software				**1,351.00**
LIC-S2A-ISM02-BLOCK	HS Integrated Storage Manager-Device Management License for OceanStor Block S2600T	1	1,351.00	1,351.00
Third Party				**1,698.00**
N8GHBA000	QLOGIC QLE2562 HBA Card,PCIE,8Gbps DualPort ,Fiber Channel Multimode LC Optic Interface,English Manual,Driver CD	1	1,698.00	1,698.00
Total of Product				**69,643.00**
Maintenance Support Service				**41,772.00**
Hi-Care Premier On-Site Service (3 years)		1	41,772.00	41,772.00
Total of Service (3 years)				**41,772.00**
Total Price				**111,415.00**
Notes: Hi-Care Premier On-Site Service include: 7*24 Technical Assistance Center Access. Access to all new software updates and Online Support. 24*7*4 Hours Onsite Hardware Replacement				

The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- Acknowledgement of new and existing problems with four (4) hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Price Storage Configuration that can be remedied by the repair or replacement of a Priced Storage Configuration component.

Huawei Technologies Co., Ltd. only sells its products to third-party resellers, who in turn, sell those products to U.S. customers. The above pricing, which also includes the required three-year maintenance and support, was obtained from one of those third-party resellers. See page 71 *("Appendix F: Third-Party Quotation")* for a copy of the third-party reseller quotation.

Priced Storage Configuration Diagram

Huawei OceanStor™ S2600T

dual controllers - Active-Active

8 GB cache per controller (16 GB total)

1 - FC 4-port I/O module per controller (8Gbps, 2 modules total)

12 - disk drives

4 - disk enclosures

24 - disk drives per enclosure

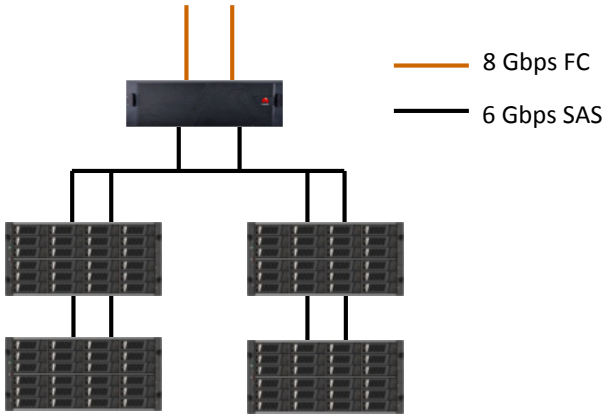
108 - 15K RPM SAS disk drives

96 - 300GB 15K RPM SAS disk drives in the four disk enclosures

12 – 300GB 15K RPM SAS disk drives in the controller enclosure

1 - Qlogic dual-port QLE 2562 FC HBA

2 Fiber Channel Connections



Priced Storage Configuration Components

Priced Storage Configuration:
1 – Qlogic dual-port QLE2562 FC HBA
Huawei OceanStor™ S2600T **dual controllers – Active-Active** 8 GB cache per controller *(16 GB total)* 1 – FC 4-port I/O module per controller *(8 Gbps, 2 modules total)* 4 – 8 Gbps front-end connections per controller *(8 total)* *(2 used, 1 per controller)* 2 –2x24 Gbps SAS backend connections per controller *(4 total, 4 used)* 12 – 300 GB disk drives
4 – Disk Enclosures 24 – 3.5” HD slots per enclosure 24 – disk drives in each enclosures
108 – 15K RPM SAS disk drives

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-1 benchmark specification, is stated in italics followed by the information to fulfill the stated requirement.

CONFIGURATION INFORMATION

Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram

Clause 9.4.3.4.1

A one page Benchmark Configuration (BC)/Tested Storage Configuration (TSC) diagram shall be included in the FDR…

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 18 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Storage Network Configuration

Clause 9.4.3.4.1

…

5. *If the TSC contains network storage, the diagram will include the network configuration. If a single diagram is not sufficient to illustrate both the Benchmark Configuration and network configuration in sufficient detail, the Benchmark Configuration diagram will include a high-level network illustration as shown in Figure 9-8. In that case, a separate, detailed network configuration diagram will also be included as described in Clause 9.4.3.4.2.*

Clause 9.4.3.4.2

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration diagram described in Clause 9.4.3.4.1 contains a high-level illustration of the network configuration, the Executive Summary will contain a one page topology diagram of the storage network as illustrated in Figure 9-9.

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) was configured with local storage and, as such, did not employ a storage network.

Host System and Tested Storage Configuration (TSC) Table of Components

Clause 9.4.3.4.3

The FDR will contain a table that lists the major components of each Host System and the Tested Storage Configuration (TSC). Table 9-10 specifies the content, format, and appearance of the table.

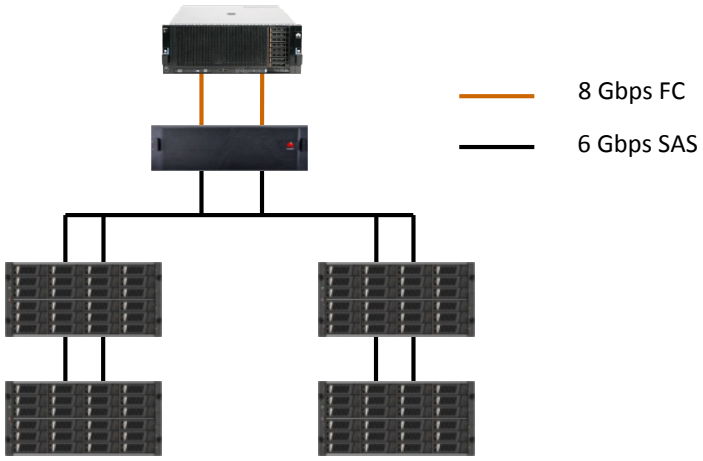
The Host System and TSC table of components may be found on page 18 *(Host System and Tested Storage Configuration Components).*

Benchmark Configuration/Tested Storage Configuration Diagram

1 – Huawei Tecal RH5485 Rack Server

1 - Qlogic dual-port QLE 2562 FC HBA

2 Fiber Channel Connections



Huawei OceanStor™ S2600T

dual controllers - Active-Active

8 GB cache per controller (16 GB total)

1 - FC 4-port I/O module per controller (8Gbps, 2 modules total)

12 - disk drives

4 - disk enclosures

24 - disk drives per enclosure

108 - 15K RPM SAS disk drives

96 - 300GB 15K RPM SAS disk drives in the four disk enclosures

12 – 300GB 15K RPM SAS disk drives in the controller enclosure

Host System and Tested Storage Configuration Components

Host System:	Tested Storage Configuration (TSC):
Huawei Tecal RH5485 Rack Servers 4 – Intel Xeon E7530 1.87 GHz CPUs 128 GB main memory Red Hat Enterprise Linux 5.5 x86_64 LVM version 2.02.56(1) PCIe	1 – QLogic dual-ported QLE2562 FC HBA
	Huawei OceanStor™ S2600T **dual controllers – Active-Active** 8 GB cache per controller *(16 GB total)* 1 – FC 4-port I/O module per controller *(8 Gbps, 2 modules total)* 4 – 8Gbps front-end connections per controller *(8 total, 2 used, 1 per controller)* 2 – 2x24 Gbps SAS-wide backend connections per controller *(4 total and 4 used)* 12 – 300 GB disk drives
	4 – Disk Enclosures 24 – 3.5” HD slots per enclosure 24 – disk drives per enclosure
	108 – 15K RPM SAS disk drives

Customer Tunable Parameters and Options

Clause 9.4.3.5.1

All Benchmark Configuration (BC) components with customer tunable parameter and options that have been altered from their default values must be listed in the FDR. The FDR entry for each of those components must include both the name of the component and the altered value of the parameter or option. If the parameter name is not self-explanatory to a knowledgeable practitioner, a brief description of the parameter's use must also be included in the FDR entry.

"Appendix B: Customer Tunable Parameters and Options" on page 61 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

Tested Storage Configuration (TSC) Description

Clause 9.4.3.5.2

The FDR must include sufficient information to recreate the logical representation of the TSC. In addition to customer tunable parameters and options (Clause 4.2.4.5.3), that information must include, at a minimum:

- *A diagram and/or description of the following:*
  - *All physical components that comprise the TSC. Those components are also illustrated in the BC Configuration Diagram in Clause 9.2.4.4.1 and/or the Storage Network Configuration Diagram in Clause 9.2.4.4.2.*
  - *The logical representation of the TSC, configured from the above components that will be presented to the Workload Generator.*
- *Listings of scripts used to create the logical representation of the TSC.*
- *If scripts were not used, a description of the process used with sufficient detail to recreate the logical representation of the TSC.*

"Appendix C: Tested Storage Configuration (TSC) Creation" on page 62 contains the detailed information that describes how to create and configure the logical TSC.

SPC-1 Workload Generator Storage Configuration

Clause 9.4.3.5.3

The FDR must include all SPC-1 Workload Generator storage configuration commands and parameters.

The SPC-1 Workload Generator storage configuration commands and parameters for this measurement appear in "Appendix D: SPC-1 Workload Generator Storage Commands and Parameters" on page 68.

ASU Pre-Fill

Clause 5.3.3

Each of the three SPC-1 ASUs (ASU-1, ASU-2 and ASU-3) is required to be completely filled with specified content prior to the execution of audited SPC-1 Tests. The content is required to consist of random data pattern such as that produced by an SPC recommended tool.

The configuration file used to complete the required ASU pre-fill appears in *"Appendix D: SPC-1 Workload Generator Storage Commands and Parameters"* on page 68.

SPC-1 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1 storage capacities and mappings used in the Tested Storage Configuration. "SPC-1 Data Repository Definitions" on page 57 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.4.3.6.1

Two tables and an illustration documenting the storage capacities and relationships of the SPC-1 Storage Hierarchy (Clause 2.1) shall be included in the FDR.

SPC-1 Storage Capacities

The Physical Storage Capacity consisted of 32,400.000 GB distributed over 108 disk drives, each with a formatted capacity of 300 GB. There was 49.392 GB (0.15%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 159.291 GB (0.49%) of the Physical Storage Capacity. There was 8,568.997 GB (26.62%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100.00% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) of Unused Storage within the Addressable Storage Capacity. The Data Protection *(Mirroring)* capacity was 16,095.658 GB of which 11,811.160 GB was utilized. The total Unused Storage capacity was 8,618.389 GB.

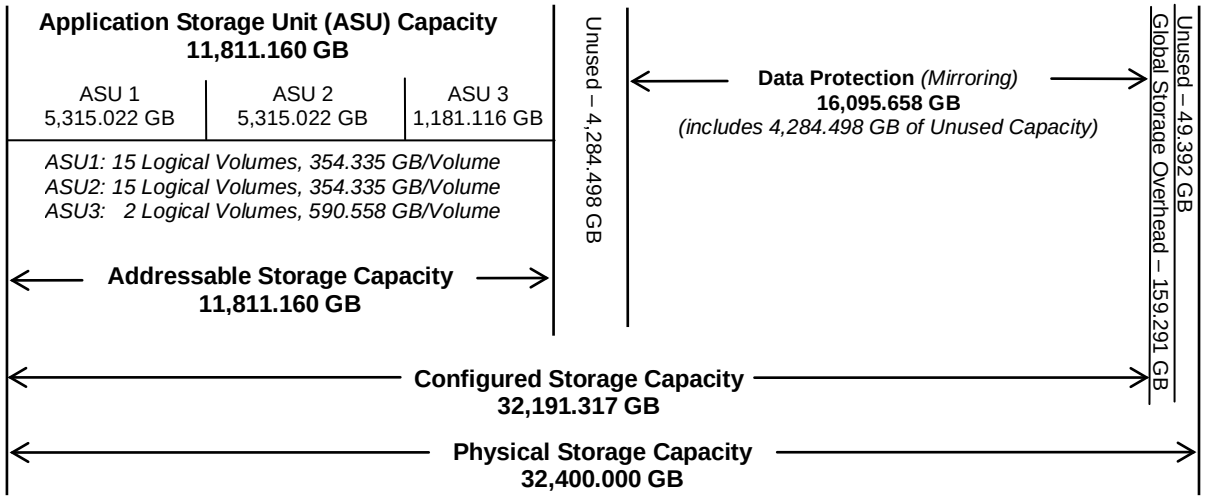
Note: The configured Storage Devices may include additional storage capacity reserved for system overhead, which is not accessible for application use. That storage capacity may not be included in the value presented for Physical Storage Capacity.

SPC-1 Storage Capacities

Storage Hierarchy Component	Units	Capacity
Total ASU Capacity	Gigabytes (GB)	11,811.160
Addressable Storage Capacity	Gigabytes (GB)	11,811.160
Configured Storage Capacity	Gigabytes (GB)	32,191.317
Physical Storage Capacity	Gigabytes (GB)	32,400.000
Data Protection *(Mirroring)*	Gigabytes (GB)	16,095.658
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	159.291
Total Unused Storage	Gigabytes (GB)	8,618.389

SPC-1 Storage Capacities and Relationships Illustration

The various storage capacities configured in the benchmark result are illustrated below *(not to scale)*.



SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	100.00%	36.69%	36.45%
Required for Data Protection *(Mirroring)*		50.00%	49.68%
Addressable Storage Capacity		36.69%	36.45%
Required Storage		0.00%	0.00%
Configured Storage Capacity			99.36%
Global Storage Overhead			0.49%
Unused Storage:			
Addressable	0.00%		
Configured		26.62%	
Physical			0.15%

Storage Capacity Utilization

Clause 9.4.3.6.2

The FDR will include a table illustrating the storage capacity utilization values defined for Application Utilization (Clause 2.8.1), Protected Application Utilization (Clause 2.8.2), and Unused Storage Ratio (Clause 2.8.3).

Clause 2.8.1

Application Utilization is defined as Total ASU Capacity divided by Physical Storage Capacity.

Clause 2.8.2

Protected Application Utilization is defined as (Total ASU Capacity plus total Data Protection Capacity minus unused Data Protection Capacity) divided by Physical Storage Capacity.

Clause 2.8.3

Unused Storage Ratio is defined as Total Unused Capacity divided by Physical Storage Capacity and may not exceed 45%.

SPC-1 Storage Capacity Utilization	
Application Utilization	36.45%
Protected Application Utilization	72.91%
Unused Storage Ratio	26.60%

Logical Volume Capacity and ASU Mapping

Clause 9.4.3.6.3

A table illustrating the capacity of each ASU and the mapping of Logical Volumes to ASUs shall be provided in the FDR. … Logical Volumes shall be sequenced in the table from top to bottom per its position in the contiguous address space of each ASU. The capacity of each Logical Volume shall be stated. … In conjunction with this table, the Test Sponsor shall provide a complete description of the type of data protection (see Clause 2.4.5) used on each Logical Volume.

Logical Volume Capacity and Mapping		
ASU-1 (5,315.022 GB)	**ASU-2 (5,315.022 GB)**	**ASU-3 (1,181.116 GB)**
15 Logical Volumes 354.335 GB per Logical Volume (354.335 GB used per Logical Volume)	15 Logical Volumes 354.335 GB per Logical Volume (354.335 GB used per Logical Volume)	2 Logical Volumes 590.558 GB per Logical Volume (590.558 GB used per Logical Volume)

The Data Protection Level used for all Logical Volumes was **Protected 1** using ***Mirroring*** as described on page 11. See "ASU Configuration" in the **IOPS Test Results File** for more detailed configuration information.

SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. "**Protected 1:** The single point of failure of any ***storage device*** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.

Protected 2: The single point of failure of any ***component*** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.

SPC-1 Test Execution Definitions" on page 58 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

The Tests must be executed in the following sequence: Primary Metrics, Repeatability, and Data Persistence. That required sequence must be uninterrupted from the start of Primary Metrics to the completion of Persistence Test Run 1. Uninterrupted means the Benchmark Configuration shall not be power cycled, restarted, disturbed, altered, or adjusted during the above measurement sequence. If the required sequence is interrupted other than for the Host System/TSC power cycle between the two Persistence Test Runs, the measurement is invalid.

SPC-1 Tests, Test Phases, and Test Runs

The SPC-1 benchmark consists of the following Tests, Test Phases, and Test Runs:

- **Primary Metrics Test**
  - Sustainability Test Phase and Test Run
  - IOPS Test Phase and Test Run
  - Response Time Ramp Test Phase
    - 95% of IOPS Test Run
    - 90% of IOPS Test Run
    - 80% of IOPS Test Run
    - 50% of IOPS Test Run
    - 10% of IOPS Test Run (LRT)
- **Repeatability Test**
  - Repeatability Test Phase 1
    - 10% of IOPS Test Run (LRT)
    - IOPS Test Run
  - Repeatability Test Phase 2
    - 10% of IOPS Test Run (LRT)
    - IOPS Test Run
- **Data Persistence Test**
  - Data Persistence Test Run 1
  - Data Persistence Test Run 2

Each Test is an atomic unit that must be executed from start to finish before any other Test, Test Phase, or Test Run may be executed.

The results from each Test, Test Phase, and Test Run are listed below along with a more detailed explanation of each component.

Primary Metrics Test – Sustainability Test Phase

Clause 5.4.4.1.1

The Sustainability Test Phase has exactly one Test Run and shall demonstrate the maximum sustainable I/O Request Throughput within at least a continuous eight (8) hour Measurement Interval. This Test Phase also serves to insure that the TSC has reached Steady State prior to reporting the final maximum I/O Request Throughput result (SPC-1 IOPS™).

Clause 5.4.4.1.2

The computed I/O Request Throughput of the Sustainability Test must be within 5% of the reported SPC-1 IOPS™ result.

Clause 5.4.4.1.4

The Average Response Time, as defined in Clause 5.1.1, will be computed and reported for the Sustainability Test Run and cannot exceed 30 milliseconds. If the Average Response time exceeds that 30-milliseconds constraint, the measurement is invalid.

Clause 9.4.3.7.1

For the Sustainability Test Phase the FDR shall contain:

1. *A Data Rate Distribution graph and data table.*
2. *I/O Request Throughput Distribution graph and data table.*
3. *A Response Time Frequency Distribution graph and table.*
4. *An Average Response Time Distribution graph and table.*
5. *The human readable Test Run Results File produced by the Workload Generator (may be included in an appendix).*
6. *A listing or screen image of all input parameters supplied to the Workload Generator (may be included in an appendix).*
7. *The Measured Intensity Multiplier for each I/O stream.*
8. *The variability of the Measured Intensity Multiplier, as defined in Clause 5.3.13.3.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 70.

Sustainability Test Results File

A link to the test results file generated from the Sustainability Test Run is listed below.

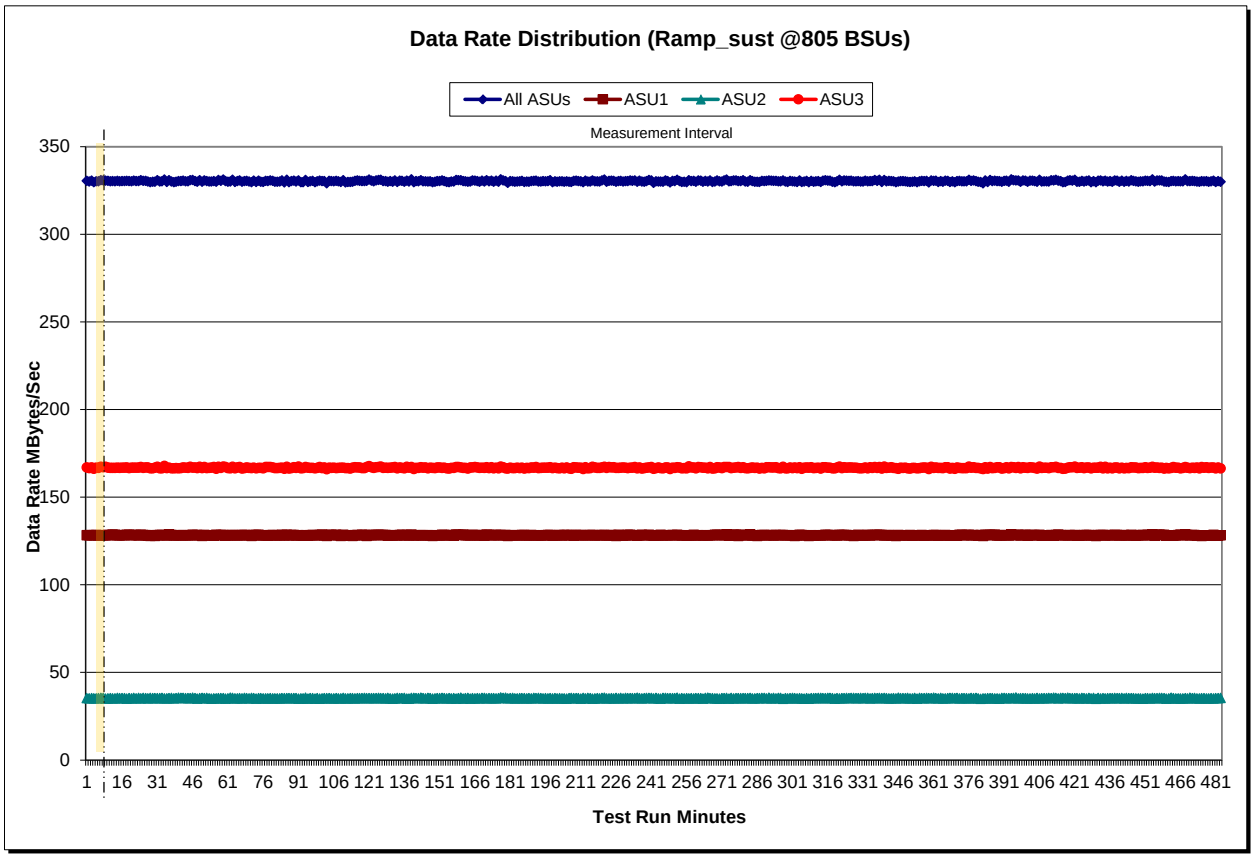
Sustainability Test Results File

Sustainability – Data Rate Distribution Data *(MB/second)*

The Sustainability Data Rate table of data is not embedded in this document due to its size. The table is available via the following URL:

Sustainability Data Rate Table

Sustainability – Data Rate Distribution Graph

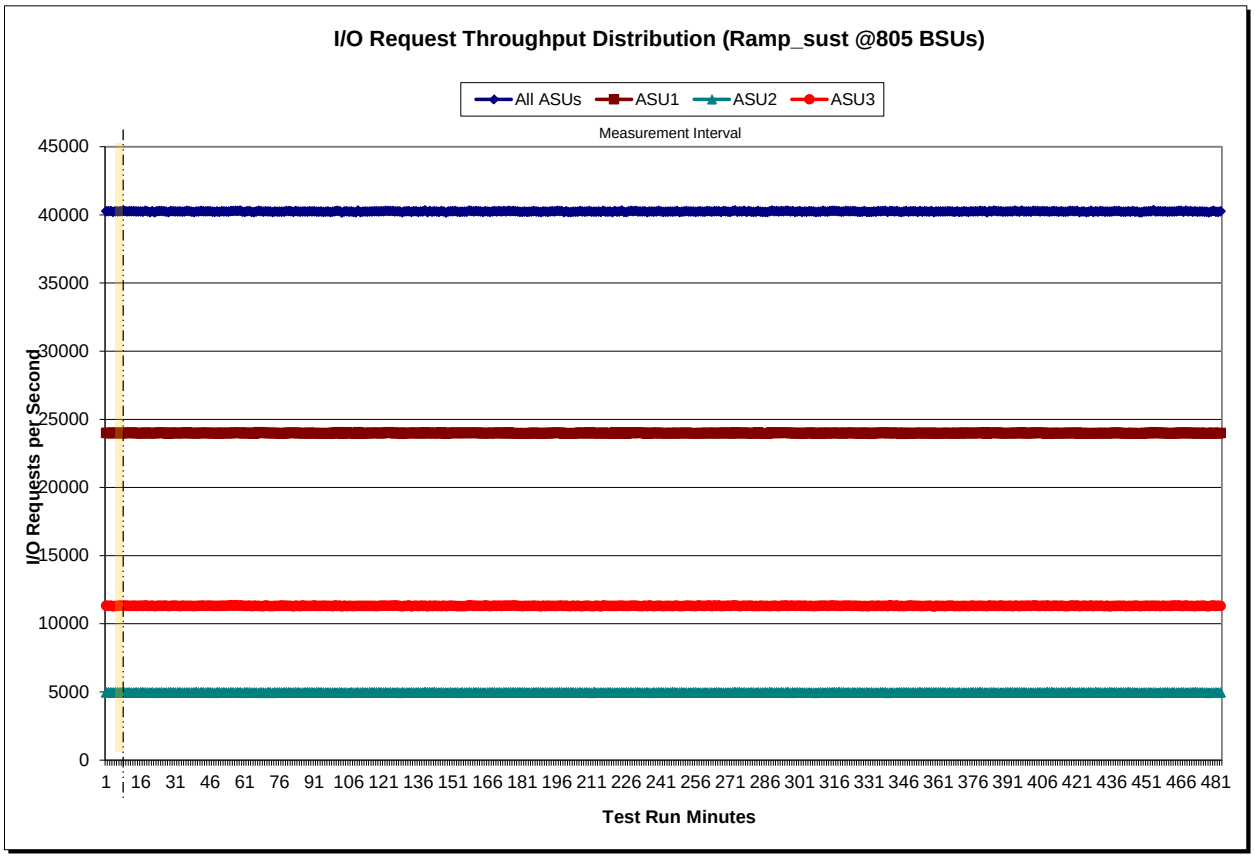


Sustainability – I/O Request Throughput Distribution Data

The Sustainability I/O Request Throughput table of data is not embedded in this document due to its size. The table is available via the following URL:

Sustainability I/O Request Throughput Table

Sustainability – I/O Request Throughput Distribution Graph

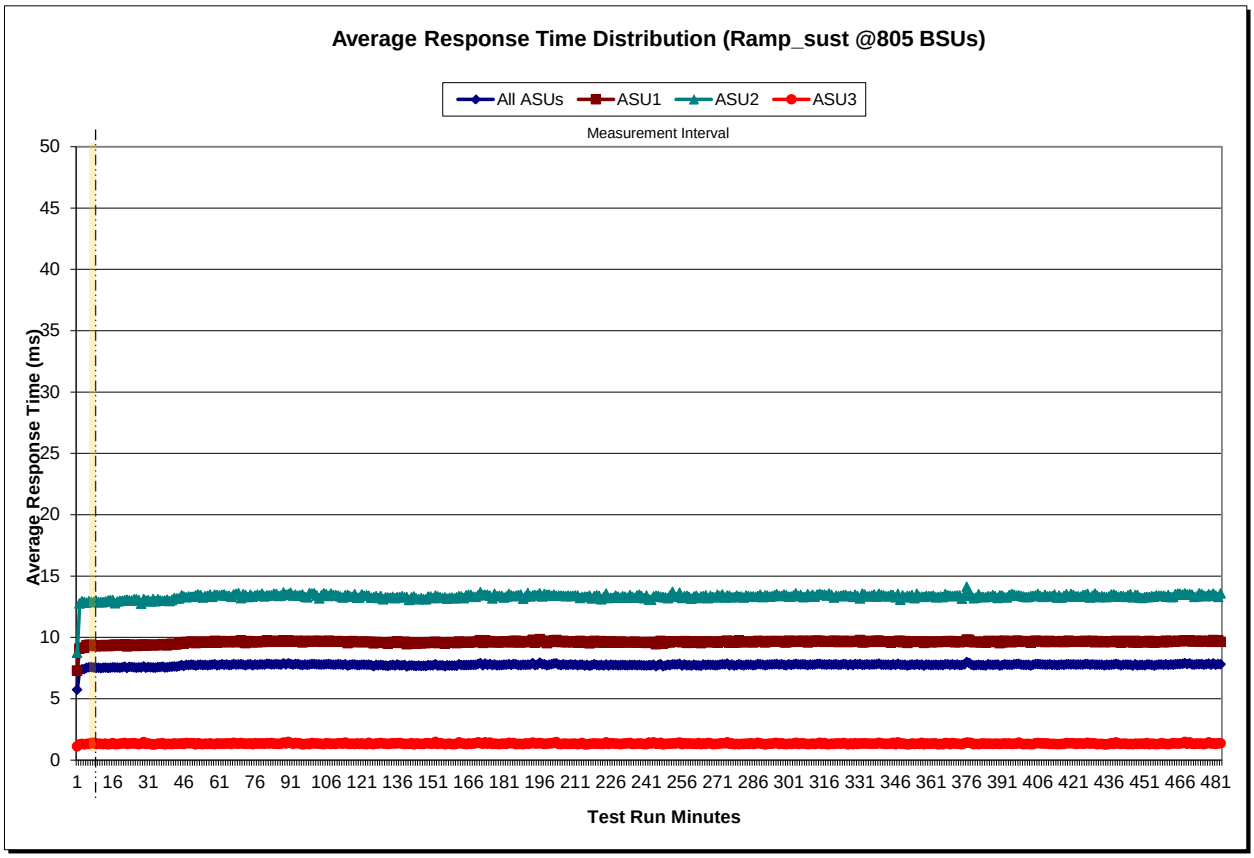


Sustainability – Average Response Time (ms) Distribution Data

The Sustainability Average Response Time table of data is not embedded in this document due to its size. The table is available via the following URL:

Sustainability Average Response Time Table

Sustainability – Average Response Time (ms) Distribution Graph



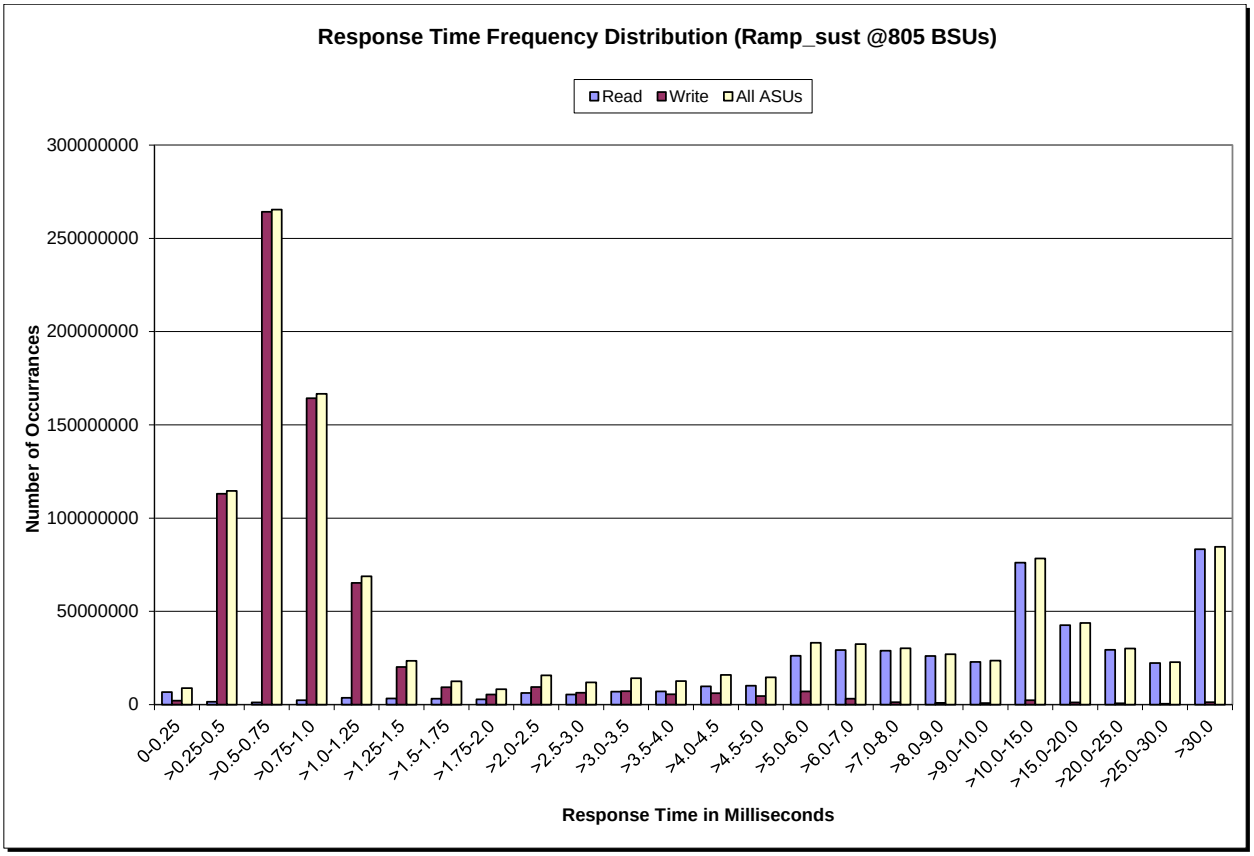
Sustainability – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	6,738,931	1,544,114	1,168,904	2,332,272	3,586,351	3,247,609	3,200,593	2,848,234
Write	2,054,553	113,009,487	264,293,601	164,293,054	65,217,023	20,176,858	9,271,893	5,411,440
All ASUs	8,793,484	114,553,601	265,462,505	166,625,326	68,803,374	23,424,467	12,472,486	8,259,674
ASU1	7,266,536	52,886,366	117,000,925	72,504,617	30,663,038	11,187,235	6,554,146	4,660,745
ASU2	690,194	12,103,736	27,383,125	16,998,583	7,178,993	2,610,960	1,511,989	1,040,929
ASU3	836,754	49,563,499	121,078,455	77,122,126	30,961,343	9,626,272	4,406,351	2,558,000

Response Time (ms)	>2.0-2.5	>2.5-3.0	>3.0-3.5	>3.5-4.0	>4.0-4.5	>4.5-5.0	>5.0-6.0	>6.0-7.0
Read	6,233,570	5,448,362	6,948,058	7,088,528	9,785,037	10,084,484	26,146,987	29,223,017
Write	9,447,781	6,399,959	7,137,828	5,515,638	6,145,265	4,561,751	7,002,394	3,167,057
All ASUs	15,681,351	11,848,321	14,085,886	12,604,166	15,930,302	14,646,235	33,149,381	32,390,074
ASU1	9,385,031	7,569,342	9,411,951	8,910,879	11,733,001	11,263,217	26,960,803	27,714,575
ASU2	1,911,641	1,287,691	1,372,008	1,085,976	1,296,038	1,152,451	2,762,259	3,090,719
ASU3	4,384,679	2,991,288	3,301,927	2,607,311	2,901,263	2,230,567	3,426,319	1,584,780

Response Time (ms)	>7.0-8.0	>8.0-9.0	>9.0-10.0	>10.0-15.0	>15.0-20.0	>20.0-25.0	>25.0-30.0	>30.0
Read	28,944,356	26,060,907	22,840,167	76,060,976	42,597,801	29,406,660	22,330,711	83,294,776
Write	1,264,436	947,920	783,174	2,285,833	1,196,422	685,264	457,266	1,281,870
All ASUs	30,208,792	27,008,827	23,623,341	78,346,809	43,794,223	30,091,924	22,787,977	84,576,646
ASU1	26,190,883	23,077,314	20,014,572	65,828,191	36,292,347	24,564,951	18,315,888	60,892,985
ASU2	3,347,632	3,409,480	3,164,457	11,079,236	6,614,443	4,938,843	4,048,062	22,503,821
ASU3	670,277	522,033	444,312	1,439,382	887,433	588,130	424,027	1,179,840

Sustainability – Response Time Frequency Distribution Graph



Sustainability – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.10 and 5.3.15.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.15.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.001	0.002	0.001	0.005	0.002	0.003	0.001

Primary Metrics Test – IOPS Test Phase

Clause 5.4.4.2

The IOPS Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of ten (10) minutes. The IOPS Test Phase immediately follows the Sustainability Test Phase without any interruption or manual intervention.

The IOPS Test Run generates the SPC-1 IOPS™ primary metric, which is computed as the I/O Request Throughput for the Measurement Interval of the IOPS Test Run.

The Average Response Time is computed for the IOPS Test Run and cannot exceed 30 milliseconds. If the Average Response Time exceeds the 30 millisecond constraint, the measurement is invalid.

Clause 9.4.3.7.2

For the IOPS Test Phase the FDR shall contain:

1. *I/O Request Throughput Distribution (data and graph).*
2. *A Response Time Frequency Distribution.*
3. *An Average Response Time Distribution.*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied to the Workload Generator.*
6. *The total number of I/O Requests completed in the Measurement Interval as well as the number of I/O Requests with a Response Time less than or equal to 30 milliseconds and the number of I/O Requests with a Response Time greater than 30 milliseconds.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 70.

IOPS Test Results File

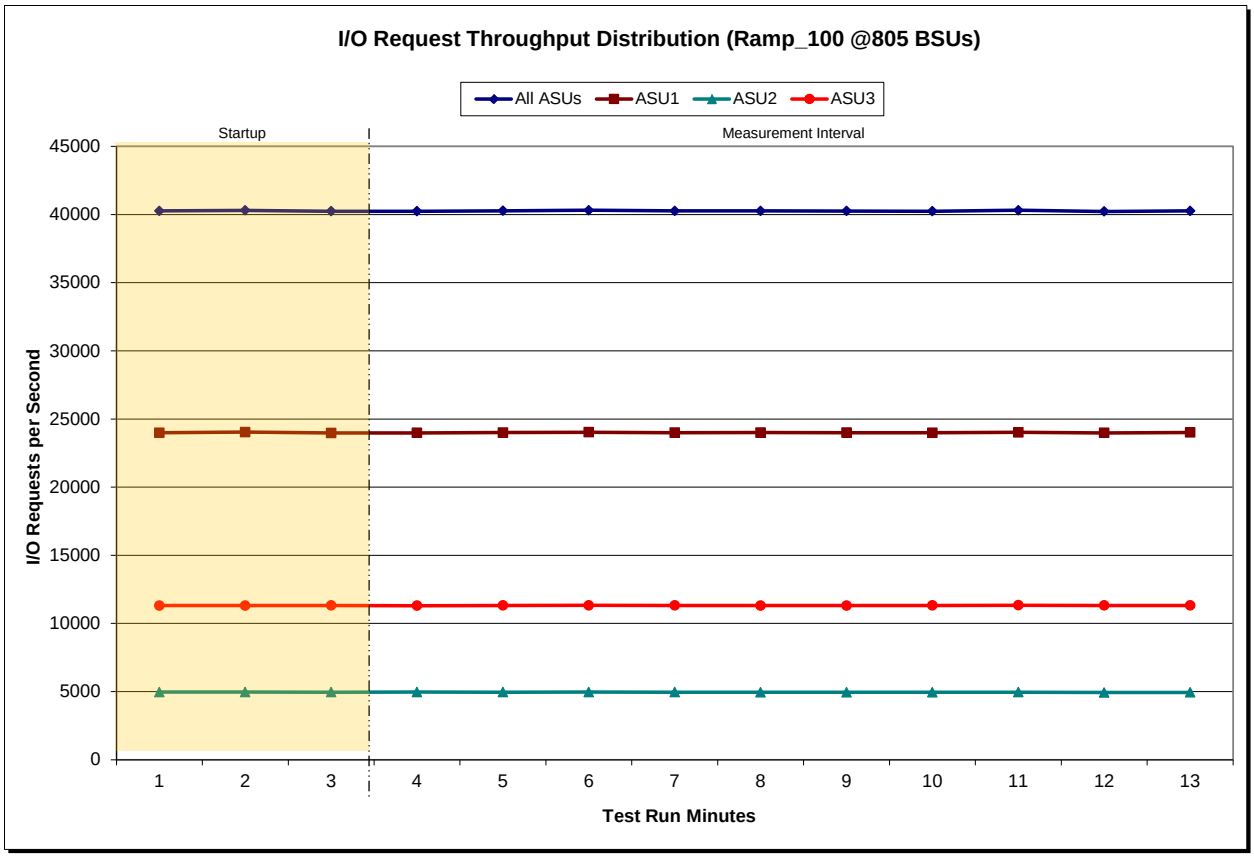
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

805 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:49:19	12:52:20	0-2	0:03:01
Measurement Interval	12:52:20	13:02:20	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	40,264.60	23,989.35	4,962.28	11,312.97
1	40,307.12	24,033.07	4,961.32	11,312.73
2	40,243.25	23,974.33	4,953.68	11,315.23
3	40,240.68	23,979.12	4,960.85	11,300.72
4	40,276.42	24,000.38	4,957.52	11,318.52
5	40,312.38	24,025.42	4,963.72	11,323.25
6	40,266.20	23,992.23	4,955.38	11,318.58
7	40,262.55	24,002.65	4,950.32	11,309.58
8	40,254.72	23,998.38	4,948.05	11,308.28
9	40,243.03	23,984.68	4,944.50	11,313.85
10	40,311.25	24,021.05	4,956.33	11,333.87
11	40,229.08	23,977.73	4,932.95	11,318.40
12	40,266.17	24,008.77	4,938.90	11,318.50
Average	***40,266.25***	***23,999.04***	***4,950.85***	***11,316.36***

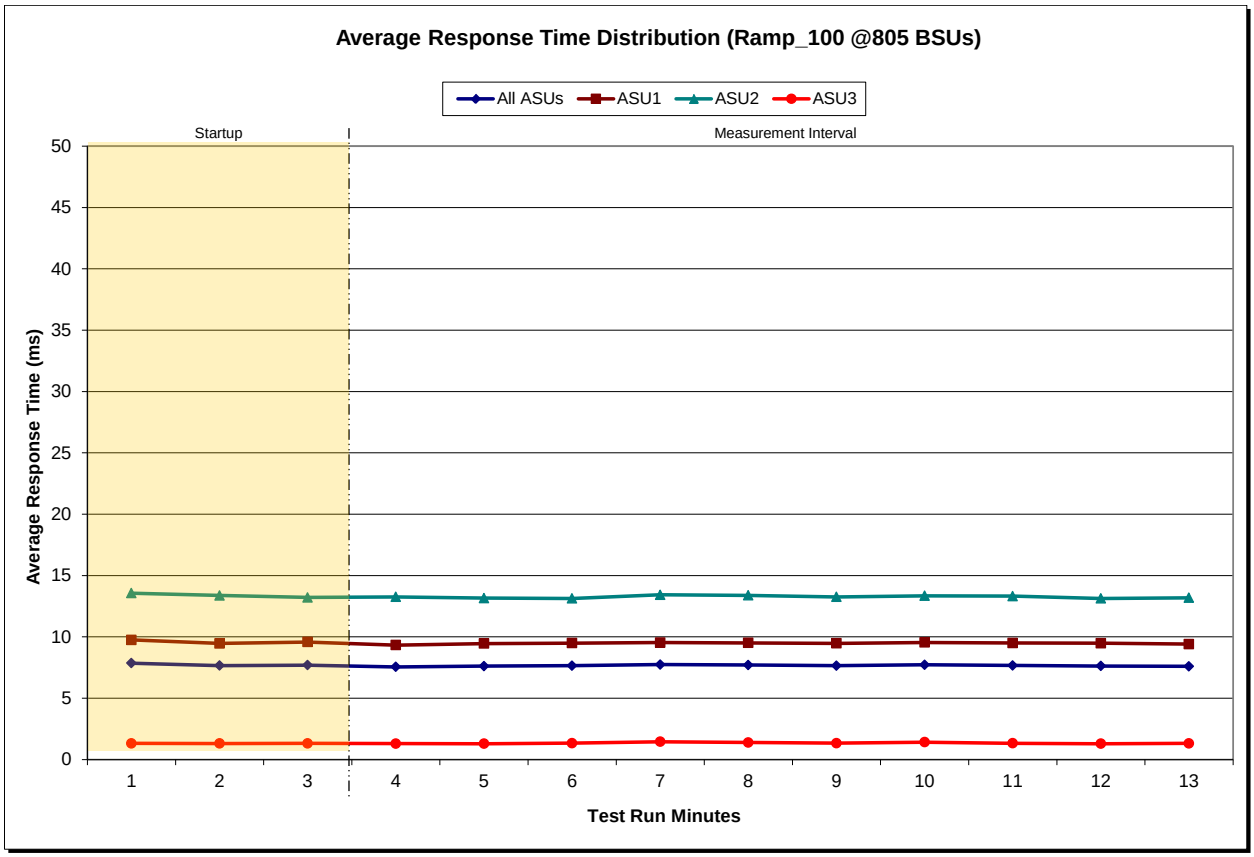
IOPS Test Run – I/O Request Throughput Distribution Graph



IOPS Test Run – Average Response Time (ms) Distribution Data

805 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:49:19	12:52:20	0-2	0:03:01
Measurement Interval	12:52:20	13:02:20	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	7.85	9.75	13.56	1.32
1	7.66	9.46	13.38	1.30
2	7.70	9.57	13.21	1.31
3	7.55	9.32	13.25	1.30
4	7.61	9.45	13.15	1.28
5	7.65	9.49	13.13	1.33
6	7.74	9.53	13.43	1.45
7	7.70	9.50	13.38	1.39
8	7.65	9.47	13.26	1.34
9	7.72	9.54	13.35	1.41
10	7.67	9.50	13.32	1.32
11	7.63	9.48	13.13	1.29
12	7.60	9.41	13.18	1.32
Average	***7.65***	***9.47***	***13.26***	***1.34***

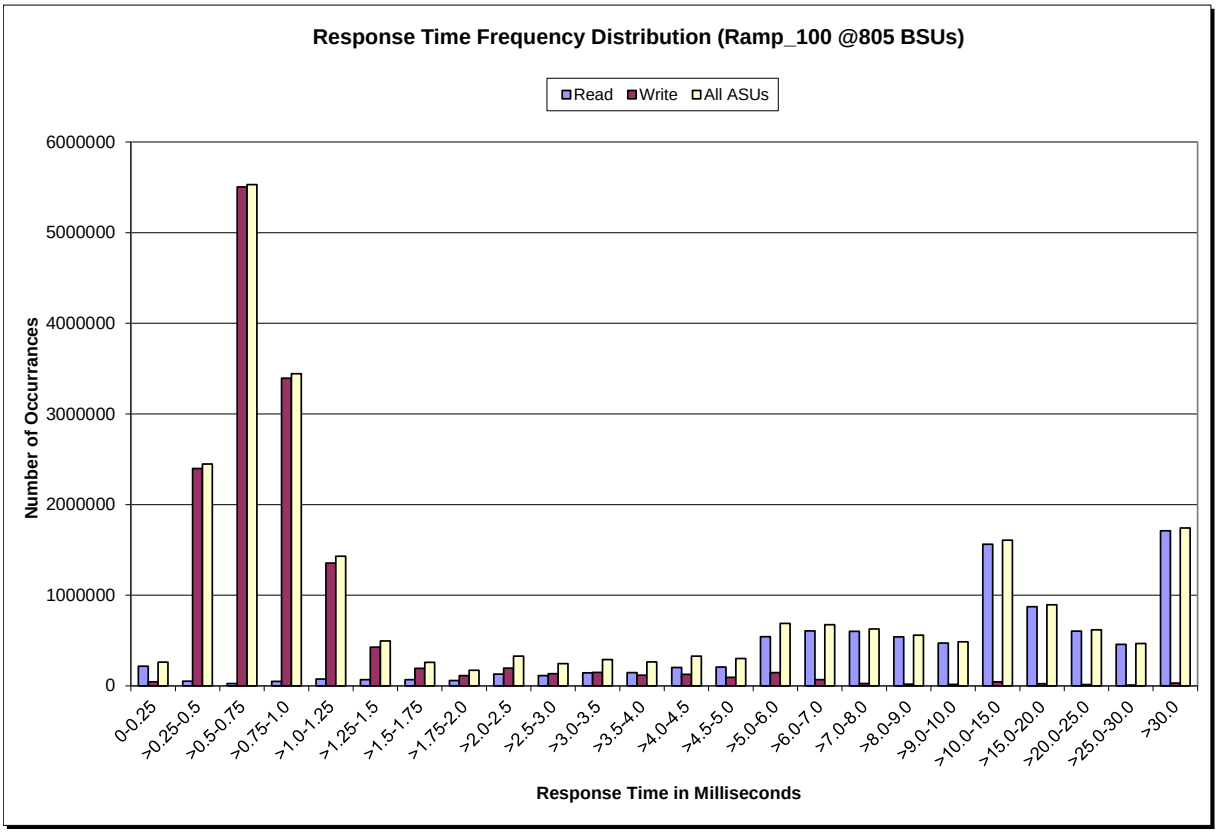
IOPS Test Run – Average Response Time (ms) Distribution Graph



IOPS Test Run – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	216,771	50,479	26,639	49,767	75,088	68,543	67,131	59,451
Write	44,666	2,397,132	5,503,556	3,393,099	1,353,866	426,768	192,273	112,493
All ASUs	261,437	2,447,611	5,530,195	3,442,866	1,428,954	495,311	259,404	171,944
ASU1	228,549	1,139,658	2,438,236	1,498,539	637,517	236,100	136,334	96,970
ASU2	14,879	256,887	570,651	349,788	148,541	55,311	31,611	21,740
ASU3	18,009	1,051,066	2,521,308	1,594,539	642,896	203,900	91,459	53,234
Response Time (ms)	**>2.0-2.5**	**>2.5-3.0**	**>3.0-3.5**	**>3.5-4.0**	**>4.0-4.5**	**>4.5-5.0**	**>5.0-6.0**	**>6.0-7.0**
Read	130,360	112,461	143,550	146,278	201,986	208,059	543,168	607,019
Write	196,165	133,312	147,333	116,852	126,708	94,412	145,674	66,903
All ASUs	326,525	245,773	290,883	263,130	328,694	302,471	688,842	673,922
ASU1	195,482	156,771	194,325	185,193	241,754	232,580	559,337	575,275
ASU2	40,071	26,816	28,244	22,829	26,964	23,901	58,124	65,257
ASU3	90,972	62,186	68,314	55,108	59,976	45,990	71,381	33,390
Response Time (ms)	**>7.0-8.0**	**>8.0-9.0**	**>9.0-10.0**	**>10.0-15.0**	**>15.0-20.0**	**>20.0-25.0**	**>25.0-30.0**	**>30.0**
Read	601,163	541,191	471,594	1,561,838	872,854	603,261	458,327	1,710,662
Write	25,478	18,101	15,128	45,429	22,323	14,437	9,747	29,998
All ASUs	626,641	559,292	486,722	1,607,267	895,177	617,698	468,074	1,740,660
ASU1	542,574	477,623	411,622	1,348,021	741,136	501,998	375,137	1,248,514
ASU2	70,574	71,677	66,514	230,139	136,791	103,301	84,009	465,838
ASU3	13,493	9,992	8,586	29,107	17,250	12,399	8,928	26,308

IOPS Test Run –Response Time Frequency Distribution Graph



IOPS Test Run – I/O Request Information

I/O Requests Completed in the Measurement Interval	I/O Requests Completed with Response Time = or < 30 ms	I/O Requests Completed with Response Time > 30 ms
24,159,493	22,418,833	1,740,660

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.10 and 5.3.15.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.15.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0,2100	0.0180	0.0699	0.0350	0.2810
COV	0.004	0.001	0.002	0.001	0.003	0.002	0.003	0.001

Primary Metrics Test – Response Time Ramp Test Phase

Clause 5.4.4.3

The Response Time Ramp Test Phase consists of five Test Runs, one each at 95%, 90%, 80%, 50%, and 10% of the load point (100%) used to generate the SPC-1 IOPS™ primary metric. Each of the five Test Runs has a Measurement Interval of ten (10) minutes. The Response Time Ramp Test Phase immediately follows the IOPS Test Phase without any interruption or manual intervention.

The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 13.

In addition, the Average Response Time measured during the 10% Test Run is the value for the SPC-1 LRT™ metric. That value represents the Average Response Time of a lightly loaded TSC.

Clause 9.4.3.7.3

The following content shall appear in the FDR for the Response Time Ramp Phase:

1. *A Response Time Ramp Distribution.*
2. *The human readable Test Run Results File produced by the Workload Generator for each Test Run within the Response Time Ramp Test Phase.*
3. *For the 10% Load Level Test Run (SPC-1 LRT™ metric) an Average Response Time Distribution.*
4. *A listing or screen image of all input parameters supplied to the Workload Generator.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 70.

Response Time Ramp Test Results File

A link to each test result file generated from each Response Time Ramp Test Run list listed below.

95% Load Level

90% Load Level

80% Load Level

50% Load Level

10% Load Level

Response Time Ramp Distribution (IOPS) Data

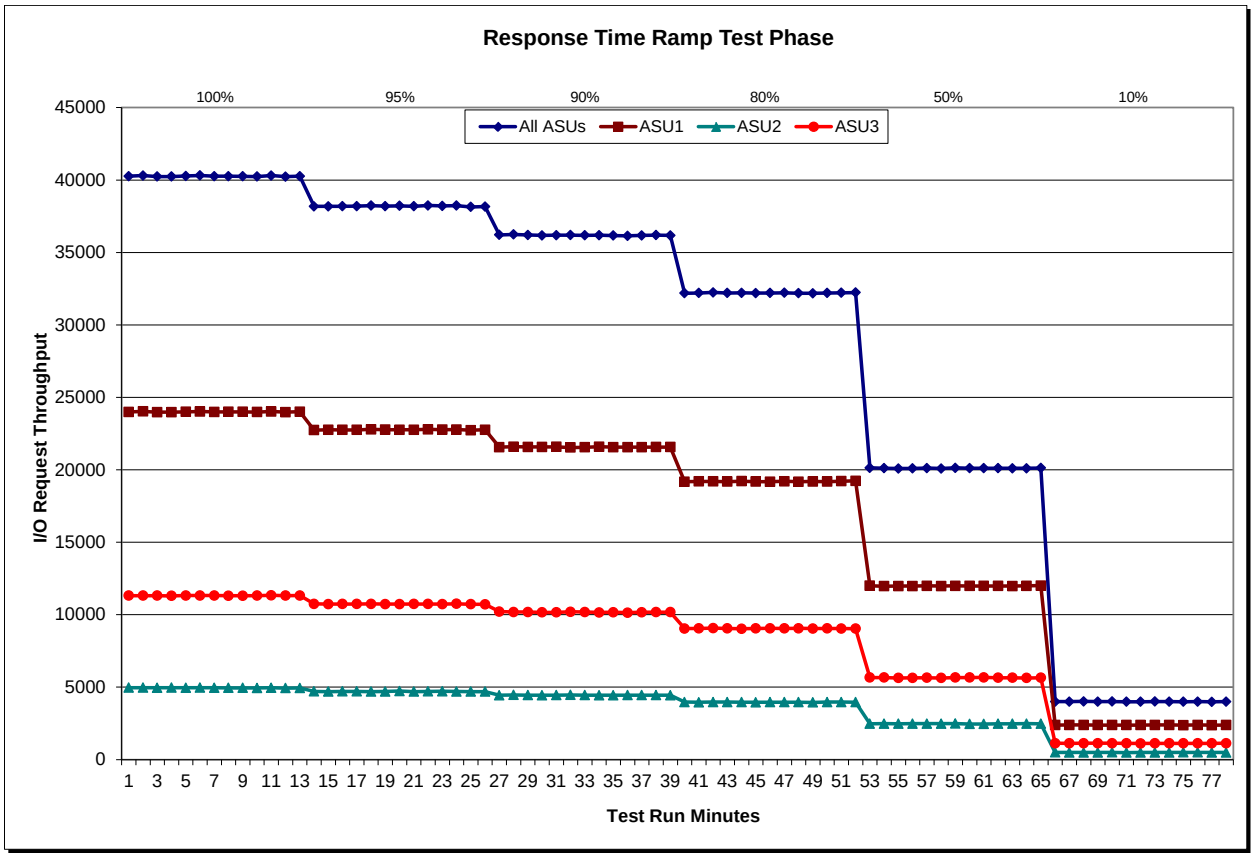
The five Test Runs that comprise the Response Time Ramp Phase are executed at 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit (BSU) load level used to produce the SPC-1 IOPS™ primary metric. The 100% BSU load level is included in the following Response Time Ramp data tables and graphs for completeness.

100% Load Level - 805 BSUs	Start	Stop	Interval	Duration	95% Load Level - 764 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:49:19	12:52:20	0-2	0:03:01	Start-Up/Ramp-Up	13:02:24	13:05:25	0-2	0:03:01
Measurement Interval	12:52:20	13:02:20	3-12	0:10:00	Measurement Interval	13:05:25	13:15:25	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	*(60 second intervals)*	All ASUs	ASU-1	ASU-2	ASU-3
0	40,264.60	23,989.35	4,962.28	11,312.97	0	38,184.72	22,735.28	4,705.70	10,743.73
1	40,307.12	24,033.07	4,961.32	11,312.73	1	38,181.42	22,763.75	4,690.52	10,727.15
2	40,243.25	23,974.33	4,953.68	11,315.23	2	38,191.37	22,754.23	4,702.62	10,734.52
3	40,240.68	23,979.12	4,960.85	11,300.72	3	38,199.33	22,751.28	4,707.38	10,740.67
4	40,276.42	24,000.38	4,957.52	11,318.52	4	38,231.63	22,794.68	4,690.62	10,746.33
5	40,312.38	24,025.42	4,963.72	11,323.25	5	38,200.22	22,771.32	4,696.17	10,732.73
6	40,266.20	23,992.23	4,955.38	11,318.58	6	38,216.97	22,762.50	4,726.50	10,727.97
7	40,262.55	24,002.65	4,950.32	11,309.58	7	38,191.05	22,761.48	4,692.03	10,737.53
8	40,254.72	23,998.38	4,948.05	11,308.28	8	38,242.20	22,795.52	4,709.67	10,737.02
9	40,243.03	23,984.68	4,944.50	11,313.85	9	38,213.10	22,767.02	4,712.60	10,733.48
10	40,311.25	24,021.05	4,956.33	11,333.87	10	38,232.47	22,778.78	4,699.67	10,754.02
11	40,229.08	23,977.73	4,932.95	11,318.40	11	38,146.62	22,729.77	4,693.12	10,723.73
12	40,266.17	24,008.77	4,938.90	11,318.50	12	38,167.25	22,761.13	4,688.42	10,717.70
Average	***40,266.25***	***23,999.04***	***4,950.85***	***11,316.36***	***Average***	***38,204.08***	***22,767.35***	***4,701.62***	***10,735.12***

90% Load Level - 724 BSUs	Start	Stop	Interval	Duration	80% Load Level -644 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:15:28	13:18:29	0-2	0:03:01	Start-Up/Ramp-Up	13:28:32	13:31:33	0-2	0:03:01
Measurement Interval	13:18:29	13:28:29	3-12	0:10:00	Measurement Interval	13:31:33	13:41:33	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	*(60 second intervals)*	All ASUs	ASU-1	ASU-2	ASU-3
0	36,215.53	21,561.77	4,443.47	10,210.30	0	32,188.72	19,176.62	3,966.62	9,045.48
1	36,244.28	21,592.63	4,465.55	10,186.10	1	32,205.08	19,198.33	3,957.53	9,049.22
2	36,207.37	21,575.92	4,447.68	10,183.77	2	32,242.20	19,197.83	3,968.45	9,075.92
3	36,177.02	21,576.85	4,442.98	10,157.18	3	32,205.43	19,181.53	3,973.07	9,050.83
4	36,191.90	21,580.68	4,450.97	10,160.25	4	32,211.20	19,215.32	3,964.38	9,031.50
5	36,199.42	21,535.92	4,463.60	10,199.90	5	32,194.23	19,187.03	3,956.72	9,050.48
6	36,182.93	21,557.13	4,444.58	10,181.22	6	32,199.97	19,175.78	3,962.52	9,061.67
7	36,187.97	21,589.02	4,443.93	10,155.02	7	32,221.03	19,203.90	3,963.05	9,054.08
8	36,167.53	21,558.63	4,441.53	10,167.37	8	32,188.18	19,172.65	3,959.82	9,055.72
9	36,146.47	21,559.27	4,447.35	10,139.85	9	32,182.90	19,189.85	3,950.02	9,043.03
10	36,177.48	21,563.80	4,449.15	10,164.53	10	32,204.27	19,184.22	3,970.00	9,050.05
11	36,200.43	21,572.08	4,449.30	10,179.05	11	32,218.43	19,211.17	3,966.98	9,040.28
12	36,175.92	21,566.38	4,437.82	10,171.72	12	32,234.57	19,238.35	3,963.90	9,032.32
Average	***36,180.71***	***21,565.98***	***4,447.12***	***10,167.61***	***Average***	***32,206.02***	***19,195.98***	***3,963.05***	***9,047.00***

50% Load Level - 402 BSUs	Start	Stop	Interval	Duration	10% Load Level - 80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:41:36	13:44:37	0-2	0:03:01	Start-Up/Ramp-Up	13:54:40	13:54:40	0-2	0:00:00
Measurement Interval	13:44:37	13:54:37	3-12	0:10:00	Measurement Interval	13:54:40	13:54:40	3-12	0:00:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	*(60 second intervals)*	All ASUs	ASU-1	ASU-2	ASU-3
0	20,132.45	12,001.03	2,471.33	5,660.08	0	4,001.25	2,379.88	496.12	1,125.25
1	20,110.97	11,967.20	2,482.23	5,661.53	1	3,998.08	2,387.43	489.62	1,121.03
2	20,085.57	11,977.03	2,473.92	5,634.62	2	4,012.52	2,392.13	493.15	1,127.23
3	20,098.73	11,977.18	2,480.00	5,641.55	3	3,999.32	2,380.35	490.45	1,128.52
4	20,117.20	11,994.07	2,476.92	5,646.22	4	4,003.65	2,382.92	495.40	1,125.33
5	20,087.50	11,975.90	2,480.72	5,630.88	5	3,989.78	2,381.47	486.63	1,121.68
6	20,136.70	11,988.30	2,488.37	5,660.03	6	3,988.43	2,382.20	491.15	1,115.08
7	20,108.37	11,985.12	2,457.62	5,665.63	7	4,005.52	2,389.77	492.88	1,122.87
8	20,112.58	11,982.03	2,460.57	5,669.98	8	4,000.05	2,388.28	492.83	1,118.93
9	20,107.22	11,982.17	2,474.33	5,650.72	9	3,993.50	2,373.57	496.68	1,123.25
10	20,101.90	11,978.02	2,473.85	5,650.03	10	4,003.30	2,385.83	495.08	1,122.38
11	20,099.50	11,988.33	2,480.55	5,630.62	11	3,984.67	2,374.63	488.03	1,122.00
12	20,124.00	12,007.27	2,470.40	5,646.33	12	4,001.53	2,381.32	489.10	1,131.12
Average	***20,109.37***	***11,985.84***	***2,474.33***	***5,649.20***	***Average***	***3,996.98***	***2,382.03***	***491.83***	***1,123.12***

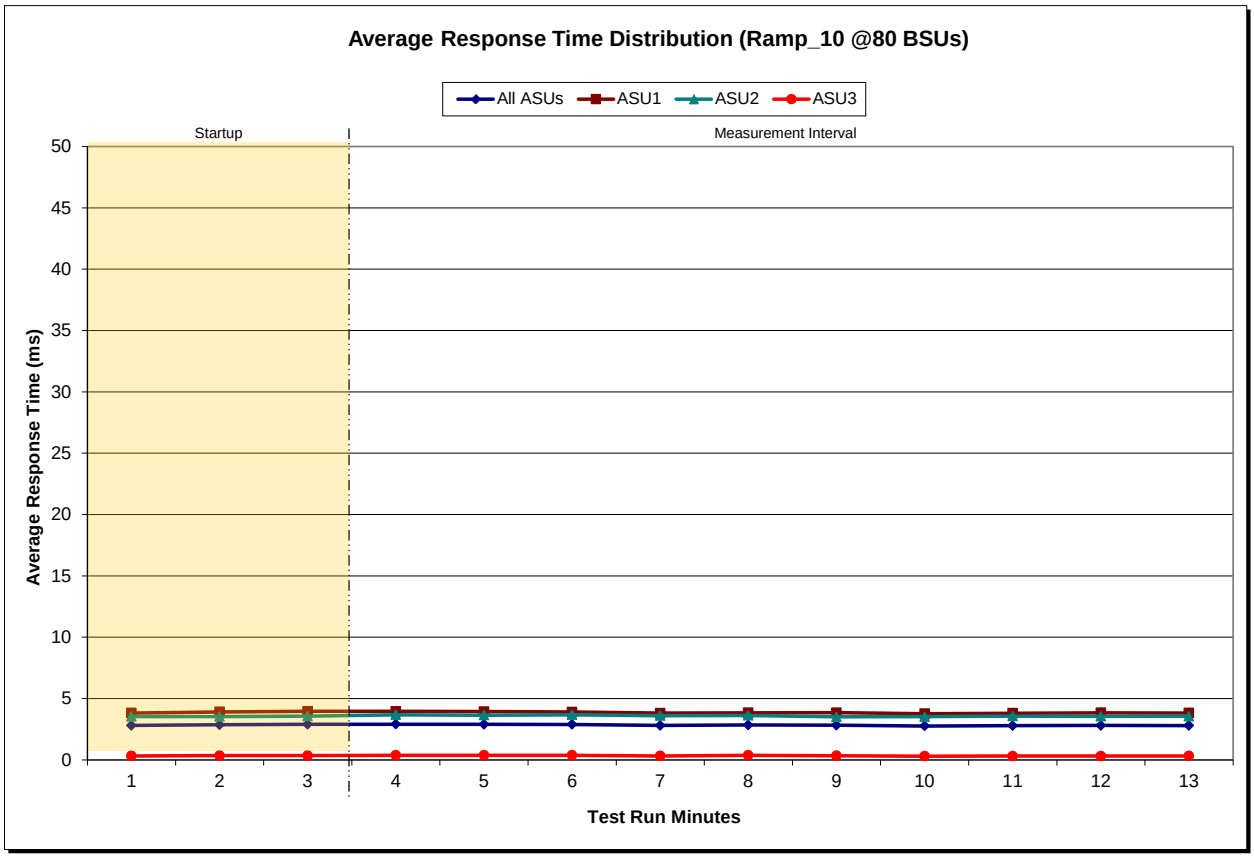
Response Time Ramp Distribution (IOPS) Graph



SPC-1 LRT™ Average Response Time (ms) Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:54:40	13:57:41	0-2	0:03:01
Measurement Interval	13:57:41	14:07:41	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.80	3.82	3.53	0.32
1	2.86	3.90	3.53	0.34
2	2.89	3.95	3.57	0.34
3	2.91	3.95	3.68	0.37
4	2.89	3.93	3.64	0.37
5	2.88	3.90	3.67	0.38
6	2.80	3.80	3.60	0.32
7	2.84	3.84	3.62	0.37
8	2.82	3.85	3.50	0.34
9	2.76	3.76	3.53	0.31
10	2.79	3.80	3.57	0.31
11	2.81	3.84	3.55	0.31
12	2.80	3.82	3.56	0.32
Average	***2.83***	***3.85***	***3.59***	***0.34***

SPC-1 LRT™ Average Response Time (ms) Distribution Graph



SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.10 and 5.3.15.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.15.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0349	0.2806	0.0703	0.2101	0.0181	0.0699	0.0351	0.2810
COV	0.007	0.004	0.010	0.006	0.014	0.006	0.009	0.004

Repeatability Test

Clause 5.4.5

The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ primary metric and the SPC-1 LRT™ metric generated in earlier Test Runs.

There are two identical Repeatability Test Phases. Each Test Phase contains two Test Runs. Each of the Test Runs will have a Measurement Interval of no less than ten (10) minutes. The two Test Runs in each Test Phase will be executed without interruption or any type of manual intervention.

The first Test Run in each Test Phase is executed at the 10% load point. The Average Response Time from each of the Test Runs is compared to the SPC-1 LRT™ metric. Each Average Response Time value must be less than the SPC-1 LRT™ metric plus 5% or less than the SPC-1 LRT™ metric plus one (1) millisecond (ms).

The second Test Run in each Test Phase is executed at the 100% load point. The I/O Request Throughput from the Test Runs is compared to the SPC-1 IOPS™ primary metric. Each I/O Request Throughput value must be greater than the SPC-1 IOPS™ primary metric minus 5%. In addition, the Average Response Time for each Test Run cannot exceed 30 milliseconds.

If any of the above constraints are not met, the benchmark measurement is invalid.

Clause 9.4.3.7.4

The following content shall appear in the FDR for each Test Run in the two Repeatability Test Phases:

1. *A table containing the results of the Repeatability Test.*
2. *An I/O Request Throughput Distribution graph and table.*
3. *An Average Response Time Distribution graph and table.*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied to the Workload Generator.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 70.

Repeatability Test Results File

The values for the SPC-1 IOPS™, SPC-1 LRT™, and the Repeatability Test measurements are listed in the tables below.

	SPC-1 IOPS™
Primary Metrics	***40,266.25***
Repeatability Test Phase 1	40,243.92
Repeatability Test Phase 2	40,255.41

The SPC-1 IOPS™ values in the above table were generated using 100% of the specified Business Scaling Unit (BSU) load level. Each of the Repeatability Test Phase values for SPC-1 IOPS™ must greater than 95% of the reported SPC-1 IOPS™ Primary Metric.

	SPC-1 LRT™
Primary Metrics	***2.83 ms***
Repeatability Test Phase 1	2.83 ms
Repeatability Test Phase 2	2.83 ms

The average response time values in the SPC-1 LRT™ column were generated using 10% of the specified Business Scaling Unit (BSU) load level. Each of the Repeatability Test Phase values for SPC-1 LRT™ must be less than 105% of the reported SPC-1 LRT™ Primary Metric or less than the reported SPC-1 LRT™ Primary Metric minus one (1) millisecond (ms).

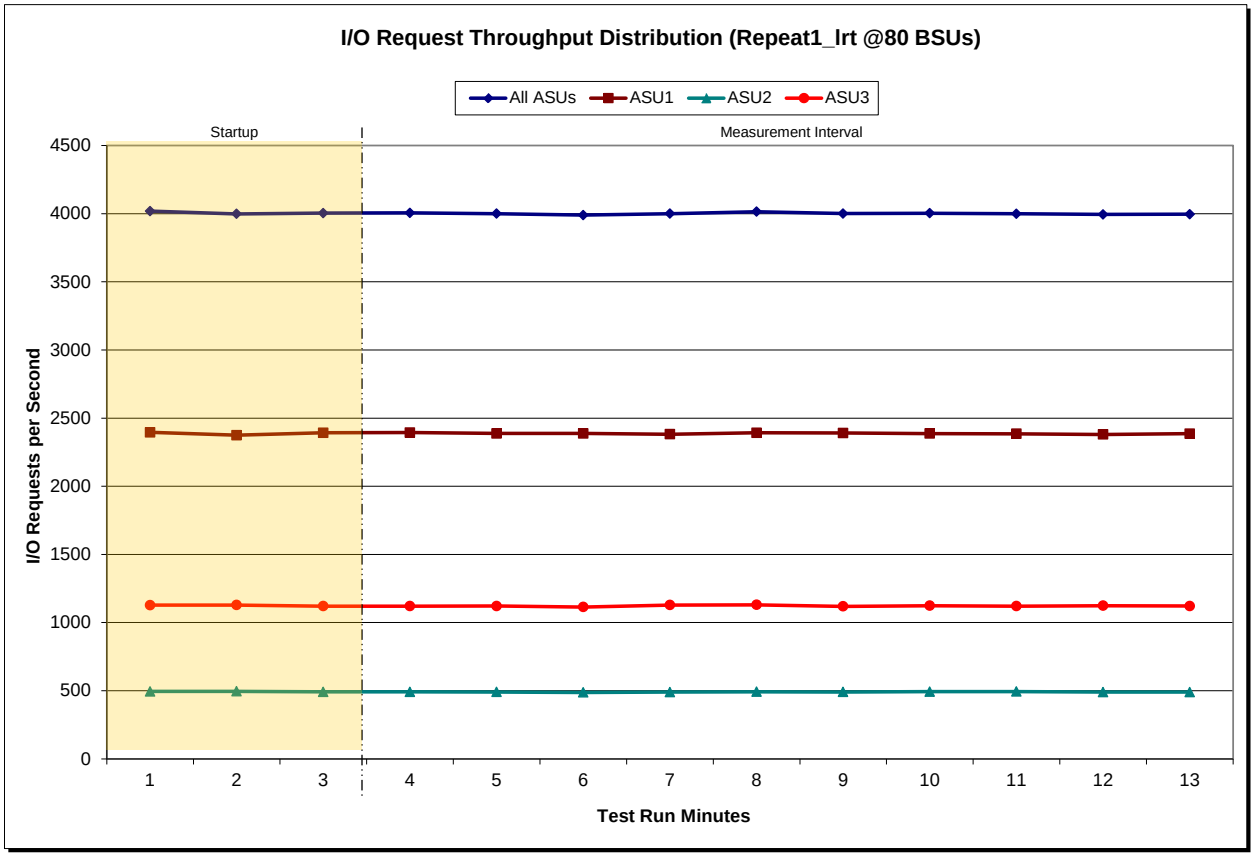
A link to the test result file generated from each Repeatability Test Run is listed below.

Repeatability Test Phase 1, Test Run 1 (LRT)
Repeatability Test Phase 1, Test Run 2 (IOPS)
Repeatability Test Phase 2, Test Run 1 (LRT)
Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:07:48	14:10:48	0-2	0:03:00
Measurement Interval	14:10:48	14:20:48	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	4,018.28	2,395.43	495.02	1,127.83
1	3,998.20	2,374.32	495.42	1,128.47
2	4,003.88	2,392.27	491.48	1,120.13
3	4,005.23	2,393.83	491.05	1,120.35
4	4,000.00	2,387.48	490.95	1,121.57
5	3,989.33	2,387.45	487.63	1,114.25
6	3,999.98	2,381.72	489.67	1,128.60
7	4,014.47	2,391.97	492.35	1,130.15
8	4,000.75	2,390.78	490.97	1,119.00
9	4,002.98	2,386.43	492.63	1,123.92
10	3,998.93	2,384.70	494.17	1,120.07
11	3,994.32	2,380.38	489.87	1,124.07
12	3,996.08	2,385.48	489.62	1,120.98
Average	***4,000.21***	***2,387.02***	***490.89***	***1,122.30***

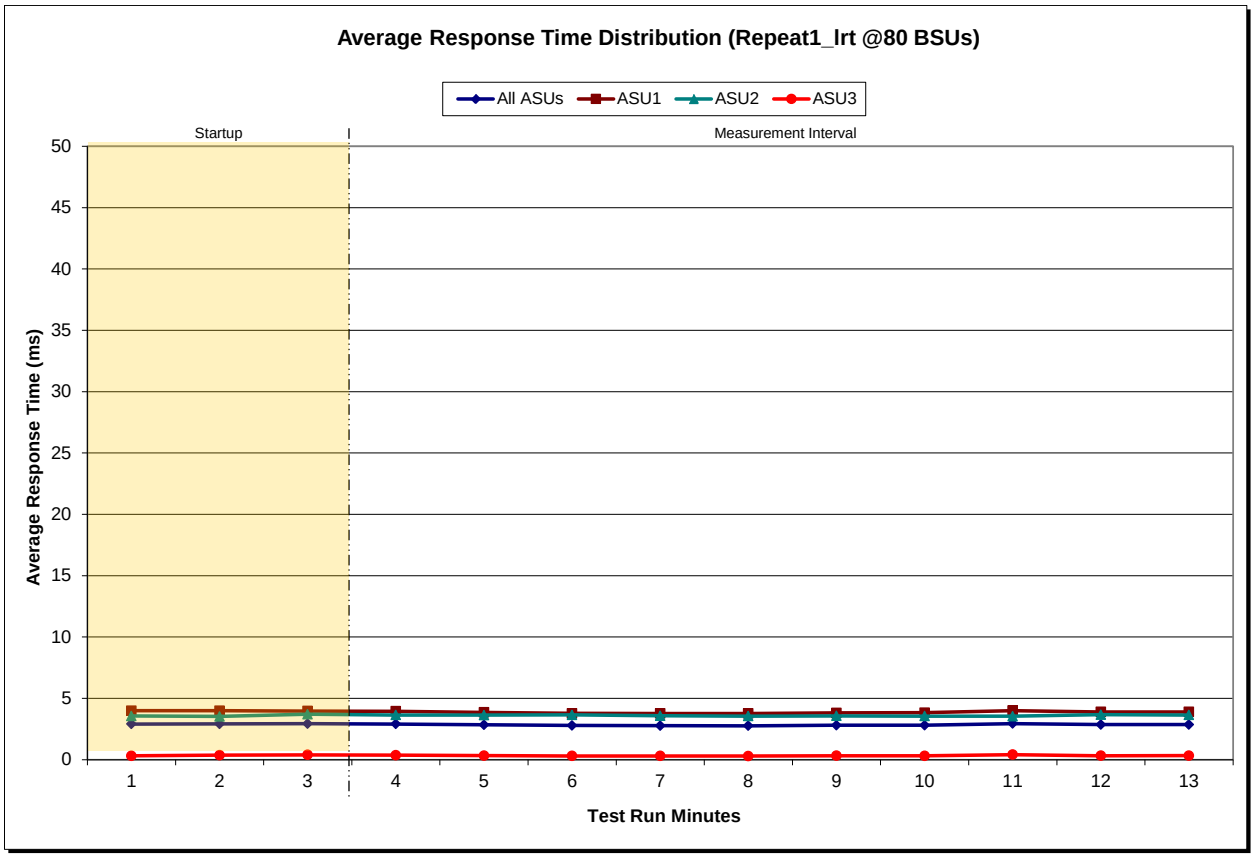
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



Repeatability 1 LRT –Average Response Time (ms) Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:07:48	14:10:48	0-2	0:03:00
Measurement Interval	14:10:48	14:20:48	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.90	3.98	3.55	0.31
1	2.91	3.99	3.52	0.36
2	2.93	3.97	3.70	0.39
3	2.90	3.94	3.64	0.37
4	2.84	3.86	3.63	0.33
5	2.79	3.78	3.64	0.30
6	2.76	3.76	3.58	0.30
7	2.76	3.77	3.55	0.30
8	2.80	3.81	3.56	0.32
9	2.81	3.83	3.55	0.31
10	2.94	4.00	3.54	0.40
11	2.86	3.89	3.67	0.32
12	2.86	3.89	3.64	0.33
Average	***2.83***	***3.85***	***3.60***	***0.33***

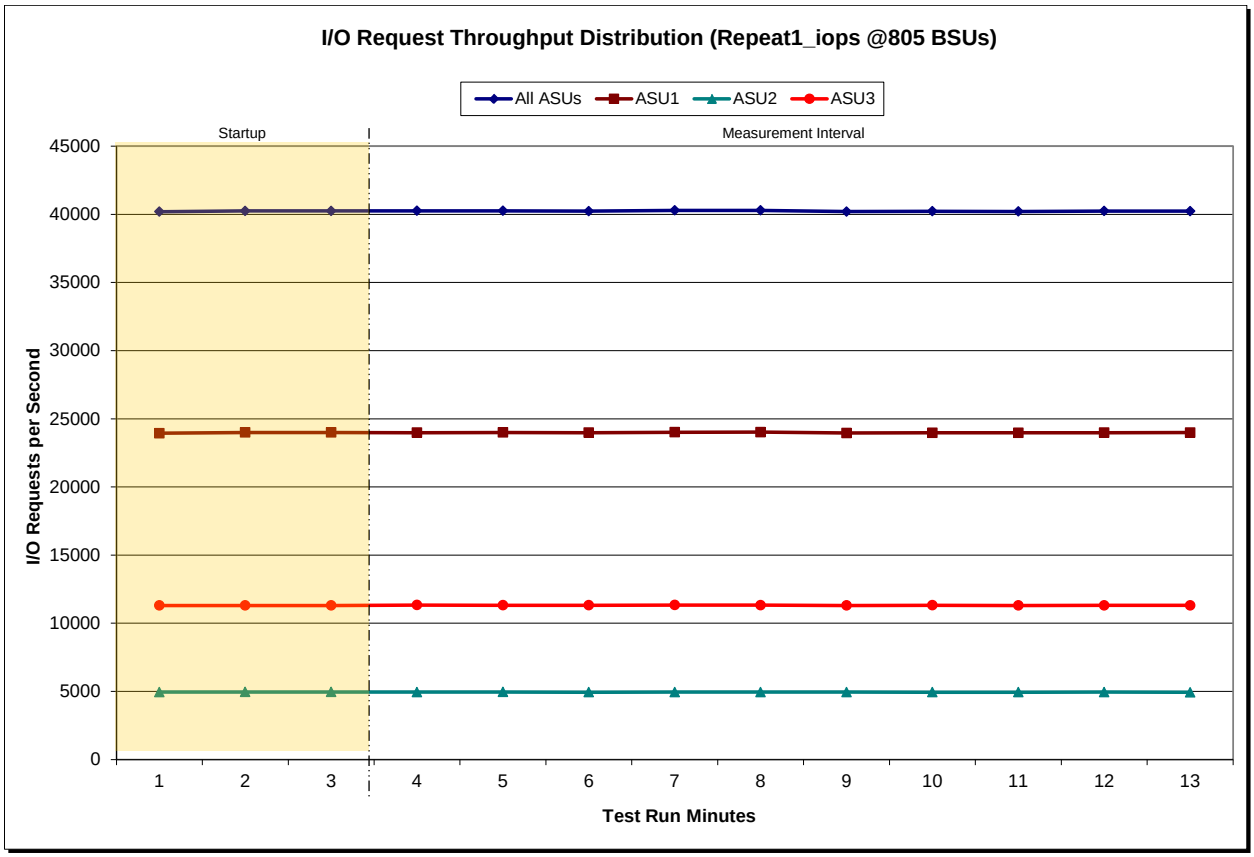
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

805 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:20:52	14:23:53	0-2	0:03:01
Measurement Interval	14:23:53	14:33:53	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	40,192.50	23,942.57	4,950.43	11,299.50
1	40,246.20	23,994.97	4,951.23	11,300.00
2	40,252.30	23,997.25	4,953.98	11,301.07
3	40,254.02	23,977.37	4,945.82	11,330.83
4	40,257.47	23,993.03	4,950.83	11,313.60
5	40,233.80	23,977.25	4,942.13	11,314.42
6	40,292.87	24,012.30	4,948.42	11,332.15
7	40,293.70	24,020.43	4,948.83	11,324.43
8	40,197.85	23,952.17	4,946.87	11,298.82
9	40,228.32	23,973.45	4,936.27	11,318.60
10	40,208.25	23,969.45	4,936.80	11,302.00
11	40,238.33	23,978.58	4,950.23	11,309.52
12	40,234.55	23,989.17	4,934.35	11,311.03
Average	***40,243.92***	***23,984.32***	***4,944.06***	***11,315.54***

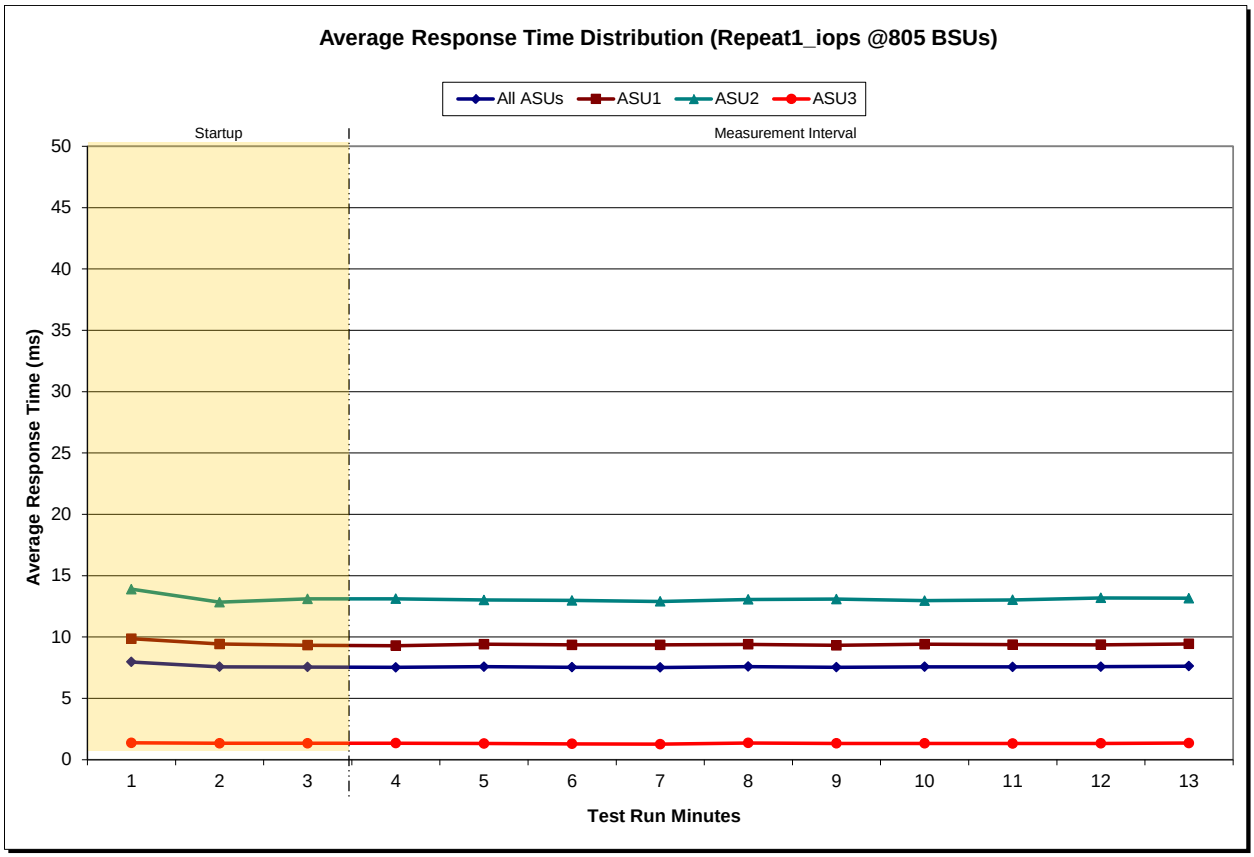
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



Repeatability 1 IOPS –Average Response Time (ms) Distribution Data

805 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:20:52	14:23:53	0-2	0:03:01
Measurement Interval	14:23:53	14:33:53	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	7.97	9.86	13.89	1.37
1	7.57	9.42	12.83	1.34
2	7.55	9.33	13.10	1.34
3	7.52	9.29	13.12	1.34
4	7.58	9.41	13.02	1.31
5	7.53	9.35	12.98	1.29
6	7.51	9.36	12.90	1.26
7	7.59	9.39	13.06	1.36
8	7.54	9.32	13.09	1.32
9	7.57	9.41	12.96	1.32
10	7.56	9.37	13.03	1.32
11	7.57	9.36	13.19	1.33
12	7.62	9.44	13.16	1.35
Average	***7.56***	***9.37***	***13.05***	***1.32***

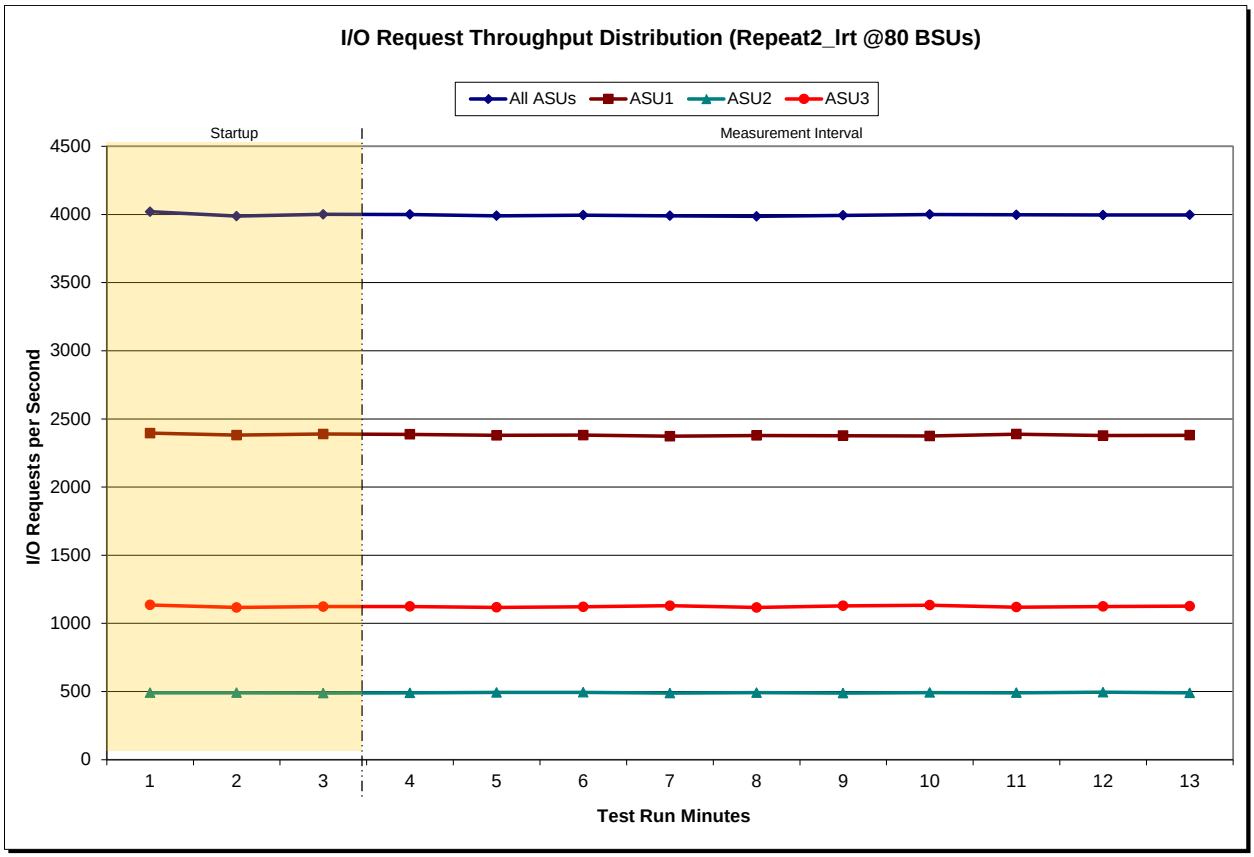
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:34:00	14:37:00	0-2	0:03:00
Measurement Interval	14:37:00	14:47:00	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	4,020.13	2,395.23	490.23	1,134.67
1	3,987.68	2,380.95	490.28	1,116.45
2	4,000.40	2,388.83	488.52	1,123.05
3	4,000.20	2,386.47	490.02	1,123.72
4	3,990.08	2,379.48	493.38	1,117.22
5	3,995.08	2,380.62	493.52	1,120.95
6	3,990.30	2,372.83	488.50	1,128.97
7	3,986.40	2,378.33	491.60	1,116.47
8	3,993.73	2,377.27	487.88	1,128.58
9	3,999.62	2,374.58	491.88	1,133.15
10	3,997.33	2,388.12	490.60	1,118.62
11	3,995.70	2,377.73	494.65	1,123.32
12	3,996.53	2,380.32	489.93	1,126.28
Average	***3,994.50***	***2,379.58***	***491.20***	***1,123.73***

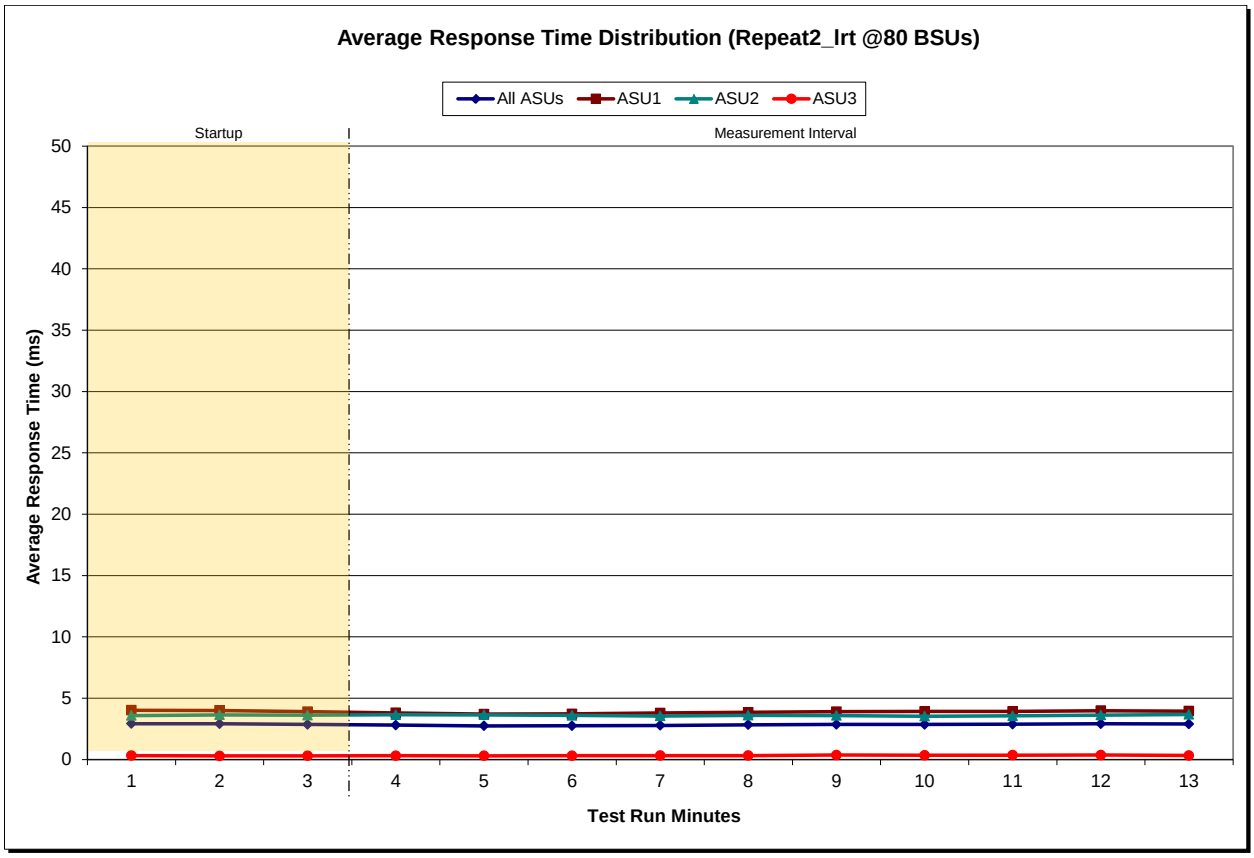
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



Repeatability 2 LRT –Average Response Time (ms) Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:34:00	14:37:00	0-2	0:03:00
Measurement Interval	14:37:00	14:47:00	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.92	4.01	3.59	0.32
1	2.92	3.99	3.64	0.30
2	2.85	3.90	3.61	0.30
3	2.80	3.80	3.65	0.31
4	2.74	3.70	3.64	0.30
5	2.75	3.72	3.60	0.31
6	2.78	3.79	3.54	0.32
7	2.83	3.85	3.61	0.32
8	2.86	3.90	3.59	0.36
9	2.86	3.92	3.53	0.34
10	2.88	3.92	3.56	0.35
11	2.92	3.98	3.62	0.36
12	2.89	3.94	3.67	0.33
Average	***2.83***	***3.85***	***3.60***	***0.33***

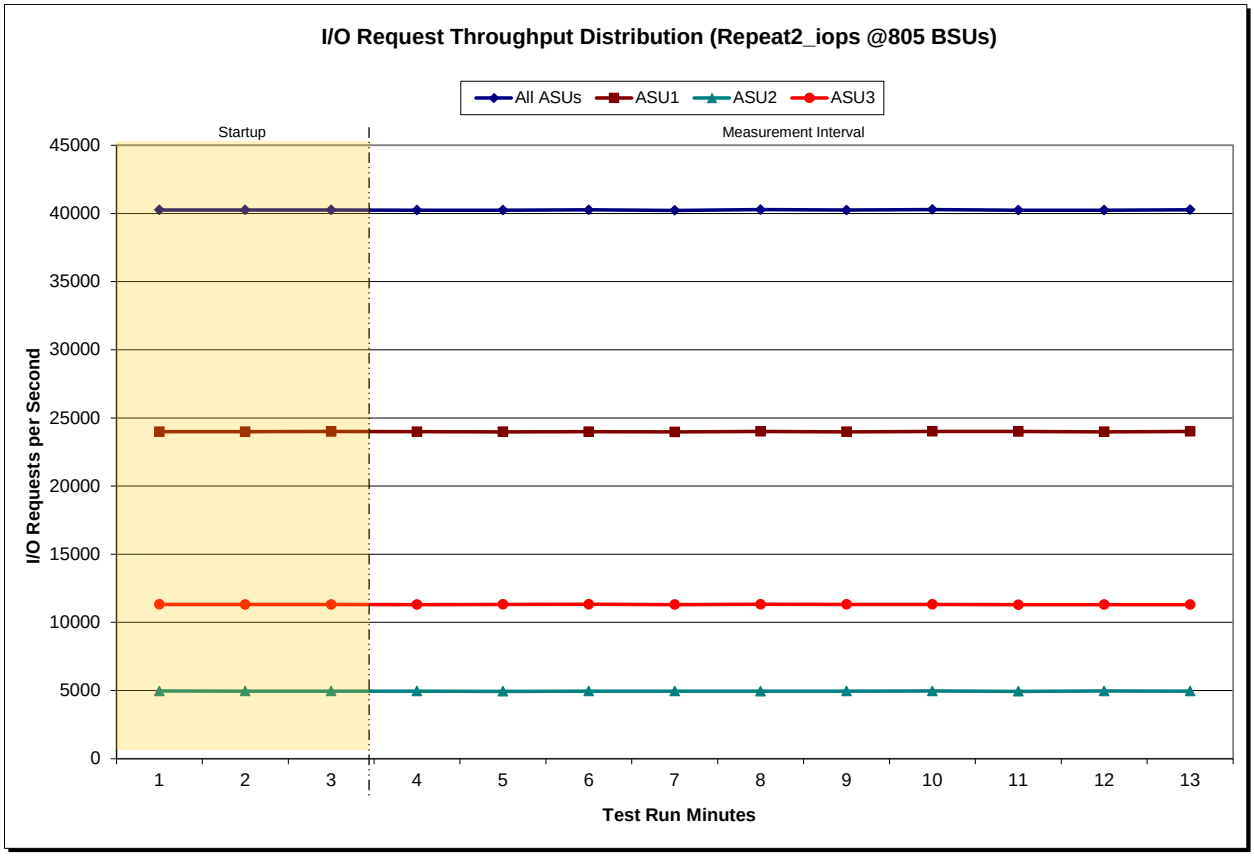
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:47:04	14:50:05	0-2	0:03:01
Measurement Interval	14:50:05	15:00:05	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	40,261.72	23,987.50	4,958.98	11,315.23
1	40,257.85	23,989.53	4,957.93	11,310.38
2	40,260.10	24,000.47	4,952.73	11,306.90
3	40,244.67	23,990.00	4,952.57	11,302.10
4	40,240.13	23,978.23	4,941.45	11,320.45
5	40,267.02	23,983.08	4,957.92	11,326.02
6	40,227.20	23,969.95	4,951.88	11,305.37
7	40,282.07	24,008.82	4,944.87	11,328.38
8	40,248.15	23,979.77	4,954.83	11,313.55
9	40,286.98	24,010.62	4,961.23	11,315.13
10	40,238.93	24,003.13	4,940.48	11,295.32
11	40,241.88	23,980.75	4,960.23	11,300.90
12	40,277.07	24,015.02	4,957.42	11,304.63
Average	***40,255.41***	***23,991.94***	***4,952.29***	***11,311.19***

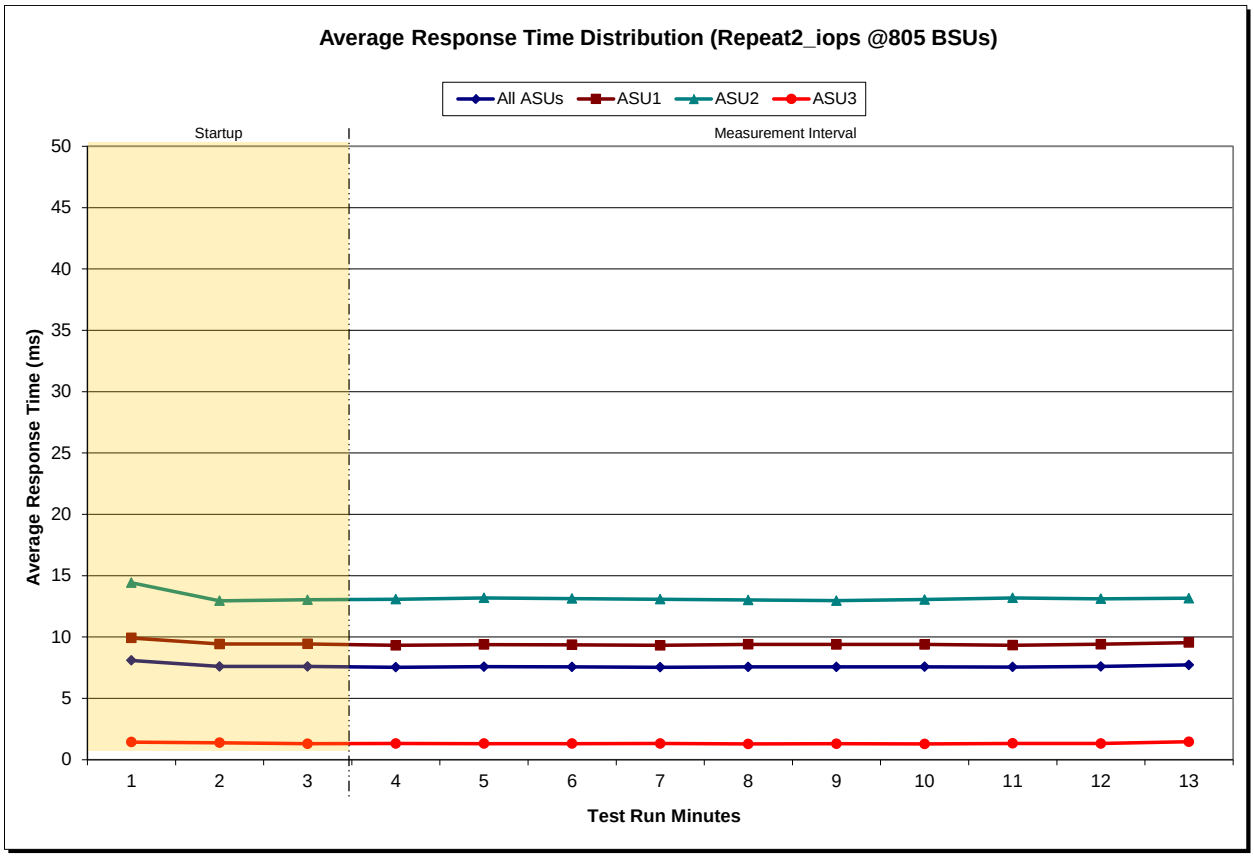
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



Repeatability 2 IOPS –Average Response Time (ms) Distribution Data

80 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:47:04	14:50:05	0-2	0:03:01
Measurement Interval	14:50:05	15:00:05	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	8.09	9.92	14.43	1.44
1	7.60	9.42	12.95	1.38
2	7.59	9.43	13.04	1.30
3	7.53	9.32	13.07	1.31
4	7.58	9.38	13.19	1.31
5	7.56	9.36	13.13	1.31
6	7.53	9.32	13.07	1.32
7	7.56	9.40	13.02	1.28
8	7.56	9.39	12.96	1.30
9	7.57	9.39	13.05	1.28
10	7.55	9.32	13.18	1.33
11	7.59	9.41	13.11	1.32
12	7.72	9.55	13.16	1.46
Average	***7.57***	***9.38***	***13.09***	***1.32***

Repeatability 2 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 1 (LRT)
Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.10 and 5.3.15.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.15.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2814	0.0702	0.2101	0.0180	0.0698	0.0349	0.2806
COV	0.012	0.004	0.009	0.003	0.011	0.007	0.006	0.003

Repeatability 1 (IOPS)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2099	0.0180	0.0699	0.0349	0.2812
COV	0.003	0.001	0.002	0.001	0.003	0.002	0.004	0.001

Repeatability 2 (LRT)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2807	0.0700	0.2100	0.0181	0.0700	0.0349	0.2813
COV	0.008	0.004	0.006	0.004	0.011	0.008	0.010	0.005

Repeatability 2 (IOPS)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0699	0.2101	0.0180	0.0700	0.0351	0.2810
COV	0.003	0.001	0.002	0.001	0.004	0.002	0.003	0.001

Data Persistence Test

Clause 6

The Data Persistence Test demonstrates the Tested Storage Configuration (TSC):

- *Is capable of maintain data integrity across a power cycle.*
- *Ensures the transfer of data between Logical Volumes and host systems occurs without corruption or loss.*

The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 IOPS™ primary metric. The bit pattern selected to be written to each block as well as the address of the block will be retained in a log file.

The Tested Storage Configuration (TSC) will be shutdown and restarted using a power off/power on cycle at the end of the above sequence of write operations. In addition, any caches employing battery backup must be flushed/emptied.

The SPC-1 Workload Generator will then use the above log file to verify each block written contains the correct bit pattern.

Clause 9.4.3.8

The following content shall appear in this section of the FDR:

1. *A listing or screen image of all input parameters supplied to the Workload Generator.*
2. *For the successful Data Persistence Test Run, a table illustrating key results. The content, appearance, and format of this table are specified in Table 9-12. Information displayed in this table shall be obtained from the Test Run Results File referenced below in #3.*
3. *For the successful Data Persistence Test Run, the human readable Test Run Results file produced by the Workload Generator (may be contained in an appendix).*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 70.

Data Persistence Test Results File

A link to each test result file generated from each Data Persistence Test is listed below.

Persistence 1 Test Results File

Persistence 2 Test Results File

Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Run Number: 1	
Total Number of Logical Blocks Written	96,475,536
Total Number of Logical Blocks Verified	79,010,000
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	10 minutes
Size in bytes of each Logical Block	512
Number of Failed I/O Requests in the process of the Test	0

In some cases the same address was the target of multiple writes, which resulted in more Logical Blocks Written than Logical Blocks Verified. In the case of multiple writes to the same address, the pattern written and verified must be associated with the last write to that address.

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 9.4.3.9

The committed delivery data for general availability (Availability Date) of all products that comprise the Priced Storage Configuration must be reported. When the Priced Storage Configuration includes products or components with different availability dates, the reported Availability Date for the Priced Storage Configuration must be the date at which all components are committed to be available.

The Huawei OceanStor™ S2600T as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.4.3.3.6

The Executive Summary shall contain a pricing spreadsheet as documented in Clause 8.3.1.

Pricing information may be found in the Priced Storage Configuration Pricing section on page 14.

TESTED STORAGE CONFIGURATION (TSC) AND PRICED STORAGE CONFIGURATION DIFFERENCES

Clause 9.4.3.3.8

The Executive Summary shall contain a list of all differences between the Tested Storage Configuration (TSC) and the Priced Storage Configuration.

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 14.

ANOMALIES OR IRREGULARITIES

Clause 9.4.3.10

The FDR shall include a clear and complete description of any anomalies or irregularities encountered in the course of executing the SPC-1 benchmark that may in any way call into question the accuracy, verifiability, or authenticity of information published in this FDR.

There were no anomalies or irregularities encountered during the SPC-1 Remote Audit of the Huawei OceanStor™ S2600T.

APPENDIX A: SPC-1 GLOSSARY

"Decimal" *(powers of ten)* Measurement Units

In the storage industry, the terms "kilo", "mega", "giga", "tera", "peta", and "exa" are commonly used prefixes for computing performance and capacity. For the purposes of the SPC workload definitions, all of the following terms are defined in "powers of ten" measurement units.

A kilobyte (KB) is equal to 1,000 (10^3) bytes.

A megabyte (MB) is equal to 1,000,000 (10^6) bytes.

A gigabyte (GB) is equal to 1,000,000,000 (10^9) bytes.

A terabyte (TB) is equal to 1,000,000,000,000 (10^{12}) bytes.

A petabyte (PB) is equal to 1,000,000,000,000,000 (10^{15}) bytes

An exabyte (EB) is equal to 1,000,000,000,000,000,000 (10^{18}) bytes

"Binary" *(powers of two)* Measurement Units

The sizes reported by many operating system components use "powers of two" measurement units rather than "power of ten" units. The following standardized definitions and terms are also valid and may be used in this document.

A kibibyte (KiB) is equal to 1,024 (2^{10}) bytes.

A mebibyte (MiB) is equal to 1,048,576 (2^{20}) bytes.

A gigibyte (GiB) is equal to 1,073,741,824 (2^{30}) bytes.

A tebibyte (TiB) is equal to 1,099,511,627,776 (2^{40}) bytes.

A pebibyte (PiB) is equal to 1,125,899,906,842,624 (2^{50}) bytes.

An exbibyte (EiB) is equal to 1,152,921,504,606,846,967 (2^{60}) bytes.

SPC-1 Data Repository Definitions

Total ASU Capacity: The total storage capacity read and written in the course of executing the SPC-1 benchmark.

Application Storage Unit (ASU): The logical interface between the storage and SPC-1 Workload Generator. The three ASUs (Data, User, and Log) are typically implemented on one or more Logical Volume.

Logical Volume: The division of Addressable Storage Capacity into individually addressable logical units of storage used in the SPC-1 benchmark. Each Logical Volume is implemented as a single, contiguous address space.

Addressable Storage Capacity: The total storage (sum of Logical Volumes) that can be read and written by application programs such as the SPC-1 Workload Generator.

Configured Storage Capacity: This capacity includes the Addressable Storage Capacity and any other storage (parity disks, hot spares, etc.) necessary to implement the Addressable Storage Capacity.

Physical Storage Capacity: The formatted capacity of all storage devices physically present in the Tested Storage Configuration (TSC).

Data Protection Overhead: The storage capacity required to implement the selected level of data protection.

Required Storage: The amount of Configured Storage Capacity required to implement the Addressable Storage Configuration, excluding the storage required for the three ASUs.

Global Storage Overhead: The amount of Physical Storage Capacity that is required for storage subsystem use and unavailable for use by application programs.

Total Unused Storage: The amount of storage capacity available for use by application programs but not included in the Total ASU Capacity.

SPC-1 Data Protection Levels

Protected 1: The single point of failure of any ***storage device*** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.

Protected 2: The single point of failure of any ***component*** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.

SPC-1 Test Execution Definitions

Average Response Time: The sum of the Response Times for all Measured I/O Requests divided by the total number of Measured I/O Requests.

Completed I/O Request: An I/O Request with a Start Time and a Completion Time (see "I/O Completion Types" below).

Completion Time: The time recorded by the Workload Generator when an I/O Request is satisfied by the TSC as signaled by System Software.

Data Rate: The data transferred in all Measured I/O Requests in an SPC-1 Test Run divided by the length of the Test Run in seconds.

Expected I/O Count: For any given I/O Stream and Test Phase, the product of 50 times the BSU level, the duration of the Test Phase in seconds, and the Intensity Multiplier for that I/O Stream.

Failed I/O Request: Any I/O Request issued by the Workload Generator that could not be completed or was signaled as failed by System Software. A Failed I/O Request has no Completion Time (see "I/O Completion Types" below).

I/O Request Throughput: The total number of Measured I/O requests in an SPC-1 Test Run divided by the duration of the Measurement Interval in seconds.

In-Flight I/O Request: An I/O Request issued by the I/O Command Generator to the TSC that has a recorded Start Time, but does not complete within the Measurement Interval (see "I/O Completion Types" below).

Measured I/O Request: A Completed I/O Request with a Completion Time occurring within the Measurement Interval (see "I/O Completion Types" below).

Measured Intensity Multiplier: The percentage of all Measured I/O Requests that were issued by a given I/O Stream.

Measurement Interval: The finite and contiguous time period, after the TSC has reached Steady State, when data is collected by a Test Sponsor to generate an SPC-1 test result or support an SPC-1 test result.

Ramp-Up: The time required for the Benchmark Configuration (BC) to produce Steady State throughput after the Workload Generator begins submitting I/O Requests to the TSC for execution.

Ramp-Down: The time required for the BC to complete all I/O Requests issued by the Workload Generator. The Ramp-Down period begins when the Workload Generator ceases to issue new I/O Requests to the TSC.

Response Time: The Response Time of a Measured I/O Request is its Completion Time minus its Start Time.

Start Time: The time recorded by the Workload Generator when an I/O Request is submitted, by the Workload Generator, to the System Software for execution on the Tested Storage Configuration (TSC).

Start-Up: The period that begins after the Workload Generator starts to submit I/O requests to the TSC and ends at the beginning of the Measurement Interval.

Shut-Down: The period between the end of the Measurement Interval and the time when all I/O Requests issued by the Workload Generator have completed or failed.

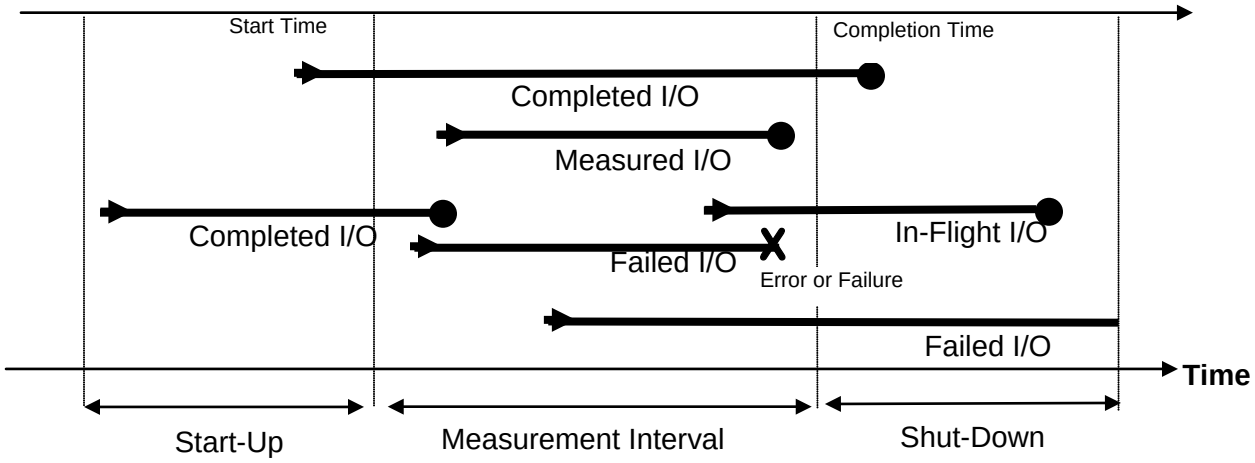
Steady State: The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant.

Test: A collection of Test Phases and or Test Runs sharing a common objective.

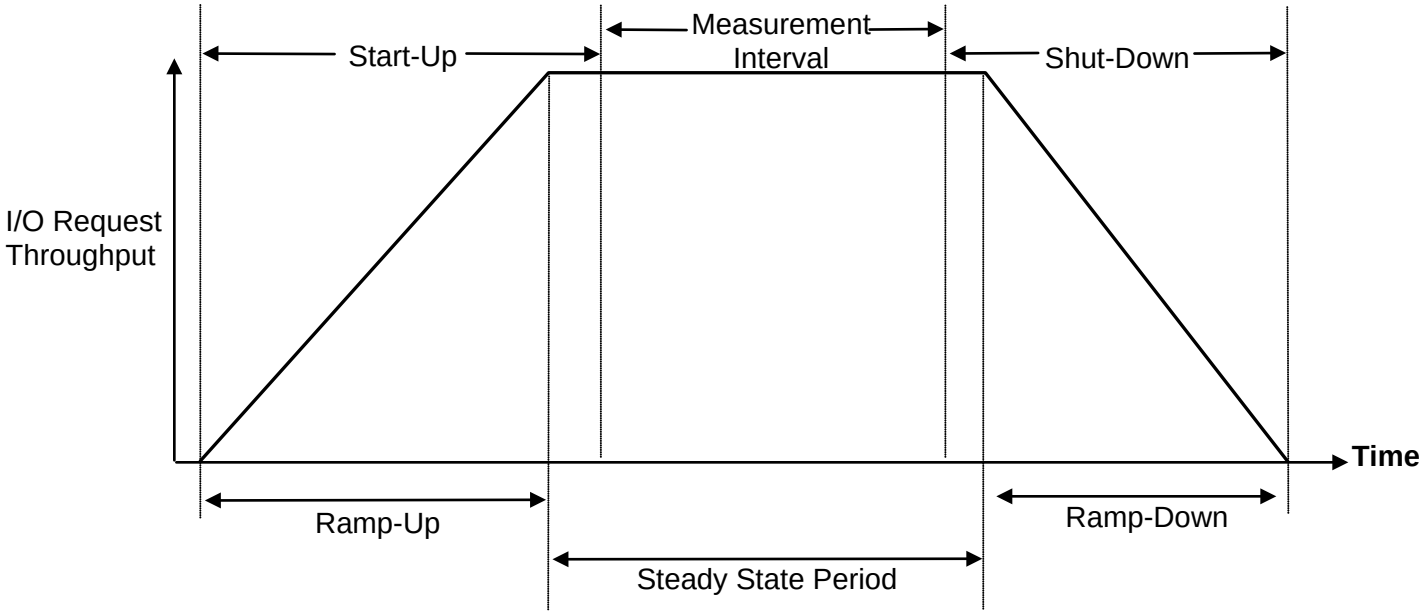
Test Run: The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

Test Phase: A collection of one or more SPC-1 Test Runs sharing a common objective and intended to be run in a specific sequence.

I/O Completion Types



SPC-1 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

Red Hat Enterprise Linux 5.5 (64-bit)

Change the I/O scheduler from ***cfq*** to ***noop*** on the Host System, which will result in all incoming I/O requests inserted into a simple, unordered FIFO queue. This was done by execution of the **scheduler.sh** script as documented in *"Appendix C: Tested Storage Configuration (TSC) Creation"*.

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

Step 1 Create Host Group and Host

Execute the following commands in OceanStor S2600T's CLI to create one host group *HostGroup001*, and add *Host001* to the host group, then add two host FC ports WWNs to *Host001*.

The ***-t*** parameter is used in the command ***addhost*** to define the host operating system type, and ***-t 0*** means Linux. The ***-type*** parameter of command ***addhostport*** means port type, and ***type 1*** means FC host port.

```
createhostgroup -n HostGroup001
addhost -group 1 -n Host001 -t 0
addhostport -host 0 -type 1 -wwn 21000024ff2089b2 -n FCInitiator001
addhostport -host 0 -type 1 -wwn 21000024ff2089b3 -n FCInitiator002
```

Step 2 Create RAID Groups and LUNs

Execute the **mklun.sh** script on the Host System, which has **expect** installed. The script will create 18 RAID Groups, 18 LUNs *(one LUN per RAID Group)* and map the LUNs to *HostGroup001*.

The ***createlun*** commands create one LUN per RAID Group and use all of the available capacity for the LUN. The ***addhostmap*** command maps a LUN to a host or a host group.

Each RAID Group, 0-17, contains six 300 GB disk drives. Four of the disk drives in RAID Group 16 are vault disk drives, each of which as 23 GiB reserved to store "dirty" data in case of a power failure.

The RAID-Disk mapping is illustrated below.

Disks: 108 300GB

There're 12 300GB disks in enclosure 0 and 24 300GB disks in each of enclosure 1-4

Disk 0,1,2,3 of enclosure 0 are used as vault disks

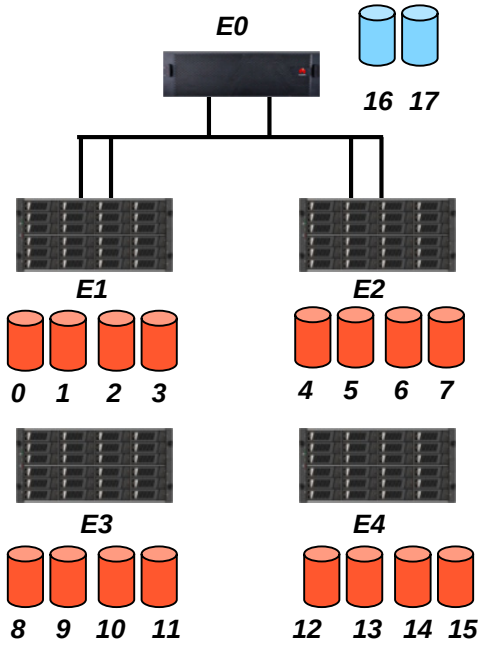
RAID Group 0,1,2,3…17

Each RG contains 6 disks belong to enclosure E0 – E4,
enclosure 0 contains 2 RGs
enclosure 1-4 each contains 4 RGs

***RAID Group 0 - 15** are used as ASU1/2*

***RAID Group 16,17** are used as ASU3*

One LUN per RAID Group



*Note: **Expect** is a Unix automation and testing tool, written by Don Libes as an extension to the Tcl scripting language, for interactive applications such as telnet, ftp, passwd, fsck, rlogin, tip, ssh, and others. It uses Unix pseudo terminals to wrap up subprocesses transparently, allowing the automation of arbitrary applications that are accessed over a terminal. Expect is an open source tool can be downloaded at the following location: http://www.nist.gov/el/msid/expect.cfm*

Step 3 Change the low and high water level of storage

Execute the following command, using the OceanStor S2600T's CLI to change the low water level to 30 and the high water level to 50.

chgcachewaterlevel -low 30

chgcachewaterlevel -high 50

Step 4 Create Volumes on the Host System

Execute the **mkvolume.sh** script on the Host System to create 32 logical volumes.

1. Create Physical Volumes

Invoke ***pvcreate*** on each block device, creating 18 physical volumes

2. Create Volume Groups

Create **vg0** using: /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

Create **vg1** using: /dev/sdr, /dev/sds

3. Create Logical Volumes

- Create 15 logical volumes on vg0 for ASU-1, each with a capacity of 330 GiB.
- Create 15 logical volumes on vg0 for ASU-2, each with a capacity of 330 GiB.
- Create 2 logical volumes on vg1 for ASU-3, each with a capacity of 550 GiB.

4. Scan Logical Volumes

Scan the logical volumes on the Host System.

Step 5 Change the schedule on each block device

Execute the **scheduler.sh** script on the Host System to change the scheduler of each block device from ***cfq*** to ***noop***.

Referenced Scripts

mklun.sh

```
#!/bin/bash

stor=129.27.228.167
stor_user=admin
stor_pswd=Admin@storage

export LANG=C

echo "creating LUN ..."

expect <<__END_CREATE_LUN
     spawn ssh $stor_user@$stor
     expect {
            "assword" {
                  send "$stor_pswd\r"
             }
            "yes/no" {
                  send "yes\r"
                  expect "assword"
                     send "$stor_pswd\r"
            }
     }
     expect ">"

     set timeout 60

     set lunid 0
     set rgid 0


     foreach enclosure {1: 2: 3: 4: }  {
            foreach diskset {0,1,2,3,4,5 6,7,8,9,10,11 12,13,14,15,16,17
18,19,20,21,22,23} {
                  set disk_list ""
                  foreach disk [split \$diskset ,] {
                        set list_unit [string map [list : ,\$disk:] \$enclosure]
                        append disk_list \$list_unit
                  }
                  send "createrg -n ASU-\$rgid -l 10 -num 2 -list \$disk_list\r"
                  expect {
                        "(y/n)" {
                              send "y\r"
                        }
                        ">" {
                              send "\r"
                        }
                  }
                  expect ">"
                  send "showrg -rg \$rgid\r"
                  expect ">"
                  if [ expr \$lunid%2 ] {
                        set ctrl b
                  } else {
                        set ctrl a
                  }
                       if { \$lunid >= 16 && \$lunid <= 41 } {
```

```
                        send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -
pretype 1 -value 4 -c \$ctrl\r"
                        } else {
                    send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -pretype 0
-c \$ctrl\r"
                        }
                    expect ">"
                    sleep 1
                    send "showlun -lun \$lunid\r"
                    expect ">"
                    send "addhostmap -group 1 -devlun \$lunid\r"
                    expect ">"
                    send "showhostmap -map [expr \$lunid + 1048576]\r"
                    expect ">"
                    incr lunid
                    incr rgid
             }
      }

      foreach enclosure {0: }  {
             foreach diskset {0,1,2,3,4,5 6,7,8,9,10,11} {
                    set disk_list ""
                    foreach disk [split \$diskset ,] {
                           set list_unit [string map [list : ,\$disk:] \$enclosure]
                           append disk_list \$list_unit
                    }
                    send "createrg -n ASU-\$rgid -l 10 -num 2 -list \$disk_list\r"
                    expect {
                           "(y/n)" {
                                  send "y\r"
                           }
                           ">" {
                                  send "\r"
                           }
                    }
                    expect ">"
                    send "showrg -rg \$rgid\r"
                    expect ">"
                    if [ expr \$lunid%2 ] {
                           set ctrl b
                    } else {
                           set ctrl a
                    }
                          if { \$lunid >= 16 && \$lunid <= 41 } {
                          send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -
pretype 1 -value 4 -c \$ctrl\r"
                          } else {
                    send "createlun -rg \$rgid -n ASU-\$lunid -susize 512 -pretype 0
-c \$ctrl\r"
                          }
                    expect ">"
                    sleep 1
                    send "showlun -lun \$lunid\r"
                    expect ">"
                    send "addhostmap -group 1 -devlun \$lunid\r"
                    expect ">"
                    send "showhostmap -map [expr \$lunid + 1048576]\r"
                    expect ">"
                    incr lunid
                    incr rgid
             }
      }
      send "exit\r"
```

```
      expect "(y/n):"
      send "y\r"
      expect EOF
__END_CREATE_LUN
```

mkvolume.sh

```
pvcreate /dev/sdb
pvcreate /dev/sdc
pvcreate /dev/sdd
pvcreate /dev/sde
pvcreate /dev/sdf
pvcreate /dev/sdg
pvcreate /dev/sdh
pvcreate /dev/sdi
pvcreate /dev/sdj
pvcreate /dev/sdk
pvcreate /dev/sdl
pvcreate /dev/sdm
pvcreate /dev/sdn
pvcreate /dev/sdo
pvcreate /dev/sdp
pvcreate /dev/sdq
pvcreate /dev/sdr
pvcreate /dev/sds

vgcreate vg0 /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
vgcreate vg1 /dev/sdr /dev/sds

lvcreate -n asu11  -i 16 -I 512 -L 330g vg0
lvcreate -n asu12  -i 16 -I 512 -L 330g vg0
lvcreate -n asu13  -i 16 -I 512 -L 330g vg0
lvcreate -n asu14  -i 16 -I 512 -L 330g vg0
lvcreate -n asu15  -i 16 -I 512 -L 330g vg0
lvcreate -n asu16  -i 16 -I 512 -L 330g vg0
lvcreate -n asu17  -i 16 -I 512 -L 330g vg0
lvcreate -n asu18  -i 16 -I 512 -L 330g vg0
lvcreate -n asu19  -i 16 -I 512 -L 330g vg0
lvcreate -n asu110  -i 16 -I 512 -L 330g vg0
lvcreate -n asu111  -i 16 -I 512 -L 330g vg0
lvcreate -n asu112  -i 16 -I 512 -L 330g vg0
lvcreate -n asu113  -i 16 -I 512 -L 330g vg0
lvcreate -n asu114  -i 16 -I 512 -L 330g vg0
lvcreate -n asu115  -i 16 -I 512 -L 330g vg0

lvcreate -n asu21  -i 16 -I 512 -L 330g vg0
lvcreate -n asu22  -i 16 -I 512 -L 330g vg0
lvcreate -n asu23  -i 16 -I 512 -L 330g vg0
lvcreate -n asu24  -i 16 -I 512 -L 330g vg0
lvcreate -n asu25  -i 16 -I 512 -L 330g vg0
lvcreate -n asu26  -i 16 -I 512 -L 330g vg0
lvcreate -n asu27  -i 16 -I 512 -L 330g vg0
lvcreate -n asu28  -i 16 -I 512 -L 330g vg0
lvcreate -n asu29  -i 16 -I 512 -L 330g vg0
lvcreate -n asu210  -i 16 -I 512 -L 330g vg0
lvcreate -n asu211  -i 16 -I 512 -L 330g vg0
lvcreate -n asu212  -i 16 -I 512 -L 330g vg0
lvcreate -n asu213  -i 16 -I 512 -L 330g vg0
lvcreate -n asu214  -i 16 -I 512 -L 330g vg0
lvcreate -n asu215  -i 16 -I 512 -L 330g vg0
```

```
lvcreate -n asu31  -i 2 -I 512 -L 550g vg1
lvcreate -n asu32  -i 2 -I 512 -L 550g vg1
```

scheduler.sh

```
echo noop > /sys/block/sdb/queue/scheduler
 echo noop > /sys/block/sdc/queue/scheduler
 echo noop > /sys/block/sdd/queue/scheduler
 echo noop > /sys/block/sde/queue/scheduler
 echo noop > /sys/block/sdf/queue/scheduler
 echo noop > /sys/block/sdg/queue/scheduler
 echo noop > /sys/block/sdh/queue/scheduler
 echo noop > /sys/block/sdi/queue/scheduler
 echo noop > /sys/block/sdj/queue/scheduler
 echo noop > /sys/block/sdk/queue/scheduler
 echo noop > /sys/block/sdl/queue/scheduler
 echo noop > /sys/block/sdm/queue/scheduler
 echo noop > /sys/block/sdn/queue/scheduler
 echo noop > /sys/block/sdo/queue/scheduler
 echo noop > /sys/block/sdp/queue/scheduler
 echo noop > /sys/block/sdq/queue/scheduler
 echo noop > /sys/block/sdr/queue/scheduler
 echo noop > /sys/block/sds/queue/scheduler
```

APPENDIX D: SPC-1 WORKLOAD GENERATOR STORAGE COMMANDS AND PARAMETERS

ASU Pre-Fill

The content of command and parameter file, used in this benchmark to execute the required ASU pre-fill, is listed below.

```
pattern=/root/S2600T/random
hd=default,vdbench=/root/vdbench,user=root,shell=ssh
hd=hd1,system=localhost
sd=default,threads=1
sd=sd1,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu11,size=354334801920
sd=sd2,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu12,size=354334801920
sd=sd3,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu13,size=354334801920
sd=sd4,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu14,size=354334801920
sd=sd5,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu15,size=354334801920
sd=sd6,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu16,size=354334801920
sd=sd7,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu17,size=354334801920
sd=sd8,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu18,size=354334801920
sd=sd9,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu19,size=354334801920
sd=sd10,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu110,size=354334801920
sd=sd11,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu111,size=354334801920
sd=sd12,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu112,size=354334801920
sd=sd13,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu113,size=354334801920
sd=sd14,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu114,size=354334801920
sd=sd15,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu115,size=354334801920
sd=sd16,hd=hd1,openflags=o_direct,lun=/dev/vg1/asu31,size=590558003200
sd=sd17,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu21,size=354334801920
sd=sd18,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu22,size=354334801920
sd=sd19,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu23,size=354334801920
sd=sd20,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu24,size=354334801920
sd=sd21,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu25,size=354334801920
sd=sd22,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu26,size=354334801920
sd=sd23,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu27,size=354334801920
sd=sd24,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu28,size=354334801920
sd=sd25,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu29,size=354334801920
sd=sd26,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu210,size=354334801920
sd=sd27,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu211,size=354334801920
sd=sd28,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu212,size=354334801920
sd=sd29,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu213,size=354334801920
sd=sd30,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu214,size=354334801920
sd=sd31,hd=hd1,openflags=o_direct,lun=/dev/vg0/asu215,size=354334801920
sd=sd32,hd=hd1,openflags=o_direct,lun=/dev/vg1/asu32,size=590558003200
wd=wd1,sd=sd*,rdpct=0,seekpct=-1,xfersize=512K
rd=PREPSSD,wd=wd1,iorate=max,elapsed=360000,interval=10
```

Primary Metrics, Repeatability and Persistence Tests

The content of SPC-1 Workload Generator command and parameter file, used in this benchmark to execute the Primary Metrics, Repeatability and Persistence Tests, is listed below.

```
sd=asu1_1,lun=/dev/vg0/asu11 ,size=354334801920
sd=asu1_2,lun=/dev/vg0/asu12 ,size=354334801920
sd=asu1_3,lun=/dev/vg0/asu13 ,size=354334801920
sd=asu1_4,lun=/dev/vg0/asu14 ,size=354334801920
sd=asu1_5,lun=/dev/vg0/asu15 ,size=354334801920
sd=asu1_6,lun=/dev/vg0/asu16 ,size=354334801920
sd=asu1_7,lun=/dev/vg0/asu17 ,size=354334801920
sd=asu1_8,lun=/dev/vg0/asu18 ,size=354334801920
sd=asu1_9,lun=/dev/vg0/asu19 ,size=354334801920
sd=asu1_10,lun=/dev/vg0/asu110,size=354334801920
sd=asu1_11,lun=/dev/vg0/asu111,size=354334801920
sd=asu1_12,lun=/dev/vg0/asu112,size=354334801920
sd=asu1_13,lun=/dev/vg0/asu113,size=354334801920
sd=asu1_14,lun=/dev/vg0/asu114,size=354334801920
sd=asu1_15,lun=/dev/vg0/asu115,size=354334801920

sd=asu2_1,lun=/dev/vg0/asu21 ,size= 354334801920
sd=asu2_2,lun=/dev/vg0/asu22 ,size= 354334801920
sd=asu2_3,lun=/dev/vg0/asu23 ,size= 354334801920
sd=asu2_4,lun=/dev/vg0/asu24 ,size= 354334801920
sd=asu2_5,lun=/dev/vg0/asu25  ,size=354334801920
sd=asu2_6,lun=/dev/vg0/asu26  ,size=354334801920
sd=asu2_7,lun=/dev/vg0/asu27  ,size=354334801920
sd=asu2_8,lun=/dev/vg0/asu28  ,size=354334801920
sd=asu2_9,lun=/dev/vg0/asu29  ,size=354334801920
sd=asu2_10,lun=/dev/vg0/asu210,size=354334801920
sd=asu2_11,lun=/dev/vg0/asu211,size=354334801920
sd=asu2_12,lun=/dev/vg0/asu212,size=354334801920
sd=asu2_13,lun=/dev/vg0/asu213,size=354334801920
sd=asu2_14,lun=/dev/vg0/asu214,size=354334801920
sd=asu2_15,lun=/dev/vg0/asu215,size=354334801920

sd=asu3_1,lun=/dev/vg1/asu31 ,size=590558003200
sd=asu3_2,lun=/dev/vg1/asu32 ,size=590558003200
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

ASU Pre-Fill, Primary Metrics Test, Repeatability Test, Persistence Test Run 1, TSC power off/power on and Persistence Test Run 2

The following script was used to execute the required ASU pre-fill, Primary Metrics Test *(Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase)*, Repeatability Test *(Repeatability Test Phase 1 and Repeatability Test Phase 2)*, and Persistence Test Run 1 in an uninterrupted sequence. The script pauses until the required TSC power off/power on cycle is completed then executes Persistence Test Run 2.

The script also included the appropriate commands to capture the detailed TSC profile listings required for a Remote Audit.

```
JAVA="/usr/java/jre1.7.0_06/bin/java -Xms1536m -Xmx1536m -Xss256k"
EXEDIR=/root/S2600T

expect shstorage.tcl > profile1_storage.log
date > profile1_volume.log
pvdisplay >> profile1_volume.log
vgdisplay >> profile1_volume.log
lvdisplay >> profile1_volume.log
date >> profile1_volume.log

../vdbench/vdbench -f prefilling.cfg -o prefilling

rm -rf spc1.cfg
cp metrics.cfg spc1.cfg


$JAVA -cp ../spc1 metrics -b 805 -t 28800
$JAVA -cp ../spc1 repeat1 -b 805
$JAVA -cp ../spc1 repeat2 -b 805

for host in host1
do
  ssh $host killall java
done

rm -rf spc1.cfg
cp persist.cfg spc1.cfg

$JAVA -cp ../spc1 persist1 -b 805

echo "Power cycle TSC, then Enter to continue"
read


expect shstorage.tcl > profile2_storage.log
date > profile2_volume.log
pvdisplay >> profile2_volume.log
vgdisplay >> profile2_volume.log
lvdisplay >> profile2_volume.log
date >> profile2_volume.log

$JAVA -cp ../spc1 persist2
```

APPENDIX F: THIRD-PARTY QUOTATION

Even Enterprises
12439 Magnolia Blvd. Suite# 303
N. Hollywood, CA 91607
Phone: 818-793-4403
Fax: 818-302-3344

Even Enterprises Quotation

Issued To:	«Company» «First_Name» «Last_Name» «City», «State»
Phone:	«Business_Phone»
Email:	«Email»

DATE ISSUED:	November 5, 2012
PAYMENT TERMS: Credit Card / Net 30 (upon approval)	
Salesperson:	Esti Even
Prices subject to change without notice	
Prices Valid for 90 days	Confidential

No.	Model	Description	Add	Unit Price ($)	Total Price ($)
1	**Phase**				**69,643.00**
1.1	**Location**				**69,643.00**
1.1.1	**S2600T**		1		**69,643.00**
1.1.1.1	**Control module**				**8,029.00**
	2C16G-12I1-AC-BASE	OceanStor S2600T Controller Enclosure(Dual Controller,AC,16GB Cache,2*6*GE iSCSI Front-End Port,2*2*24G SAS Back-End Port(Wide Port),with UPS Cache Protected Module,HS Storage Array Control System Software,SPE32C0212)	1	8,029.00	8,029.00
1.1.1.2	**Disk Enclosure**				**11,908.00**
	DAE12435U4-AC-2	OceanStor DAE12435U4 Disk Enclosure(4U,3.5",AC,SAS Expansion Module,without Disk Unit,with HS SAS in Band Management Software)	4	2,977.00	11,908.00
1.1.1.3	**Hard Disk Drives**				**44,064.00**
	SAS300-15K-2	300GB 15K RPM SAS Disk Unit(3.5")	108	408.00	44,064.00
1.1.1.4	**IO Interface**				**2,438.00**
	LPU4F8	4*8Gbps Fibre Channel I/O modules(Total 4 ports)	2	1,219.00	2,438.00
1.1.1.5	**Accessory**				**155.00**
	SS-OP-D-LC-M-3	Patchcord,DLC/PC-DLC/PC,Multimode,2mm Parallel,3m	8	11.00	88.00
	MINI-SAS-3	Purchased Cable,MiniSAS Cable,Key246,3m	1	67.00	67.00
1.1.1.6	**Storage management software**				**1,351.00**
	LIC-S2A-ISM02-BLOCK	HS Integrated Storage Manager-Device Management License for OceanStor Block S2600T	1	1,351.00	1,351.00
1.1.1.7	**Third Party**				**1,698.00**
	N8GHBA000	QLOGIC QLE2562 HBA Card,PCIE,8Gbps DualPort ,Fiber Channel Multimode LC Optic Interface,English Manual,Driver CD	1	1,698.00	1,698.00
Total of Product					**69,643.00**
1.1.1.8	**Maintenance Support Service**				**41,772.00**
	Hi-Care Premier On-Site Service (3 years)		1	41,772.00	41,772.00
Total of Service (3 years)					**41,772.00**
Total Price					**111,415.00**

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